Maryland Stadium Authority

Request for Proposals

Building Commissioning Services

Hagerstown Multi-Use Sports and Events Facility

Issue Date: September 7, 2022

KEY INFORMATION SUMMARY SHEET

MARYLAND STADIUM AUTHORITY

Request for Proposals
Building Commissioning Services
Hagerstown Multi-Use Sports and Events Facility

RFP Issue Date:	September 7, 2022
Procurement Officer:	Natasha Speaks Maryland Stadium Authority 351 West Camden Street, Suite 300 Baltimore, Maryland 21201 Phone: 443-522-1052 E-mail: nspeaks@mdstad.com
Procurement Method:	Competitive Sealed Proposals
MBE Participation Goal:	10% overall
Pre-Proposal Conference:	September 14, 2022 at 12:00 p.m. (Local Time)
Closing Date and Time Technical Proposals:	September 27, c2022 at 1:00 p.m. (Local Time)

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SECTION 1

GENERAL INFORMATION

1.1 Summary Statement

The Maryland Stadium Authority (hereinafter "MSA") is issuing this Request for Proposals (hereinafter "RFP") to Building Commissioning Services firms to implement and manage the commissioning process for the Hagerstown Multi-Use Sports and Events Facility (the "Project"). The project scope will include, but is not limited to, the commissioning of newly built, aluminum entrances, storefronts, and windows, brick veneer, and new MEP systems which include AHUs, DOAS units, energy recovery modules, make-up air units, air-cooled condensing units, VRF systems, heat pumps, ductless split AC units, terminal heaters, pumps, exhaust fans, VFDs, DDC Control Systems, lighting controls, emergency generator, automatic transfer switch, and lightning protection.

The Design Development documents, produced by Pendulum, are attached hereto as **Attachment F**. The project is currently in the design phase and will be built under a guaranteed maximum price (GMP) via the Design Build method.

1.2 Abbreviations and Definitions

For purposes of this RFP, the following abbreviations and terms have the meanings indicated below:

a. **Architect/Engineer ("A/E")** - The Design-Builder's design team responsible for providing professional engineering, architectural, and design services for the Project.

b. **Basis of Design (BOD)** – Narrative of Owner's project requirements and conceptual design developed during the programming phase.

c. **Building Enclosure Commissioning (BECx)** - The process by which the design and constructed performance of building enclosure materials, components, assemblies and systems are validated to meet defined objectives and requirements of the project, as established by the owner. (Source: NIBS 3-2012).

d. **Building Enclosure Commissioning Authority (BECxA)** - Entity that is designated to formally document the project-specific Building Enclosure Commissioning. This entity should be trained, experienced and knowledgeable in the process of building enclosure commissioning and possess basic architectural and building science knowledge of the design, performance, systems, and construction related to the building enclosure. The BECxA role may be accomplished by the BES, CxA or an additional member to the team.

(Source: NIBS 3-2012).

e. **Building Enclosure Specialists (BES) -** This person or party is deemed an "expert" in the building enclosure systems anticipated to be used on the proposed building and possesses the experience and technical qualifications to design, critique, validate and support the team in the project development and construction validation. (Source: NIBS 3-2012).

f. **COMAR** - Code of Maryland Regulations (available at http://www.dsd.state.md.us).

g. **Contract -** The contract or agreement entered into between MSA and the selected Offeror. The Contract will include all general terms and conditions, and will incorporate the entire RFP, including any amendments and addenda to the RFP, and all or indicated portions of the selected Offeror's proposal. A sample contract is attached hereto as **Attachment J.**

h. **Consultant –** The selected Offeror pursuant to the terms of this RFP.

i. **Commissioning Agent (CxA)** – Person responsible for ensuring the building systems are installed and operating in accordance with the project design.

j. **Commissioning Authority –**An entity identified by the Owner who leads, plans, schedules, and coordinates the commissioning team to implement the commissioning process. (Source: ASHRA 0-2005).

k. **Commissioning Team** – The individuals responsible for implementing and executing the commissioning process.

l. **Design Builder (DB)** – A third party engaged by the Owner to provide pre-construction and construction management services. The DB is Turner Construction Company and Pendulum (hereinafter "DB").

m. **eMMA** - eMaryland Marketplace Advantage (https://emma.maryland.gov).

n. **LEED** - A third-party certification program and the nationally accepted benchmark for the design, construction, and operation of high performance green buildings developed by the U.S. Green Building Council (USGBC).

o. **Local Time** – Time in the Eastern Time Zone as observed by the State.

p. **MBE** –Minority Business Enterprise certified by the Maryland Department of Transportation (hereinafter "MDOT").

q. **MSA** – Maryland Stadium Authority (www.mdstad.com).

r. **MSA Business Hours** – 8:30 a.m. to 5:00 p.m., local time, Monday through

Friday, excluding State holidays.

s. **MSA Procurement Policies** – MSA procurement policies and procedures (available at www.mdstad.com).

t. **Notice to Proceed (NTP)** – A formal notification issued by the Procurement Officer that directs the Consultant to perform work and establishes the date on which the work is to commence on a Project.

u. **Offeror** - An entity that submits a Proposal in response to this RFP.

v. **Procurement Officer (PO)** – The MSA representative responsible for this RFP. MSA may change the Procurement Officer at any time and will provide written notice to the Offerors of any such change.

w. **Project** – The Hagerstown Multi-Use Sports and Events Facility includes, among other things, aluminum entrances, storefronts, and windows, brick veneer, and new MEP systems which include AHUs, DOAS units, energy recovery modules, make-up air units, air-cooled condensing units, VRF systems, heat pumps, ductless split AC units, terminal heaters, pumps, exhaust fans, VFDs, DDC Control Systems, lighting controls, emergency generator, automatic transfer switch, and lightning protection.

x. **Project Manager (PM) -** The MSA representative that is primarily responsible for monitoring the daily activities of the Contract and for providing technical assistance to the Consultant.

y. **Project Team** – The Maryland Stadium Authority; the Client; the DB and consultants, and any other consultant/entity the MSA may engage to participate in the effort.

z. **Proposal** - The submission provided by Offerors in response to this RFP.

aa. **RFP** - This Request for Proposals.

bb. **Selection Committee**- The representatives selecting the Consultant.

cc. **State –** State of Maryland.

1.3 Contract Type

The contract that results from this RFP will include a fixed fee for professional services and a contingency amount to be used by MSA in its sole discretion. After execution, the Contract amount shall not be exceeded without the necessary contract modification.

1.4 Contract Duration

The term of the Contract will be for a period necessary to complete the scope of work and as agreed upon by MSA and the Consultant.

1.5 Procurement Officer

The sole point-of-contact for purposes of this RFP is the Procurement Officer listed below:

Natasha Speaks
Maryland Stadium Authority
351 West Camden Street, Suite 300
Baltimore, Maryland 21201
Cell: 443-522-1052
Email: nspeaks@mdstad.com

MSA may change the Procurement Officer at any time and will provide written notice to the Offerors if any such change occurs.

1.6 Pre-Proposal Conference

A virtual pre-proposal conference ("Conference") will be held on **September 14, 2022 at 12:00 p.m. (Local Time)**. Please use the link below to register:

https://us02web.zoom.us/meeting/register/tZcsfuugqzwrHdRUfb4yFdY2HdtC5gpzQhS9

1.7 The Project Manager

The Project Manager is:

Cedric Lowe
Maryland Stadium Authority
351 West Camden Street, Suite 300
Baltimore, Maryland 21201
Email: clowe@mdstad.com

MSA may substitute the PM at any time. Prior to Contract award, written notice of any substitution will be provided to Offerors and, if post award, to the Consultant.

1.8 e-Maryland Marketplace Advantage

In order to receive a Contract award, a vendor must be registered on eMMA. Registration is free. Go here to register: https://procurement.maryland.gov Click on "New Vendor? Register Now" to begin the process and follow the prompts.

1.9 Questions

Questions regarding this RFP shall be submitted electronically in Word or PDF formats via the following link no later than **September 16, 2022 at 1:00 p.m. (Local Time):**

https://mdstad.sharefile.com/r-r009b8cf11a1b48609953b534b3bc42c0

Please include information regarding the name of the firm, representative's name, and contact information. Based on the availability of time to research and communicate an answer, the Procurement Officer will decide whether an answer can be given before the proposal closing date. Answers to all substantive questions that have not previously been answered, and are not clearly specific to the requestor, will be responded via addendum.

1.10 Technical Proposals - Closing Date and Time

To be considered, Technical Proposals must be uploaded to the following link no later than **September 27, 2022 at 1:00 p.m. (Local Time):**

https://mdstad.sharefile.com/r-r945e175a62564616bd507a03adf4b8f8

Requests for an extension of this date and time will not be granted. Offerors shall allow sufficient electronic transmission time to ensure timely receipt. Proposals received by MSA after the deadline will not be considered. Proposals will not be reviewed publicly.

1.11 Virtual Oral Presentations

MSA reserves the right to conduct virtual oral presentation. In the event that MSA exercises its right, short-listed Offerors will be required to make virtual oral presentations to the Selection Committee. Significant representations made by an Offeror during their oral presentation must be confirmed in writing. All such representations will become part of the Offeror's Proposal and are binding if a Contract is awarded as a result of this RFP. The tentative date for Oral Presentations is October 12, 2022. In your Technical Proposal, please state your availability for the dates provided. Typically, oral presentations will follow a specified format and generally be limited to 45 minutes [30 minutes for the presentation and 15 minutes for questions]. The Procurement Officer will notify the short-listed Offerors with details and instructions prior to the presentation.

The presentation must consist of, but not be limited to, a discussion of the Offeror's specific approach to the project, understanding of the scope of work, and how it intends to execute the work within schedule and budget.

1.12 Duration of Offer

Proposals submitted in response to this RFP are irrevocable for **180 days** following the closing date for proposals, the deadline for the submission of Best and Final Offers ("BAFO"), if requested, or the date any protest concerning this RFP is finally resolved. This period may be extended at the Procurement Officer's request only with the Offeror's written agreement.

1.13 Offeror's Affidavit

a. Bid/Proposal Affidavit. Each Offeror shall complete and submit the Bid/Proposal Affidavit attached hereto as **Attachment A** with the Offeror's Technical Proposal.

b. Contract Affidavit. A successful Offeror will be required to complete a Contract Affidavit in the form attached hereto as **Attachment C** and provide to MSA within five (5) business days after notification of proposed recommendation of award of the Agreement. An executed Contract Affidavit should not be submitted with an Offeror's Proposal.

1.14 Acceptance of Terms and Conditions

By submitting a Proposal, the Offeror if selected for award, shall be deemed to have accepted all of the terms and conditions set forth in this RFP including all attachments.

1.15 Procurement Method

The Contract resulting from this RFP will be awarded in accordance with the Competitive Sealed Proposals process under Section 3 (C) of MSA's Procurement Policies. MSA's Procurement Policies are available for review on MSA's website or may be obtained by contacting the Procurement Officer.

1.16 Arrearages

By submitting a response to this RFP, an Offeror represents that it is not in arrears in the payment of any obligations due and owing the State of Maryland, including, by way of example only, the payment of taxes and employee benefits, and that it will not become so in arrears during the term of the Contract if selected for contract award.

1.17 Revisions to the RFP

a. If the RFP is revised before the Proposal Closing Date, MSA shall post any addenda to the RFP on eMMA and MSA's website and shall endeavor to provide such addenda to all prospective Offerors that were sent this RFP or are otherwise known by the Procurement Officer to have obtained this RFP. It

remains the responsibility of all prospective Offerors to check eMMA and MSA's website for any addenda issued prior to the Proposal Submission Deadline.

b. Acknowledgment of the receipt of all addenda to this RFP issued before the Proposal Closing Date shall be included in the Transmittal Letter accompanying the Offeror's Technical Proposal.

c. Addenda made after the Proposal Closing Date will be sent only to those Offerors that remain under award consideration as of the issuance date of the addenda.

d. Acknowledgement of the receipt of addenda to the RFP issued after the Proposal Closing Date shall be in the manner specified in the addendum notice.

e. Failure to acknowledge receipt of an addendum does not relieve the Offeror from complying with the terms, additions, deletions, or corrections set forth in the addendum, and may cause the Proposal to be deemed not reasonably susceptible of being selected for award.

1.18 Cancellations; Discussions

MSA reserves the right to cancel this RFP, to accept or reject any and all proposals, in whole or in part, received in response to this RFP, to waive or permit cure of minor irregularities, and to conduct discussions with any or all qualified or potentially qualified Offerors in any manner necessary to serve the best interests of MSA. This may be followed by submission of Offeror-revised Proposals and best and final offers ("BAFO"). MSA also reserves the right, in its sole discretion, to award a contract based upon written proposals received, without prior discussions or negotiations.

1.19 False Statements

MSA incorporates by reference the provisions of Section 11-205.1 of the State Finance and Procurement Article of the Annotated Code of Maryland regarding truthfulness in the information included in the Contract documents. Offeror shall comply with the obligations set forth therein, including, without limitation, the following:

a. In connection with a procurement Contract, a person may not willfully:
   1. Falsify, conceal, or suppress a material fact by any scheme or device;
   2. Make a false or fraudulent statement or representation of a material fact; or
   3. Use a false writing or document that contains a false or fraudulent statement or entry of a material fact.

b. A person may not aid or conspire with another person to commit an act under

subsection of this section.

c. A person who violates any provision of this section is guilty of a felony and on conviction is subject to a fine not exceeding $20,000 or imprisonment not exceeding five years or both.

1.20 Minority Business Enterprise

Minority Business Enterprises are encouraged to respond to this solicitation.

a. An overall MBE subcontractor participation goal as identified in the Key Information Summary Sheet has been established for this procurement, representing a percentage of the total contract dollar value, including all renewal option terms, if any. All subcontractors named by the Offeror as part of their MBE Schedule must be certified with the Maryland Department of Transportation (MDOT).

b. Notwithstanding any subgoals established for this RFP, the Contractor is encouraged to use a diverse group of subcontractors and suppliers from any/all of the various MBE classifications to meet the remainder of the overall MBE participation goal.

c. By submitting a response to this solicitation, the Offeror acknowledges the overall MBE subcontractor participation goal and subgoals and commits to achieving the overall goal and subgoals by utilizing certified minority business enterprises, or requests a full or partial waiver of the overall goal and subgoals.

   An Offeror that does not commit to meeting the entire MBE participation goal must submit a request for waiver with its proposal submission that is supported by good faith efforts documentation to meet the MBE goal made prior to submission of its proposal as outlined in **Attachment D-1B**, Waiver Guidance. Failure of an Offeror to properly complete, sign, and submit **Attachment D-1A** at the time it submits its technical Proposal will result in the rejection of the Proposal and the Offeror being deemed not reasonably susceptible of being selected for award.

d. Attachments

   a) D-1 to D-5 – The following Minority Business Enterprise participation instructions, and forms are provided to assist Offerors:

      - Attachment D-1A MBE Utilization and Fair Solicitation Affidavit & MBE Participation Schedule (must be submitted with Proposal)
      - Attachment D-1B Waiver Guidance
      - Attachment D-1C Good Faith Efforts Documentation to Support Waiver Request

- Attachment D-2 Outreach Efforts Compliance Statement
- Attachment D-3A MBE Subcontractor Project Participation Certification
- Attachment D-3B MBE Prime Project Participation Certification
- Attachment D-4A Prime Contractor Paid/Unpaid MBE Invoice Report
- Attachment D-4B MBE Prime Contractor Report
- Attachment D-5 Subcontractor Paid/Unpaid MBE Invoice Report

b) The Offeror shall include with its Proposal a completed MBE Utilization and Fair Solicitation Affidavit (**Attachment D-1A**) whereby:

1. The Offeror acknowledges the certified MBE participation goal and commits to make a good faith effort to achieve the goal and any applicable subgoals, or requests a waiver, and affirms that MBE subcontractors were treated fairly in the solicitation process; and
2. The Offeror responds to the expected degree of MBE participation, as stated in the solicitation, by identifying the specific commitment of certified MBEs at the time of Proposal submission. The Offeror shall specify the percentage of total contract value associated with each MBE subcontractor identified on the MBE participation schedule, including any work performed by the MBE prime (including a prime participating as a joint venture) to be counted towards meeting the MBE participation goals.
3. The Offeror requesting a waiver should review **Attachment D-1B** (Waiver Guidance) and **D-1C** (Good Faith Efforts Documentation to Support Waiver Request) prior to submitting its request.

c) If the Offeror fails to submit a complete Attachment D-1A with the technical proposal as required, the Procurement Officer will deem the Proposal not reasonably susceptible of being selected for award.

d) Offerors are responsible for verifying that each MBE (including any MBE prime and MBE prime participating in a joint venture) selected to meet the goal and any subgoals and subsequently identified in Attachment D-1A is appropriately certified by the Maryland Department of Transportation and has the correct NAICS codes allowing it to perform the committed work.

e) Within ten (10) Business Days from notification that it is the recommended awardee or from the date of the actual award, whichever is earlier, the Offeror must provide the following documentation to the Procurement Officer:

1. Outreach Efforts Compliance Statement (**Attachment D-2**);
2. MBE Subcontractor/Prime Project Participation Certification (**Attachment D-3A/3B**); and
3. Any other documentation required by the Procurement Officer to ascertain Offeror responsibility in connection with the certified MBE subcontractor participation goal or any applicable subgoals.

4. Further, if the recommended awardee believes a waiver (in whole or in part) of the overall MBE goal or of any applicable subgoal is necessary, the recommended awardee must submit a fully-documented waiver request that complies with COMAR 21.11.03.11. If the recommended awardee fails to return each completed document within the required time, the Procurement Officer may determine that the recommended awardee is not responsible and, therefore, not eligible for Contract award. If the Agreement has already been awarded, the award is voidable.

f) A current directory of certified MBEs is available through the Maryland State Department of Transportation (MDOT), Office of Minority Business Enterprise, 7201 Corporate Center Drive, Hanover, Maryland 21076. The phone numbers are (410) 865-1269, 1-800-544-6056, or TTY (410) 865-1342. The directory is also available on the MDOT website at http://mbe.mdot.maryland.gov/directory/. The most current and up-to-date information on MBEs is available via this website. Only MDOT-certified MBEs may be used to meet the MBE subcontracting goals.
g) An Offeror that requests a waiver of the goal or any of the applicable subgoals will be responsible for submitting the Good Faith Efforts Documentation to Support Waiver Request (**Attachment D-1C**) and all documentation within ten (10) Business Days from notification that it is the recommended awardee or from the date of the actual award, whichever is earlier, as required in COMAR 21.11.03.11.
h) All documents, including the MBE Utilization and Fair Solicitation Affidavit & MBE Participation Schedule (**Attachment D-1A**), completed and submitted by the Offeror in connection with its certified MBE participation commitment shall be considered a part of the Agreement and are hereby expressly incorporated into the Agreement by reference thereto. All of the referenced documents will be considered a part of the Proposal for order of precedence purposes (see Sample Contract – **Attachment J**).
i) The Offeror is advised that liquidated damages will apply in the event the Contractor fails to comply in good faith with the requirements of the MBE program and pertinent Contract.

1.21 Incurred Expenses; Economy of Preparation

MSA will not be responsible for any costs incurred by an Offeror in preparing and submitting a proposal, making an oral presentation, providing a demonstration or performing any other activities related to this RFP. Proposals should be prepared simply and economically, providing a straightforward, concise description of how the Offeror proposes to meet the requirements of this RFP.

1.22 Protests/Disputes

Any protest or dispute related to this RFP or a resulting Agreement shall be subject to Section 10 of MSA's Procurement Policies and Procedures and the relevant

provisions of the Agreement.

1.23 Public Information Act Note

a. The Offeror should give specific attention to the clear identification of those portions of its Proposal that it considers confidential and/or proprietary commercial information or trade secrets, and provide justification why such materials, upon request, should not be disclosed by MSA under the Public Information Act, Md. Code Ann., General Provisions Article, Title 4 Offerors are advised to read carefully the requirements set forth in Section 4.e(b) herein regarding identification of confidential or proprietary information. (See also RFP Section 1.31 "Confidentiality").

b. This information should be identified by page and section number and placed after the Title Page and before the Table of Contents in the Technical Proposal and if applicable, separately in the Financial Proposal.

c. Offerors are advised that, upon request for this information from a third party, the Procurement Officer is required to make an independent determination whether the information must be disclosed.

1.24 Offeror Responsibilities

a. The Offerors shall be able to provide all goods and services required by this RFP and the successful Offeror shall be responsible for Agreement performance including any subcontractor participation.

b. All subcontractors must be identified, and a complete description of their roles relative to the Proposal must be included in the Offeror's Proposal. If applicable, subcontractors utilized in meeting the established MBE participation goal(s) for this solicitation shall be identified as provided in the appropriate attachment(s) to this RFP (see Section 1.20 "Minority Participation Enterprise").

c. If an Offeror is the subsidiary of another entity, all information submitted by the Offeror including but not to, references and financial reports, or experience and documentation (e.g. insurance policies, bonds, letters of credit) used to meet the minimum qualifications, if any shall pertain exclusively to the Offeror, unless the parent organization will guarantee the performance of the subsidiary. If applicable, the Offeror's Proposal shall contain an explicit statement, signed by an authorized representative of the parent entity, stating that the parent entity will guarantee the performance of the subsidiary.

d. A performance guarantee by a parent entity of the Offeror under this section will not automatically result in crediting the Offeror with the experience or qualifications of the parent under any evaluation criteria pertaining to the actual Offeror's experience and qualifications. Instead, the Offeror will be

evaluated on the extent to which MSA determines that the experience and qualifications of the parent are applicable to and shared with the Offeror, any stated intent by the parent to be directly involved in the performance of the Agreement, and the value of the parent's participation as determined by MSA.

1.25 Patents, Copyrights, and Intellectual Property

a. If the Consultant furnishes any design, device, material, process or other item that is covered by a patent or copyright or that is proprietary to or a trade secret of another, it shall obtain the necessary permission or license to permit MSA to use such item.

b. The Consultant will defend or settle, at its own expense, any claim or suit against MSA alleging that any such item furnished by the Consultant infringes any patent, trademark, copyright, or trade secret. If a third party claims that a product infringes that party's patent, trademark, copyright or trade secret, the Consultant will defend MSA against that claim at the Consultant's expense and will pay all damages, costs, and attorney's fees that a court finally awards, provided MSA: (i) promptly notifies Consultant in writing of the claim; and (ii) allows the Consultant to control, and cooperates with the Consultant in, the defense and any related settlement negotiations. The obligations of this paragraph are in addition to those stated in the next paragraph.

c. If any product(s) furnished by the Consultant become, or in the Consultant's opinion is/are likely to become, the subject of a claim of infringement, the Consultant will, at its option and expense: (i) procure for MSA the right to continue using the applicable item; (ii) replace the product with a non-infringing product substantially complying with the item's specifications; or (iii) modify the item so that it becomes non- infringing and performs in a substantially similar manner to the original item.

1.26 Non-Availability of Funding

If the General Assembly fails to appropriate funds or if funds are not otherwise made available for continued performance for any fiscal period of a Contract succeeding the first fiscal period, the Contract shall be canceled automatically as of the beginning of the fiscal year for which funds were not appropriated or otherwise made available; provided, however, that this will not affect the rights of the Consultant and/or MSA under any termination clause in the Contract. The effect of termination of the Contract hereunder will be to discharge the Consultant, and MSA from future performance of the Contract, but not from their rights and obligations existing at the time of termination. The Consultant shall be reimbursed for the reasonable value of any nonrecurring costs incurred but not amortized in the price of the Contract. MSA shall notify the Consultant as soon as it has knowledge that funds may not be available for the continuation of the Contract for each succeeding fiscal period beyond the first.

1.27 Financial Disclosure

The Consultant shall comply with §13-221 of the State Finance and Procurement Article of the Annotated Code of Maryland, which requires that every person that enters into contracts, leases, or other agreements with the State or its agencies during a calendar year under which the business is to receive in the aggregate, $100,000 or more, shall, within 30 days after the aggregate value of these contracts, leases or other agreements reaches $100,000, file with the Secretary of the State of Maryland certain specified information to include disclosure of beneficial ownership of the business.

1.28 Non-Exclusive Use

Neither this RFP nor any resulting Contract shall be construed to require MSA to use any Offeror or exclusively use the Consultant for the services described in this RFP. MSA reserve the right to obtain services of any nature from other sources when it is in the best interest of MSA to do so and without notice to any party. MSA makes no guarantees that it will purchase any products or services from the Consultant resulting from this RFP.

1.29 Sustainability Policies

MSA is committed to procuring all supplies, services, maintenance, construction, and architect-engineer services in a manner consistent with the promotion of sound environmental practices.

1.30 Payments by Electronic Fund Transfer

By submitting a response to this RFP, the Offeror agrees to accept payments by electronic funds transfer (EFT) unless the State Comptroller's Office grants an exemption from this method of payment. The awarded CM shall register using the COT/GAD X-10 Vendor Electronic Funds Transfer (ETF) Registration Request form. MSA will provide the required EFT forms to the awarded Offeror. Requests for exemption are strictly the responsibility of the awarded CM.

1.31 Confidentiality

Subject to the Maryland Public Information Act and any other applicable laws, all confidential or proprietary information and documentation relating to either party to a Contract resulting from this RFP (including without limitation any information or data stored within the Consultant's computer systems) shall be held in absolute confidence by the other party. Each party shall, however, be permitted to disclose relevant confidential information to its officers, agents, and employees to the extent that such disclosure is necessary for the performance of their duties under the Contract, provided that the data may be collected, used, disclosed, stored, and disseminated only as provided by and consistent with the law. The provisions of this section shall not apply to information that (a) is lawfully in the

public domain; (b) has been independently developed by the other party without violation of the Contract; (c) was already in the possession of such party; (d) was supplied to such party by a third-party lawfully in possession thereof and legally permitted to further disclose the information; or (e) such party is required to disclose by law.

1.32 Loss of Data

In the event of loss of any MSA data or records where such loss is due to the intentional act or omission or negligence of the Consultant or any of its subconsultants or agents, the Consultant shall be responsible for recreating such lost data in the manner and on the schedule set by the Procurement Officer. The Consultant shall ensure that all data is backed up and recoverable by the Consultant.

1.33 Non-Hiring of Employees

No official or employee of the State, as defined in State Government Article §15-102, Annotated Code of Maryland, whose duties as such official or employee include matters relating to or affecting the subject matter of this procurement, shall, during the pendency and term of a resulting Contract, and while serving as an official or employee of the State, become or be an employee of the Consultant or any entity that is a subconsultant on said Contract.

1.34 Nondiscrimination in Employment

The Consultant agrees: (a) not to discriminate in any manner against an employee or applicant for employment because of race, color, religion, creed, age, sex, marital status, sexual orientation, national origin, ancestry, or disability of a qualified individual with a disability; (b) to include a provision similar to that contained in subsection (a) above in any subcontract except a subcontract for standard commercial supplies or raw materials; and (c) to post, and to cause subconsultants to post, in conspicuous places available to employees and applicants for employment, notices setting forth the substance of this clause.

1.35 Contingent Fee Prohibition

The Consultant warrants that it has not employed or retained any person, partnership, corporation, or other entity, other than a bona fide employee, bona fide agent, bona fide salesperson or commercial selling agency working for the Consultant, to solicit or secure a Contract, and that it has not paid or agreed to pay any person, partnership, corporation, or other entity, other than a bona fide employee, bona fide agent, bona fide salesperson or commercial selling agency, any fee or other consideration contingent on the making of a Contract.

1.36 Political Contribution Disclosure

The Consultant shall comply with Election Law Article, §§14-101 to 14-108, Annotated Code of Maryland, which requires that every person that enters into Contracts, leases, or other agreements with the State, a county, an incorporated municipality, or its agencies, during a calendar year in which the person receives in the aggregate $100,000 or more, shall file with the State Board of Elections a statement disclosing contributions in excess of $500 made during the reporting period to a candidate for elective office in any primary or general election. The statement shall be filed with the State Board of Elections (1) before a purchase or execution of a lease or Contract by the State, a county, an incorporated municipality, or their agencies, and shall cover the preceding two calendar years; and (2) if the contribution is made after the execution of a lease or Contract, then twice a year, throughout the Contract term, on: (a) February 5, to cover the 6-month period ending January 31; and (b) August 5, to cover the 6-month period ending July 31.

1.37 Verification of Registration and Tax Payment

Before a corporation can do business in the State, it must be registered with the Department of Assessments and Taxation, State Office Building, Room 803, 301 West Preston Street, Baltimore, Maryland 21201. It is strongly recommended that any potential Offeror complete registration prior to the closing date for receipt of Proposals. An Offeror's failure to complete registration with the Department of Assessments and Taxation may disqualify an otherwise successful Offeror from final consideration and recommendation for Contract award.

1.38 MBE and Prevailing Wage Compliance System

As part of MSA's commitment to assist firms in complying with legal and Contractual requirements, MSA maintains a web-based MBE and prevailing wage compliance system. The system was designed to provide various work- flow automation features that improve the project reporting process. This system will monitor Contract compliance for all Program Contracts. The prime firm, its first-tier consultants, and all MBE participation subconsultants awarded Contracts will be required to use the web-based system to submit project information including, but not limited to, certification of payments made and received and certified payroll records (if the Contract includes prevailing wage and/or workforce development requirements). MSA may require additional information related to the Contract to be provided electronically through the system at any time before, during, or after Contract award.

1.39 Maryland Law

This RFP shall be construed, interpreted, and enforced according to the laws of the State of Maryland.

SECTION 2

OFFEROR'S QUALIFICATIONS

At a minimum, Offerors shall meet the following qualifications to be considered for award:

2.1 Qualifications

a. Offeror shall be a firm specializing in providing commissioning services and experienced in establishing, overseeing, monitoring, tracking, and reporting commissioning requirements;

b. Offeror shall have significant experience participating in all phases of construction including design review, submittal review, construction monitoring, owner training, O&M review, post acceptance, final and post occupancy commissioning;

c. Offeror shall have significant experience in developing and implementing project specific commissioning plans for new construction projects;

d. Offeror shall demonstrate a minimum of seven (7) years of experience providing fundamental and enhanced building enclosure commissioning services;

e. Offeror shall demonstrate knowledge of LEED accreditation requirements and building techniques;

f. Offeror shall have a minimum of three (3) years of experience in developing building and systems maintenance plans;

g. Offeror shall have experience with complex integration of new systems in buildings 60,000GSF or larger;

h. Offeror shall have experience with large public gathering venues such as athletic facilities, hotels/conference centers, convention centers, educational facilities, office buildings, etc; and,

i. Offeror shall meet the insurance requirements stated in the Sample Contract, **Attachment J.**

SECTION 3

PURPOSE AND SCOPE OF WORK

3.1 Purpose

The MSA is issuing this Request for Proposals to implement and manage building commissioning services for the Hagerstown Multi-Use Sports and Events Facility (the "Project") in Hagerstown, MD. MSA is seeking a commissioning firm to implement the commissioning process in the new facility. The objective of commissioning is to ensure that all energy-related and other building systems installed are performing per the design intent and provide documented confirmation that the new facility systems fulfill the operational, functional, and performance requirements of MSA, its occupants, and the maintainability standards of the Operation and Maintenance (O&M) personnel. To reach this goal, it is necessary for the commissioning process to fully document and implement the project requirements for system function, performance, and maintenance, as well as to verify and document compliance with these criteria throughout design, construction, start-up, and the post occupancy period of operation for mechanical, electrical, plumbing, and life safety systems. Commissioning services shall be performed on all mechanical, electrical, plumbing, and building enclosure systems. The selected Offeror will work closely with the Project Team in a cooperative and coordinated fashion.

The commissioning process will systematically document that the specified components and systems have been properly manufactured, installed, and are functioning as specified. This process shall be completed through pre-functional checkout and system functional testing to verify and document the proper operation of all equipment in various modes, critical alarms, and under anticipated performance conditions.

The Consultant will work closely with the MSA, the DB, and other project participants in a cooperative and coordinated fashion. The MSA will deliver the project via the Design Build method. The Design Builder on the project is comprised of Turner Construction Company and Pendulum.

3.2 Scope of Services

The Consultant will be responsible for all commissioning activities in accordance with ASHRAE and NIBS Guidelines on a single project, inclusive of design input and reviews, installation verification, equipment startup, pre-functional checkout, and full system functional testing. Commissioning services will be provided for 24 months after substantial completion. Testing, verification and reporting on the performance of all commissioned systems is to be completed in a systematic fashion based on an approved project-specific commissioning plan.

Consultant will be responsible for testing, evaluating, and confirming the proper integration of new equipment installed as part of the Project.

At a minimum, the Consultant will commission the following systems:

- Mechanical & Plumbing Systems and Equipment
  - Air Handling Units
  - DOAS Units
  - Energy Recovery Modules
  - Make-Up Air Units
  - Air Cooled Condensing Units
  - Variable Refrigerant Flow Systems
  - Heat Pumps
  - Ductless Split AC Units
  - Terminal Heaters
  - Pumps
  - Exhaust Fans
  - VFDs
  - DDC Control Systems
  - Electrical Systems & Equipment
  - Automatic Transfer Switches
  - Lighting and Daylighting Controls
  - Lightning Protection
  - Motor Controllers
  - Transformers
  - Panelboards
  - Grounding Systems
  - Emergency Generator
- Building Enclosure Systems
- Special Systems
  - Kitchen equipment

After substantial completion but prior to final acceptance, the Consultant shall work with the Project Team to capture trending data on all commissioned equipment from a continuous seven (7) calendar day period, confirming

satisfactory system performance.

The scope of work includes the following general tasks.

a. Serve as the Commissioning Agent (CxA) and Building Enclosure Specialists (BES) (herein after *Commissioning Authority*) for the Project.

    1. Provide Commissioning Services and deliverables in accordance with this RFP and ASHRAE Guideline 0-2005.
    2. Provide Building Enclosure Commissioning services and deliverables in accordance with this RFP and NIBS Guideline 3-2012.

b. Conduct formal design reviews and document in a formal report. The design review report must also address completeness of design documents regarding system performance, operability, maintainability, energy efficiency and sustainability of the overall design during the pre-construction phase. At a minimum, the design reviews must confirm the design complies with the current statutes of State energy codes. Formal reviews are required, at the conclusion of each phase of A/E document submission (DD, CD 70%, and CD 95%). The Commissioning Authority will be brought into the design process as early as possible, but no later than the conclusion of the Design Development phase. Additional reviews may be required at the discretion of MSA if the design submissions are deemed insufficient or incomplete.

c. Develop full commissioning specifications (requirements) for all mechanical, electrical, plumbing, special systems, and building enclosure equipment and systems tailored to scale and complexity of the project. Coordinate with and integrate into the project specifications produced by the Project Team.

d. Coordinate a design phase controls integration meeting for the building energy management system and temperature controls integration with the Project Team to discuss EMS and equipment control integration issues, and sequences of operations between equipment, and systems, to ensure that integration issues such as point matrix delineation and operational sequences of commissioned systems are clearly described in the specifications.

e. Coordinate commissioning activities and required meetings with the Project Team through both the design and construction phases, along with final acceptance, turnover and certification of the project.

f. Conduct, schedule, manage the commissioning kick off meeting during the design phase with the A/E, and hold another kick off meeting for the DB & sub-contractors during the construction phase of the project. Provide a detailed commissioning schedule with durations delineated to integrate with the overall project schedule. The Commissioning Authority shall work with CM's Project Scheduler to integrate commissioning activities into overall project schedule.

g. Develop, implement and track a project-specific commissioning plan incorporating the requirements from the Project's commissioning specifications and include all project-specific equipment pre-functional checklists, startup checkout forms, detailed commissioning schedule, and issues log templates.

   1. Commissioning plan shall be developed in accordance with ASHRAE Guideline 0-2005 and NIBS Guideline 3-2012 to include all mechanical, electrical, plumbing, and building enclosure systems and equipment

h. At a minimum, the Commissioning plan shall include:

   1. Brief overview of the commissioning process.
   2. Identification of the roles of primary commissioning participants and their responsibilities.
   3. Define the proper communication protocols and methods for distribution of information amongst the Project Team.
   4. Review of the Basis of Design.
   5. List of all commissioned features and systems including a master list of all pertinent equipment and systems.
   6. Description of the management, communication and reporting of the plan.
   7. Outline of the commissioning scope, including submittal review, observation, start-up, testing, and mock-up inspection.
   8. List of the expected written work products: pre-functional checklists of commissioned equipment, startup checkout forms, issues log tracking forms, functional test procedures and forms, and other reports mandated.
   9. Detailed commissioning schedule with durations delineated for the equipment to be commissioned.
   10. Description of the rigor and scope of testing including sampling method. All major equipment including central plant equipment, (air handling units, etc.) must be fully tested and may not be sampled.

i. The Commissioning Authority must review the construction documents during the design phase to ensure that each commissioned feature or system meets the Basis of Design (BOD) relative to functionality, reduction in energy use & atmosphere protection, water use reduction, ease of maintenance, affordability, indoor environmental quality and local environmental impacts.

j. Review and comment on project submittals as it pertains to: commissioning and compliance with contract documents, any deviation for energy efficiency requirements of the specified equipment, as well as warranty provisions.

   - Generate and distribute a list of submittals requiring the Commissioning Authority's review.

k. Review and comment on project specific mock-ups as it pertains to the building enclosure system(s).

l. Perform site visits to observe general construction progress for preparation of commissioning activities. Specify total number of site observation visits planned for the project. Site visits cannot be less than monthly once installation has commenced.

m. Witness component and equipment startup to ensure that startup efforts are performed in accordance with the commissioning plan, contract documents, and manufacturer requirements.

n. Witness component testing to ensure that proper procedures are followed. Direct the execution of all functional performance testing with the trade contractors. All major equipment (chillers, boilers, main air handling units, dedicated outdoor units, energy recovery units, heat and vent units, etc.) must be fully tested, no is sampling allowed. Smaller or repetitive units may be sampled at no less than 20%.
   - Included as part of the 24-month post occupancy warranty period, provide opposite season testing of HVAC equipment and systems.

o. Monitor and report on the training of operation and maintenance personnel. Review the draft-training plan and trainer qualification.

p. Perform 10-month post-acceptance pre-warranty end review of outstanding commissioning issues, operational deficiencies, equipment failures, building operator and occupant complaints, and results from EMS systems monitoring and trending. Document all systems operation, maintenance, performance, systems alterations and changes, and re- testing and re-commissioning needs, as required.

q. Conduct commissioning meetings during the construction phase, inspect, test, log and track all deficient items. Responsible for generating and managing a master issues log and ensure issues are addressed. This report is to be produced and submitted to the Owner, DB, and responsible contractor at a minimum of a monthly basis. Additionally, a written list of all outstanding commissioning issues and any testing that is scheduled for a later date must be included. All outstanding environmentally or economically responsive feature deficiencies must be corrected or listed in the commissioning report. All completed functional tests should be listed in an appendix to the commissioning report

r. Develop and complete the final commissioning report at the completion of all commissioning activities including seasonal start-ups. The Final Commissioning Report shall be developed in accordance with ASHRAE Guideline 0-2005 and NIBS Guideline 3-2012 and include, at a minimum:

   1. Final version of lessons learned and benefits resulting from commissioning. Design phase as well as construction phase considerations should both be addressed.
   2. Completed record of all pre-functional checklists, startup checkout forms, final results of functional tests including trending data demonstrating

satisfactory system performance over seven (7) calendar days, and enclosure test records.

3. Building maintenance plan as defined in Section 3.2(t) and Building Enclosure Preventative Maintenance Program as defined in Section 3.2(u).
4. Signed letter confirming the commissioning plan has been successfully executed and the design intent of the Project has been achieved.

s. Review the assembly of O&M manuals by the Contractor documenting design criteria, design assumptions and limitations, system descriptions, operating parameters, performance capabilities, and maintenance requirements as stipulated in the contract documents.

t. Develop a specific Building Maintenance Plan ("BMP") for the entire building's critical systems in accordance with the design, manufacturer's recommendations. This specific BMP development is to be completed prior substantial completion of the project and shall address all systems within the scope of commissioning.
   - Critical systems include, but are not limited to, HVAC and associated controls, life safety, electrical, lighting, and plumbing systems.

u. Develop a specific Building Enclosure Preventative Maintenance Plan in accordance with manufacturer recommendations, to be submitted prior to substantial completion.

3.3 Schedule

The schedule outlining the current project timelines are attached as **Attachment I.**

SECTION 4

PROPOSAL SUBMISSION AND REQUIREMENTS

4.1 Solicitation Process

The solicitation will follow a multi-step process to select the successful Offeror.

1. Step 1– Submission of Technical Proposal

   Offerors will submit a technical Proposal in accordance with Section 4.3 to demonstrate their experience (including meeting the minimum requirements and ability to execute the Project successfully). Upon receipt of the technical Proposals, proposals will be reviewed and those deemed responsible and reasonably susceptible of being selected for award will be reviewed by the Selection Committee. Offerors must respond to all requirements of the RFP. Offerors that fail to do so shall be deemed not reasonably susceptible of being selected for award.

2. Step 2 – Review of Technical Proposals

   The Selection Committee will review technical Proposals and rank the Proposals according to technical merit. Based on their achieved technical rankings, selected Offerors will be "short-listed" to participate in the oral presentation phase of the procurement.

3. Step 3 –Short-list and Oral Presentation

   Short-listed Offerors will be asked to attend a virtual oral presentation. Offerors that are not short-listed will be notified that they are not reasonably susceptible of being selected for award.

4. Step 4 – Selection for the Financial Proposal Phase

   After oral presentations and based on achieved rankings, the Selection Committee will select which short-listed firms will be requested to submit a financial Proposal. Offerors that are not short-listed will be notified that they are not reasonably susceptible of being selected for award.

5. Step 5 – Recommendation for Award

   The Offeror deemed to provide the best value (Technical and Financial) to the Project by the Selection Committee will be recommended for award. The Offeror deemed to provide the best value (Technical and Financial) to the Project by the Selection Committee will be recommended for award.

4.2 Submission – General Requirements

Offerors shall submit proposals labeled "**Request for Proposals – Building Commissioning Services – Hagerstown Multi-Use Sports and Events Facility – Request for Proposals – Volume I – Technical Proposal**". All pages of each proposal volume must be consecutively numbered from beginning (Page 1) to end (Page "x"). The final page shall state "Final Page".

Technical proposals shall be uploaded electronically to the link provided in Section 1.10 of the RFP, as revised by any addendum. **The electronic submissions (formatted as .pdf file) shall include the firm's name in the file name and shall be formatted so each page can be legibly printed in 8 ½" x 11" format.**

4.3 Volume I – Technical Proposal

This section provides specific instructions for submission of the Offeror's Technical Proposal. The Technical Proposal shall follow the format provided below.

a. Transmittal Letter

A transmittal letter must be included in the Technical Proposal. The purpose of this letter is to transmit the proposal to the Procurement Officer. The transmittal letter should be brief and signed by an individual who is authorized to commit the Offeror to the services and requirements as stated in this RFP.

b. Title and Table of Contents

The Technical Proposal shall begin with a title page bearing the name and address of the Offeror, point of contact information (including e-mail address), and the title of this RFP. A table of contents for the Proposal should follow the title page. Information claimed to be confidential shall be clearly identified**. Unless there is a compelling case, an entire proposal** should not be labeled confidential. Only those portions that can reasonably be shown to be proprietary or confidential should be so labeled.

c. Executive Summary

The Offeror shall condense and highlight the contents of the technical Proposal in a separate section titled "Executive Summary." The summary shall acknowledge the receipt of any amendments or addenda associated with this RFP and identify its tax identification number. The Executive Summary shall not exceed two (2) pages. The summary shall identify any exceptions the Offeror has taken to the RFP requirements and/or sample Contract – **Attachment J**. Offerors shall also identify any joint ventures at the time of submission, if any, and the roles these relationships will have in the performance of a Contract. Upon MSA's request,

Offerors shall make available within 24 hours the joint venture scope of work documents and/or agreement.

<u>Warning</u>: Exceptions to terms and conditions may result in having the proposal deemed as not reasonably susceptible of being selected for award. If an Offeror takes no exception, the Executive Summary should so state.

d. Work Plan and Offeror's Experience

Section 3 (Scope of Work) of the RFP, provides Offerors with information on the desired outcome of this solicitation. At a minimum, Offerors shall address the following:

1. Demonstrate that they meet the qualifications set forth in Section 2 (Offeror's Qualifications) of the RFP.
2. Offeror's organization and how it intends to complete the scope of work outlined in the RFP. Please provide a general description of your company's approach to the commissioning process for the specific Project and identify some potential challenges and proposed course of action plans.
3. The Offeror shall convey project related experience by completing the Experience Form included as **Attachment K.**
4. Schedule:
   Offerors shall include a detailed schedule of activities and durations.
5. Experience:
   The names, titles, and resumes of key management personnel (staffing plan) directly involved with managing the work that will be required under the Contract.
6. Provide work samples of the following deliverables:
   - Issues Log
   - Commissioning Plan
   - Final Commissioning Report (including pre-functional checklist, start-up forms, and final results of functional testing)
   - Building Maintenance Plan
   - Building Enclosure Preventative Maintenance Plan

Note: During proposal evaluation, MSA reserves the right to require that the Offeror provide a copy of its most current Annual Report or audited Statement of Financial Condition to include a Balance Sheet, Income Statement and Cash Flow Statement or other acceptable financial information. These documents may be relied upon in any determination regarding the Offeror's financial responsibility.

e. Other Required Submissions

In addition, Offerors must submit the following items in the Technical Proposal:

A. Completed Bid/Proposal Affidavit **(Attachment A);**

B. Completed Conflict of Interest Information/Affidavit and Disclosure **(Attachment B)**;

C. Work Capacity Summary Form for Key Management and Personnel, including subconsultants (**Attachment G**); and,

D. Verification from the Offeror's insurance carrier/provider identifying the Offeror's current policy limits and current deductible amounts, including coverage limits for Commercial General Liability, Excess Liability, Automobile, Worker's Comp/Employer Liability, and any additional insurance coverages held by the Offeror are to be identified and submitted.

E. A completed Corporate Profile **(Attachment E)**.

F. An accurately completed and signed MBE Form D1- "MBE Utilization and Fair Solicitation Affidavit and MBE Participation Schedule" (see **Attachment D**). Per COMAR regulation 21.11.03.09.C (5), failure to include and/or accurately complete this form shall result in a determination that the proposal is not susceptible for award.

4.4 Volume II - Financial Proposal

a. Required Submissions

Short-listed Offerors will receive additional instructions regarding the submission of the financial proposal. Any Offeror requested to submit a financial proposal must submit the following items in the Financial Proposal:

1. The sample pricing form is included in this RFP as **Attachment H**.

SECTION 5

EVALUATION CRITERIA AND SELECTION PROCEDURE

5.1 Evaluation Criteria

Evaluation of the Proposals will be performed by the Selection Committee and will be based on the criteria set forth below. Technical criteria shall be given more weight than financial criteria.

5.2 Technical Criteria

Criteria used to rate the Technical Proposal includes, without limitation, the following:

a. Adequacy of the Work Plan presented to provide the proposed services; adequacy of the Offeror's proposed work approach, and sample Inspection forms.

b. Experience and qualifications of the Offeror and its key management personnel (Staffing Plan), with specific emphasis on similar projects.

c. Past Performance and Offeror References

d. Work Capacity.

e. Oral Presentation (if required)

f. Overall Quality of Submission.

5.3 Financial Criteria

All qualified short-listed Offerors will be given a score based on their evaluated financial proposal. The score for each other financial proposal will be determined on a pro-rata basis compared to the lowest evaluated financial proposal.

5.4 Reciprocal Preference

Although Maryland law does not authorize procuring agencies to favor resident Offeror in awarding procurement contracts, many other states do grant their resident businesses preferences over Maryland contractors. Therefore, as described in COMAR 21.05.01.04, a resident business preference may be given if: a responsible Offeror whose headquarters, principal base of operations, or principal site that will primarily provide the services required by this RFP is in another state submits the most advantageous offer; the other state gives a preference to its residents through law, policy, or practice; and the preference does not conflict with a federal law or grant affecting the Contract. The preference given

will be identical to the preference that the other state, through law, policy, or practice gives to its residents.

5.5 General Selection Process

a. The Contract will be awarded in accordance with the competitive sealed proposals process under Section 3(C) of MSA's Procurement Policies.

b. Prior to award of a Contract pursuant to this RFP, MSA may require any and all Offerors to submit such additional information bearing upon the Offeror's ability to perform the Contract as MSA may deem appropriate. MSA may also consider any information otherwise available concerning the financial, technical and other qualifications or abilities of the Offeror.

c. MSA may hold discussions with any or all Offerors judged reasonably susceptible of being selected for award, or potentially so. MSA also reserves the right to develop a short-list of Offerors deemed most qualified based upon their Technical Proposals and conduct discussions with only the short-listed Offerors. However, MSA also reserves the right to make an award without holding discussions. Whether or not discussions are held, MSA may determine an Offeror to be not responsible or not reasonably susceptible of being selected for award, in its sole and absolute discretion, at any time after the initial closing date for receipt of proposals and the review of those proposals.

5.6 Award Determination

Upon completion of all evaluations, discussions and negotiations, and reference checks, the Procurement Officer will recommend award of the contract to the responsible Offeror whose proposal is determined to be the most advantageous to MSA considering technical evaluation factors and price factors as set forth in this RFP. The award is subject to approval by the MSA Board of Directors.

ATTACHMENTS

All attachments can be accessed via the following Share File link:
https://mdstad.sharefile.com/d-sefd15acb1a8c4b39bfd6fb91e529f793

A. .....BID/PROPOSAL AFFIDAVIT

B. .....CONFLICT OF INTEREST AFFIDAVIT

C. ..... CONTRACT AFFIDAVIT

D. ..... MBE INSTRUCTIONS AND FORMS

E. .....CORPORATE PROFILE

F. .....DESIGN DEVELOPMENT DOCUMENTS

G. ..... CAPACITY SUMMARY SHEET

H. ..... PRICING FORM

I. .....ANTICIPATED PROJECT SCHEDULE

J. .....SAMPLE CONTRACT (to be issued via addendum)

K. ..... EXPERIENCE FORM

Attachment A

BID/PROPOSAL AFFIDAVIT

Attachment A. Bid/Proposal Affidavit

A. AUTHORITY

I hereby affirm that I, _____ (name of affiant) am the _____ (title) and duly authorized representative of _____ (name of business entity) and that I possess the legal authority to make this affidavit on behalf of the business for which I am acting.

B. CERTIFICATION REGARDING COMMERCIAL NONDISCRIMINATION

The undersigned Bidder/Offeror hereby certifies and agrees that the following information is correct: In preparing its Bid/proposal on this project, the Bidder/Offeror has considered all Bid/proposals submitted from qualified, potential subcontractors and suppliers, and has not engaged in "discrimination" as defined in § 19-103 of the State Finance and Procurement Article of the Annotated Code of Maryland. "Discrimination" means any disadvantage, difference, distinction, or preference in the solicitation, selection, hiring, or commercial treatment of a vendor, subcontractor, or commercial customer on the basis of race, color, religion, ancestry, or national origin, sex, age, marital status, sexual orientation, sexual identity, genetic information or an individual's refusal to submit to a genetic test or make available the results of a genetic test, disability, or any otherwise unlawful use of characteristics regarding the vendor's, supplier's, or commercial customer's employees or owners. "Discrimination" also includes retaliating against any person or other entity for reporting any incident of "discrimination". Without limiting any other provision of the solicitation on this project, it is understood that, if the certification is false, such false certification constitutes grounds for the State to reject the Bid/proposal submitted by the Bidder/Offeror on this project, and terminate any contract awarded based on the Bid/proposal. As part of its Bid/proposal, the Bidder/Offeror herewith submits a list of all instances within the past four (4) years where there has been a final adjudicated determination in a legal or administrative proceeding in the State of Maryland that the Bidder/Offeror discriminated against subcontractors, vendors, suppliers, or commercial customers, and a description of the status or resolution of that determination, including any remedial action taken. Bidder/Offeror agrees to comply in all respects with the State's Commercial Nondiscrimination Policy as described under Title 19 of the State Finance and Procurement Article of the Annotated Code of Maryland.

B-1. CERTIFICATION REGARDING MINORITY BUSINESS ENTERPRISES.

The undersigned Bidder/Offeror hereby certifies and agrees that it has fully complied with the State Minority Business Enterprise Law, State Finance and Procurement Article, § 14-308(a)(2), Annotated Code of Maryland, which provides that, except as otherwise provided by law, a contractor may not identify a certified minority business enterprise in a Bid/proposal and:

(1) Fail to request, receive, or otherwise obtain authorization from the certified minority business enterprise to identify the certified minority bid/proposal;

(2) Fail to notify the certified minority business enterprise before execution of the contract of its inclusion in the Bid/proposal;

(3) Fail to use the certified minority business enterprise in the performance of the contract; or

(4) Pay the certified minority business enterprise solely for the use of its name in the Bid/proposal.

Without limiting any other provision of the solicitation on this project, it is understood that if the certification is false, such false certification constitutes grounds for the State to reject the

Bid/proposal submitted by the Bidder/Offeror on this project, and terminate any contract awarded based on the Bid/proposal.

B-2. CERTIFICATION REGARDING VETERAN-OWNED SMALL BUSINESS ENTERPRISES.

The undersigned Bidder/Offeror hereby certifies and agrees that it has fully complied with the State veteran-owned small business enterprise law, State Finance and Procurement Article, § 14-605, Annotated Code of Maryland, which provides that a person may not:

(1) Knowingly and with intent to defraud, fraudulently obtain, attempt to obtain, or aid another person in fraudulently obtaining or attempting to obtain public money, procurement contracts, or funds expended under a procurement contract to which the person is not entitled under this title;

(2) Knowingly and with intent to defraud, fraudulently represent participation of a veteran-owned small business enterprise in order to obtain or retain a Bid/proposal preference or a procurement contract;

(3) Willfully and knowingly make or subscribe to any statement, declaration, or other document that is fraudulent or false as to any material matter, whether or not that falsity or fraud is committed with the knowledge or consent of the person authorized or required to present the declaration, statement, or document;

(4) Willfully and knowingly aid, assist in, procure, counsel, or advise the preparation or presentation of a declaration, statement, or other document that is fraudulent or false as to any material matter, regardless of whether that falsity or fraud is committed with the knowledge or consent of the person authorized or required to present the declaration, statement, or document;

(5) Willfully and knowingly fail to file any declaration or notice with the unit that is required by COMAR 21.11.13; or

(6) Establish, knowingly aid in the establishment of, or exercise control over a business found to have violated a provision of § B-2(1) -(5) of this regulation.

C. AFFIRMATION REGARDING BRIBERY CONVICTIONS

I FURTHER AFFIRM THAT:

Neither I, nor to the best of my knowledge, information, and belief, the above business (as is defined in Section 16-101(b) of the State Finance and Procurement Article of the Annotated Code of Maryland), or any of its officers, directors, partners, controlling stockholders, or any of its employees directly involved in the business's contracting activities including obtaining or performing contracts with public bodies has been convicted of, or has had probation before judgment imposed pursuant to Criminal Procedure Article, § 6-220, Annotated Code of Maryland, or has pleaded nolo contendere to a charge of, bribery, attempted bribery, or conspiracy to bribe in violation of Maryland law, or of the law of any other state or federal law, except as follows (indicate the reasons why the affirmation cannot be given and list any conviction, plea, or imposition of probation before judgment with the date, court, official or administrative body, the sentence or disposition, the name(s) of person(s) involved, and their current positions and responsibilities with the business):

_____

_____

D. AFFIRMATION REGARDING OTHER CONVICTIONS

I FURTHER AFFIRM THAT:

Neither I, nor to the best of my knowledge, information, and belief, the above business, or any of its officers, directors, partners, controlling stockholders, or any of its employees directly involved in the business's contracting activities including obtaining or performing contracts with public bodies, has:

(1) Been convicted under state or federal statute of:

(a) A criminal offense incident to obtaining, attempting to obtain, or performing a public or private contract; or

(b) Fraud, embezzlement, theft, forgery, falsification or destruction of records or receiving stolen property;

(2) Been convicted of any criminal violation of a state or federal antitrust statute;

(3) Been convicted under the provisions of Title 18 of the United States Code for violation of the Racketeer Influenced and Corrupt Organization Act, 18 U.S.C. § 1961 et seq., or the Mail Fraud Act, 18 U.S.C. § 1341 et seq., for acts in connection with the submission of Bids/Proposals for a public or private contract;

(4) Been convicted of a violation of the State Minority Business Enterprise Law, § 14-308 of the State Finance and Procurement Article of the Annotated Code of Maryland;

(5) Been convicted of a violation of § 11-205.1 of the State Finance and Procurement Article of the Annotated Code of Maryland;

(6) Been convicted of conspiracy to commit any act or omission that would constitute grounds for conviction or liability under any law or statute described in subsections (1)— (5) above;

(7) Been found civilly liable under a state or federal antitrust statute for acts or omissions in connection with the submission of Bids/Proposals for a public or private contract;

(8) Been found in a final adjudicated decision to have violated the Commercial Nondiscrimination Policy under Title 19 of the State Finance and Procurement Article of the Annotated Code of Maryland with regard to a public or private contract;

(9) Been convicted of a violation of one or more of the following provisions of the Internal Revenue Code:

(a) §7201, Attempt to Evade or Defeat Tax;

(b) §7203, Willful Failure to File Return, Supply Information, or Pay Tax,

(c) §7205, Fraudulent Withholding Exemption Certificate or Failure to Supply Information;

(d) §7206, Fraud and False Statements, or

(e) §7207 Fraudulent Returns, Statements, or Other Documents;

(10) Been convicted of a violation of 18 U.S.C. §286 Conspiracy to Defraud the Government with Respect to Claims, 18 U.S.C. §287, False, Fictitious, or Fraudulent Claims, or 18 U.S.C. §371, Conspiracy to Defraud the United States;

(11) Been convicted of a violation of the Tax-General Article, Title 13, Subtitle 7 or Subtitle 10, Annotated Code of Maryland;

(12) Been found to have willfully or knowingly violated State Prevailing Wage Laws as provided in the State Finance and Procurement Article, Title 17, Subtitle 2, Annotated Code of Maryland, if:

(a) A court:

(i) Made the finding; and

(ii) Decision became final; or

(b) The finding was:

(i) Made in a contested case under the Maryland Administrative Procedure act; and

(ii) Not overturned on judicial review;

(13) Been found to have willfully or knowingly violated State Living Wage Laws as provided in the State Finance and Procurement Article, Title 18, Annotated Code of Maryland, if:

(a) A court:

(i) Made the finding; and

(ii) Decision became final; or

(b) The finding was:

(i) Made in a contested case under the Maryland Administrative Procedure act; and

(ii) Not overturned on judicial review;

(14) Been found to have willfully or knowingly violated the Labor and Employment Article, Title 3, Subtitles 3, 4, or 5, or Title 5, Annotated Code of Maryland, if:

(a) A court:

(i) Made the finding; and

(ii) Decision became final; or

(b) The finding was:

(i) Made in a contested case under the Maryland Administrative Procedure act; and

(ii) Not overturned on judicial review; or

(15) Admitted in writing or under oath, during the course of an official investigation or other proceedings, acts or omissions that would constitute grounds for conviction or liability under any law or statute described in §§ B and C and subsections D(1)—(14) above, except as follows (indicate reasons why the affirmations cannot be given, and list any conviction, plea, or imposition of probation before judgment with the date, court, official or administrative body, the sentence or disposition, the name(s) of the person(s) involved and their current positions and responsibilities with the business, and the status of any debarment):

_____

_____

E. AFFIRMATION REGARDING DEBARMENT

I FURTHER AFFIRM THAT:

Neither I, nor to the best of my knowledge, information, and belief, the above business, or any of its officers, directors, partners, controlling stockholders, or any of its employees directly involved in the business's contracting activities, including obtaining or performing contracts with public bodies, has ever been suspended or debarred (including being issued a limited denial of participation) by any public entity, except as follows (list each debarment or suspension providing the dates of the suspension or debarment, the name of the public entity and the status of the proceedings, the

name(s) of the person(s) involved and their current positions and responsibilities with the business, the grounds of the debarment or suspension, and the details of each person's involvement in any activity that formed the grounds of the debarment or suspension).

_____

_____

F. AFFIRMATION REGARDING DEBARMENT OF RELATED ENTITIES

I FURTHER AFFIRM THAT:

(1) The business was not established and does not operate in a manner designed to evade the application of or defeat the purpose of debarment pursuant to Sections 16-101, et seq., of the State Finance and Procurement Article of the Annotated Code of Maryland; and

(2) The business is not a successor, assignee, subsidiary, or affiliate of a suspended or debarred business, except as follows (you must indicate the reasons why the affirmations cannot be given without qualification):

_____

_____

G. SUBCONTRACT AFFIRMATION

I FURTHER AFFIRM THAT:

Neither I, nor to the best of my knowledge, information, and belief, the above business, has knowingly entered into a contract with a public body under which a person debarred or suspended under Title 16 of the State Finance and Procurement Article of the Annotated Code of Maryland will provide, directly or indirectly, supplies, services, architectural services, construction related services, leases of real property, or construction.

H. AFFIRMATION REGARDING COLLUSION

I FURTHER AFFIRM THAT:

Neither I, nor to the best of my knowledge, information, and belief, the above business has:

(1) Agreed, conspired, connived, or colluded to produce a deceptive show of competition in the compilation of the accompanying Bid/proposal that is being submitted; or

(2) In any manner, directly or indirectly, entered into any agreement of any kind to fix the Bid/proposal price of the Bidder/Offeror or of any competitor, or otherwise taken any action in restraint of free competitive bidding in connection with the contract for which the accompanying Bid/proposal is submitted.

I. CERTIFICATION OF TAX PAYMENT

I FURTHER AFFIRM THAT:

Except as validly contested, the business has paid, or has arranged for payment of, all taxes due the State of Maryland and has filed all required returns and reports with the Comptroller of the Treasury, State Department of Assessments and Taxation, and Department of Labor, Licensing, and Regulation, as applicable, and will have paid all withholding taxes due the State of Maryland prior to final settlement.

J. CONTINGENT FEES

I FURTHER AFFIRM THAT:

The business has not employed or retained any person, partnership, corporation, or other entity, other than a bona fide employee, bona fide agent, bona fide salesperson, or commercial selling agency working for the business, to solicit or secure the Contract, and that the business has not paid or agreed to pay any person, partnership, corporation, or other entity, other than a bona fide employee, bona fide agent, bona fide salesperson, or commercial selling agency, any fee or any other consideration contingent on the making of the Contract.

K. CERTIFICATION REGARDING INVESTMENTS IN IRAN

(1) The undersigned certifies that, in accordance with State Finance and Procurement Article, §17-705, Annotated Code of Maryland:

(a) It is not identified on the list created by the Board of Public Works as a person engaging in investment activities in Iran as described in State Finance and Procurement Article, §17-702, Annotated Code of Maryland; and

(b) It is not engaging in investment activities in Iran as described in State Finance and Procurement Article, §17-702, Annotated Code of Maryland.

(2) The undersigned is unable to make the above certification regarding its investment activities in Iran due to the following activities:

_____

_____

L. CONFLICT MINERALS ORIGINATED IN THE DEMOCRATIC REPUBLIC OF CONGO (FOR SUPPLIES AND SERVICES CONTRACTS)

I FURTHER AFFIRM THAT:

The business has complied with the provisions of State Finance and Procurement Article, §14-413, Annotated Code of Maryland governing proper disclosure of certain information regarding conflict minerals originating in the Democratic Republic of Congo or its neighboring countries as required by federal law.

M. PROHIBITING DISCRIMINATORY BOYCOTTS OF ISRAEL

I FURTHER AFFIRM THAT:

In preparing its bid/proposal on this project, the Bidder/Offeror has considered all bid/proposals submitted from qualified, potential subcontractors and suppliers, and has not, in the solicitation, selection, or commercial treatment of any subcontractor, vendor, or supplier, refused to transact or terminated business activities, or taken other actions intended to limit commercial relations, with a person or entity on the basis of Israeli national origin, or residence or incorporation in Israel and its territories. The Bidder/Offeror also has not retaliated against any person or other entity for reporting such refusal, termination, or commercially limiting actions. Without limiting any other provision of the solicitation for bid/proposals for this project, it is understood and agreed that, if this certification is false, such false certification will constitute grounds for the State to reject the bid/proposal submitted by the Bidder/Offeror on this project, and terminate any contract awarded based on the bid/proposal.

N. I FURTHER AFFIRM THAT:

Any claims of environmental attributes made relating to a product or service included in the bid or bid/proposal are consistent with the Federal Trade Commission's Guides for the Use of Environmental Marketing Claims as provided in 16 C.F.R. §260, that apply to claims about the environmental attributes of a product, package or service in connection with the marketing, offering for sale, or sale of such item or service.

O. ACKNOWLEDGEMENT

I ACKNOWLEDGE THAT this Affidavit is to be furnished to the Procurement Officer and may be distributed to units of: (1) the State of Maryland; (2) counties or other subdivisions of the State of Maryland; (3) other states; and (4) the federal government. I further acknowledge that this Affidavit is subject to applicable laws of the United States and the State of Maryland, both criminal and civil, and that nothing in this Affidavit or any contract resulting from the submission of this Bid/proposal shall be construed to supersede, amend, modify or waive, on behalf of the State of Maryland, or any unit of the State of Maryland having jurisdiction, the exercise of any statutory right or remedy conferred by the Constitution and the laws of Maryland with respect to any misrepresentation made or any violation of the obligations, terms and covenants undertaken by the above business with respect to (1) this Affidavit, (2) the contract, and (3) other Affidavits comprising part of the contract.

I DO SOLEMNLY DECLARE AND AFFIRM UNDER THE PENALTIES OF PERJURY THAT THE CONTENTS OF THIS AFFIDAVIT ARE TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE, INFORMATION, AND BELIEF.

By: _____

Signature of Authorized Representative and Affiant

Printed Name: _____

Printed Name of Authorized Representative and Affiant

Title: _____

Title

Date: _____

Date

Attachment B

CONFLICT OF INTEREST AFFIDAVIT

Attachment B. Conflict of Interest Affidavit and Disclosure

Reference COMAR 21.05.08.08

A. "Conflict of interest" means that because of other activities or relationships with other persons, a person is unable or potentially unable to render impartial assistance or advice to the State, or the person's objectivity in performing the contract work is or might be otherwise impaired, or a person has an unfair competitive advantage.

B. "Person" has the meaning stated in COMAR 21.01.02.01B (64) and includes a Offeror, Contractor, consultant, or subcontractor or sub-consultant at any tier, and also includes an employee or agent of any of them if the employee or agent has or will have the authority to control or supervise all or a portion of the work for which a Proposal is made.

C. The Offeror warrants that, except as disclosed in §D, below, there are no relevant facts or circumstances now giving rise or which could, in the future, give rise to a conflict of interest.

D. The following facts or circumstances give rise or could in the future give rise to a conflict of interest (explain in detail — attach additional sheets if necessary):

E. The Offeror agrees that if an actual or potential conflict of interest arises after the date of this affidavit, the Offeror shall immediately make a full disclosure in writing to the procurement officer of all relevant facts and circumstances. This disclosure shall include a description of actions which the Offeror has taken and proposes to take to avoid, mitigate, or neutralize the actual or potential conflict of interest. If the contract has been awarded and performance of the contract has begun, the Contractor shall continue performance until notified by the procurement officer of any contrary action to be taken.

I DO SOLEMNLY DECLARE AND AFFIRM UNDER THE PENALTIES OF PERJURY THAT THE CONTENTS OF THIS AFFIDAVIT ARE TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE, INFORMATION, AND BELIEF.

Date: _____ By: _____

(Authorized Representative and Affiant)

SUBMIT THIS AFFIDAVIT WITH BID/PROPOSAL

Attachment C

CONTRACT AFFIDAVIT

Contract Affidavit

A. AUTHORITY

I hereby affirm that I, _____ (name of affiant) am the _____ (title) and duly authorized representative of _____ (name of business entity) and that I possess the legal authority to make this affidavit on behalf of the business for which I am acting.

B. CERTIFICATION OF REGISTRATION OR QUALIFICATION WITH THE STATE DEPARTMENT OF ASSESSMENTS AND TAXATION

I FURTHER AFFIRM THAT:

The business named above is a (check applicable box):

(1) Corporation - ☐ domestic or ☐ foreign;

(2) Limited Liability Company - ☐ domestic or ☐ foreign;

(3) Partnership - ☐ domestic or ☐ foreign;

(4) Statutory Trust - ☐ domestic or ☐ foreign;

(5) ☐ Sole Proprietorship.

and is registered or qualified as required under Maryland Law. I further affirm that the above business is in good standing both in Maryland and (IF APPLICABLE) in the jurisdiction where it is presently organized, and has filed all of its annual reports, together with filing fees, with the Maryland State Department of Assessments and Taxation. The name and address of its resident agent (IF APPLICABLE) filed with the State Department of Assessments and Taxation is:

Name and Department ID Number: _____

Address: _____

and that if it does business under a trade name, it has filed a certificate with the State Department of Assessments and Taxation that correctly identifies that true name and address of the principal or owner as:

Name and Department ID Number: _____

Address: _____

C. FINANCIAL DISCLOSURE AFFIRMATION

I FURTHER AFFIRM THAT:

I am aware of, and the above business will comply with, the provisions of State Finance and Procurement Article, §13-221, Annotated Code of Maryland, which require that every business that enters into contracts, leases, or other agreements with the State of Maryland or its agencies during a calendar year under which the business is to receive in the aggregate $200,000 or more shall, within 30 days of the time when the aggregate value of the contracts, leases, or other agreements reaches $200,000, file with the Secretary of State of Maryland certain specified information to include disclosure of beneficial ownership of the business.

D. POLITICAL CONTRIBUTION DISCLOSURE AFFIRMATION

I FURTHER AFFIRM THAT:

I am aware of, and the above business will comply with, Election Law Article, Title 14, Annotated Code of Maryland, which requires that every person that enters into a procurement contract with the State, a county, or a municipal corporation, or other political subdivision of the State, during a calendar year in which the person receives a contract with a governmental entity in the amount of

$200,000 or more, shall file with the State Board of Elections statements disclosing: (a) any contributions made during the reporting period to a candidate for elective office in any primary or general election; and (b) the name of each candidate to whom one or more contributions in a cumulative amount of $500 or more were made during the reporting period. The statement shall be filed with the State Board of Elections: (a) before execution of a contract by the State, a county, a municipal corporation, or other political subdivision of the State, and shall cover the 24 months prior to when a contract was awarded; and (b) if the contribution is made after the execution of a contract, then twice a year, throughout the contract term, on or before: (i) May 31, to cover the six (6) month period ending April 30; and (ii) November 30, to cover the six (6) month period ending October 31.

E. DRUG AND ALCOHOL FREE WORKPLACE

(Applicable to all contracts unless the contract is for a law enforcement agency and the agency head or the agency head's designee has determined that application of COMAR 21.11.08 and this certification would be inappropriate in connection with the law enforcement agency's undercover operations.)

I CERTIFY THAT:

(1) Terms defined in COMAR 21.11.08 shall have the same meanings when used in this certification.

(2) By submission of its Proposal, the business, if other than an individual, certifies and agrees that, with respect to its employees to be employed under a contract resulting from this solicitation, the business shall:

(a) Maintain a workplace free of drug and alcohol abuse during the term of the contract;

(b) Publish a statement notifying its employees that the unlawful manufacture, distribution, dispensing, possession, or use of drugs, and the abuse of drugs or alcohol is prohibited in the business' workplace and specifying the actions that will be taken against employees for violation of these prohibitions;

(c) Prohibit its employees from working under the influence of drugs or alcohol;

(d) Not hire or assign to work on the contract anyone who the business knows, or in the exercise of due diligence should know, currently abuses drugs or alcohol and is not actively engaged in a bona fide drug or alcohol abuse assistance or rehabilitation program;

(e) Promptly inform the appropriate law enforcement agency of every drug-related crime that occurs in its workplace if the business has observed the violation or otherwise has reliable information that a violation has occurred;

(f) Establish drug and alcohol abuse awareness programs to inform its employees about:

(i) The dangers of drug and alcohol abuse in the workplace;

(ii) The business's policy of maintaining a drug and alcohol free workplace;

(iii) Any available drug and alcohol counseling, rehabilitation, and employee assistance programs; and

(iv) The penalties that may be imposed upon employees who abuse drugs and alcohol in the workplace;

(g) Provide all employees engaged in the performance of the contract with a copy of the statement required by §E(2)(b), above;

(h) Notify its employees in the statement required by §E(2)(b), above, that as a condition of continued employment on the contract, the employee shall:

(i) Abide by the terms of the statement; and

(ii) Notify the employer of any criminal drug or alcohol abuse conviction for an offense occurring in the workplace not later than 5 days after a conviction;

(i) Notify the procurement officer within 10 days after receiving notice under §E(2)(h)(ii), above, or otherwise receiving actual notice of a conviction;

(j) Within 30 days after receiving notice under §E(2)(h)(ii), above, or otherwise receiving actual notice of a conviction, impose either of the following sanctions or remedial measures on any employee who is convicted of a drug or alcohol abuse offense occurring in the workplace:

(i) Take appropriate personnel action against an employee, up to and including termination; or

(ii) Require an employee to satisfactorily participate in a bona fide drug or alcohol abuse assistance or rehabilitation program; and

(k) Make a good faith effort to maintain a drug and alcohol free workplace through implementation of §E(2)(a)—(j), above.

(3) If the business is an individual, the individual shall certify and agree as set forth in §E(4), below, that the individual shall not engage in the unlawful manufacture, distribution, dispensing, possession, or use of drugs or the abuse of drugs or alcohol in the performance of the contract.

(4) I acknowledge and agree that:

(a) The award of the contract is conditional upon compliance with COMAR 21.11.08 and this certification;

(b) The violation of the provisions of COMAR 21.11.08 or this certification shall be cause to suspend payments under, or terminate the contract for default under COMAR 21.07.01.11 or 21.07.03.15, as applicable; and

(c) The violation of the provisions of COMAR 21.11.08 or this certification in connection with the contract may, in the exercise of the discretion of the Board of Public Works, result in suspension and debarment of the business under COMAR 21.08.03.

F. CERTAIN AFFIRMATIONS VALID

I FURTHER AFFIRM THAT:

To the best of my knowledge, information, and belief, each of the affirmations, certifications, or acknowledgements contained in that certain Bid/Proposal Affidavit dated _____, and executed by me for the purpose of obtaining the contract to which this Exhibit is attached remains true and correct in all respects as if made as of the date of this Contract Affidavit and as if fully set forth herein.

I DO SOLEMNLY DECLARE AND AFFIRM UNDER THE PENALTIES OF PERJURY THAT THE CONTENTS OF THIS AFFIDAVIT ARE TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE, INFORMATION, AND BELIEF.

Date: _____

By: _____ (print name of Authorized Representative and Affiant)

_____ (signature of Authorized Representative and Affiant)

Attachment D

MBE INSTRUCTIONS AND FORMS

Attachment D. Minority Business Enterprise (MBE) Forms

D-1A
MBE UTILIZATION AND FAIR SOLICITATION AFFIDAVIT
& MBE PARTICIPATION SCHEDULE

PART 1 - INSTRUCTIONS

PLEASE READ BEFORE COMPLETING THIS DOCUMENT

This form includes Instructions and the MBE Utilization and Fair Solicitation Affidavit & MBE Participation Schedule which must be submitted with the bid/proposal. If the bidder/offeror fails to accurately complete and submit this Affidavit and Schedule with the bid or proposal, the Procurement Officer shall deem the bid non-responsive or shall determine that the proposal is not reasonably susceptible of being selected for award unless the inaccuracy is determined to be the result of a minor irregularity that is waived or cured in accordance with COMAR 21.06.02.04.

1. Contractor shall structure its procedures for the performance of the work required in this Contract to attempt to achieve the minority business enterprise (MBE) subcontractor participation goal stated in the Invitation for Bids or Request for Proposals. Contractor agrees to exercise good faith efforts to carry out the requirements set forth in these Instructions, as authorized by the Code of Maryland Regulations (COMAR) 21.11.03.

2. MBE Goals and Subgoals: Please review the solicitation for information regarding the Contract's MBE overall participation goals and subgoals. After satisfying the requirements for any established subgoals, the Contractor is encouraged to use a diverse group of subcontractors and suppliers from the various MBE classifications to meet the remainder of the overall MBE participation goal.

3. MBE means a minority business enterprise that is certified by the Maryland Department of Transportation ("MDOT"). Only MBEs certified by MDOT may be counted for purposes of achieving the MBE participation goals. In order to be counted for purposes of achieving the MBE participation goals, the MBE firm, including a MBE prime, must be MDOT-certified for the services, materials or supplies that it is committed to perform on the MBE Participation Schedule. A firm whose MBE certification application is pending may not be counted.

4. Please refer to the MDOT MBE Directory at https://mbe.mdot.maryland.gov/directory/ to determine if a firm is certified with the appropriate North American Industry Classification System ("NAICS") Code **and** the product/services description (specific product that a firm is certified to provide or specific areas of work that a firm is certified to perform). For more general information about NAICS codes, please visit https://www.census.gov/eos/www/naics/. Only those specific products and/or services for which a firm is certified in the MDOT Directory can be used for purposes of achieving the MBE participation goals. **CAUTION:** If the firm's NAICS Code is in graduated status, such services/products may not be counted for purposes of achieving the MBE participation goals. A NAICS Code is in the graduated status if the term "Graduated" follows the Code in the MDOT MBE Directory.

5. **Guidelines Regarding MBE Prime Self-Performance.** Please note that when a certified MBE firm participates as a prime contractor on a Contract, a procurement agency may count the distinct, clearly defined portion of the work of the Contract that the certified MBE firm performs with its own workforce toward fulfilling up to, but no more than, fifty-percent (50%) of the overall

MBE participation goal, including up to one hundred percent (100%) of not more than one of the MBE participation subgoals, if any, established for the Contract.

- ✓ In order to receive credit for self-performance, an MBE prime must be certified in the appropriate NAICS code to do the work and must list its firm in the MBE Participation Schedule, including the certification category under which the MBE prime is self-performing and include information regarding the work it will self-perform.
- ✓ For the remaining portion of the overall goal and the remaining subgoals, the MBE prime must also identify on the MBE Participation Schedule the other certified MBE subcontractors used to meet those goals or request a waiver.
- ✓ These guidelines apply to the work performed by the MBE Prime that can be counted for purposes of meeting the MBE participation goals. These requirements do not affect the MBE Prime's ability to self-perform a greater portion of the work in excess of what is counted for purposes of meeting the MBE participation goals.
- ✓ Please note that the requirements to meet the MBE participation overall goal and subgoals are distinct and separate. If the contract has subgoals, regardless of MBE Prime's ability to self-perform up to 50% of the overall goal (including up to 100% of any subgoal), the MBE Prime must either commit to use other MBEs for each of any remaining subgoals or request a waiver. As set forth in Attachment 1-B Waiver Guidance, the MBE Prime's ability to self-perform certain portions of the work of the Contract will not be deemed a substitute for the good faith efforts to meet any remaining subgoal or the balance of the overall goal.
- ✓ In certain instances where the percentages allocated to MBE participation subgoals add up to more than 50% of the overall goal, the portion of self-performed work that an MBE Prime may count toward the overall goal may be limited to less than 50%. Please refer to the Governor's Office of Small Minority & Women Business Affairs' website for the MBE Prime Regulations Q&A for illustrative examples. http://www.goMDsmallbiz.maryland.gov/Documents/MBE_Toolkit/MBEPrimeRegulation_QA.pdf

6. Subject to items 1 through 5 above, when a certified MBE performs as a participant in a joint venture, a procurement agency may count a portion of the total dollar value of the Contract equal to the distinct, clearly-defined portion of the work of the Contract that the certified MBE performs with its own forces toward fulfilling the Contract goal, and not more than one of the Contract subgoals, if any.

7. The work performed by a certified MBE firm, including an MBE prime, can only be counted towards the MBE participation goal(s) if the MBE firm is performing a commercially useful function on the Contract. Please refer to COMAR 21.11.03.12-1 for more information regarding these requirements.

8. **Materials and Supplies: New Guidelines Regarding MBE Participation.**

   - ✓ Regular Dealer (generally identified as a wholesaler or supplier in the MDOT Directory): Up to 60% of the costs of materials and supplies provided by a certified MBE may be counted towards the MBE participation goal(s) if such MBE is a Regular Dealer of such materials and supplies. Regular Dealer is defined as a firm that owns, operates, or maintains a store, a warehouse, or any other establishment in which the materials, supplies, articles, or equipment are of the general character described by the specifications required under the contract and are bought, kept in stock, or regularly sold or leased to the

public in the usual course of business; and does not include a packager, a broker, a manufacturer's representative, or any other person that arranges or expedites transactions.

Example for illustrative purposes of applying the 60% rule:

Overall contract value: $2,000,000
Total value of supplies: $100,000

Calculate Percentage of Supplies to overall contract value: $100,000 divided by $2,000,000 = 5%

Apply 60% Rule - Total percentage of Supplies/Products 5% x 60% = 3%

3% *would be counted towards achieving the MBE Participation Goal and Subgoal, if any, for the MBE supplier in this example.*

- ✓ Manufacturer: A certified MBE firm's participation may be counted in full if the MBE is certified in the appropriate NAICS code(s) to provide products and services as a manufacturer.

- ✓ Broker: With respect to materials or supplies purchased from a certified MBE that is neither a manufacturer nor a regular dealer, a unit may apply the entire amount of fees or commissions charged for assistance in the procurement of the materials and supplies, fees, or transportation charges for the delivery of materials and supplies required on a procurement toward the MBE contract goals, provided a unit determines the fees to be reasonable and not excessive as compared with fees customarily allowed for similar services. A unit may not apply any portion of the costs of the materials and supplies toward MBE goals.

- ✓ Furnish and Install and other Services: The participation of a certified MBE supplier, wholesaler, and/or regular dealer certified in the proper NAICS code(s) to furnish and install materials necessary for successful contract completion may be counted in full. Includes the participation of other MBE service providers in the proper NAICS code(s) may be counted in full.

9. **Dually certified firms**. An MBE that is certified in more than one subgroup category may only be counted toward goal fulfillment of ONE of those categories with regard to a particular contract.

   Example: A woman-owned Hispanic American (dually certified) firm may be used to fulfill the women-owned OR Hispanic American subgoal, but not both on the same contract.

10. CAUTION: The percentage of MBE participation, computed using the percentage amounts determined for all of the MBE firms listed in PART 3, MUST meet or exceed the MBE participation goal and subgoals (if applicable) as set forth in PART 2- for this solicitation. If a bidder/offeror is unable to meet the MBE participation goal or any subgoals (if applicable), then the bidder/offeror must request a waiver in PART 2 or the bid will be deemed not responsive, or the proposal not reasonably susceptible of being selected for award. You may wish to use the attached Goal/Subgoal Worksheet to assist in calculating the percentages and confirming that your commitment meets or exceeds the applicable MBE participation goal and subgoals (if any).

11. If you have any questions as to whether a firm is certified to perform the specific services or provide specific products, please contact MDOT's Office of Minority Business Enterprise at 1-

800-544-6056 or via email to mbe@mdot.state.md.us sufficiently prior to the submission due date.

Subgoals (if applicable)

Total African American MBE Participation:	_____%
Total Asian American MBE Participation:	_____%
Total Hispanic American MBE Participation:	_____%
Total Women-Owned MBE Participation:	_____%

Overall Goal

Total MBE Participation (include all categories):	_____%

PART 2 - MBE UTILIZATION AND FAIR SOLICITATION AFFIDAVIT & MBE PARTICIPATION SCHEDULE

This MBE Utilization and Fair Solicitation Affidavit and MBE Participation Schedule must be completed in its entirety and included with the bid/proposal. If the bidder/offeror fails to accurately complete and submit this Affidavit and Schedule with the bid or proposal as required, the Procurement Officer shall deem the bid non-responsive or shall determine that the proposal is not reasonably susceptible of being selected for award.

In connection with the bid/proposal submitted in response to the Request for Proposals for Building Commissioning Services for the Hagerstown Multi-Use Sports & Events Facility, I affirm the following:

1. **MBE Participation (PLEASE CHECK ONLY ONE)**

☐ I acknowledge and intend to meet IN FULL both the overall certified Minority Business Enterprise (MBE) participation goal of 10% percent and no subgoals.

Therefore, I am not seeking a waiver pursuant to COMAR 21.11.03.11. I acknowledge that by checking the above box and agreeing to meet the stated goal and subgoal(s), if any, I **must** complete PART 3 - MBE Participation Schedule and Part 4 Signature Page in order to be considered for award.

OR

☐ After making good faith outreach efforts prior to making this submission, I conclude that I am unable to achieve the MBE participation goal and/or subgoals. I hereby request a waiver, in whole or in part, of the overall goal and/or subgoals I acknowledge that by checking this box and requesting a partial waiver of the stated goal and/or one or more of the stated subgoal(s) if any, I must complete Part 3, the MBE Participation Schedule and Part 4 Signature Page for the portion of the goal and/or subgoal(s) if any, for which I am not seeking a waiver, in order to be considered for award. I acknowledge that by checking this box and requesting a full waiver of the stated goal and the stated subgoal(s) if any, I must complete Part 4 Signature Page in order to be considered for award.

Additional MBE Documentation

I understand that if I am notified that I am the apparent awardee or as requested by the Procurement Officer, I must submit the following documentation within 10 working days of receiving notice of the potential award or from the date of conditional award (per COMAR 21.11.03.10), whichever is earlier:

(a) Good Faith Efforts Documentation to Support Waiver Request (Attachment D-1C)

(b) Outreach Efforts Compliance Statement (Attachment D-2);

(c) MBE Subcontractor/MBE Prime Project Participation Statement (Attachments D-3A and 3B);

(d) Any other documentation, including additional waiver documentation if applicable, required by the Procurement Officer to ascertain bidder or offeror responsibility in connection with the certified MBE participation goal and subgoals, if any.

I understand that if I fail to return each completed document within the required time, the Procurement Officer may determine that I am not responsible and therefore not eligible for contract award. If the contract has already been awarded, the award is voidable.

Information Provided to MBE firms

In the solicitation of subcontract quotations or offers, MBE firms were provided not less than the same information and amount of time to respond as were non-MBE firms.

PART 3 - MBE PARTICIPATION SCHEDULE

SET FORTH BELOW ARE THE (I) CERTIFIED MBES I INTEND TO USE, (II) THE PERCENTAGE OF THE TOTAL CONTRACT VALUE ALLOCATED TO EACH MBE FOR THIS PROJECT AND, (III) THE ITEMS OF WORK EACH MBE WILL PROVIDE UNDER THE CONTRACT. I HAVE CONFIRMED WITH THE MDOT DATABASE THAT THE MBE FIRMS IDENTIFIED BELOW (INCLUDING ANY SELF-PERFORMING MBE PRIME FIRMS) ARE PERFORMING WORK ACTIVITIES FOR WHICH THEY ARE MDOT-CERTIFIED.

Prime Contractor	Project Description	Project/Contract Number
	Building Commissioning Services Hagerstown Multi-Use Sports & Events Facility	

LIST INFORMATION FOR EACH CERTIFIED MBE FIRM YOU AGREE TO USE TO ACHIEVE THE MBE PARTICIPATION GOAL AND SUBGOALS, IF ANY. MBE PRIMES: PLEASE COMPLETE BOTH SECTIONS A AND B BELOW.

SECTION A: For MBE Prime Contractors ONLY (including MBE Primes in a Joint Venture)

MBE Prime Firm Name:_____

MBE Certification Number: _____

(If dually certified, check only one box.)

☐ African American-Owned
☐ Hispanic American- Owned
☐ Asian American-Owned
☐ Women-Owned
☐ Other MBE Classification

NAICS code: _____

Percentage of total Contract Value to be performed with own forces and counted towards the MBE **overall participation goal** (up to 50% of the overall goal): _____% **Please refer to Item #8 in Part 1- Instructions of this document for new MBE participation guidelines regarding materials and supplies.**

Percentage of total Contract Value to be performed with own forces and counted towards the **subgoal**, if any, for my MBE classification (up to 100% of not more than one subgoal): _____%

☐ Supplier, wholesaler and/or regular dealer (count 60%)
☐ Manufacturer (count 100%)
☐ Broker (count reasonable fee/commission only)
☐ Furnish and Install and other Services (count 100%)

Complete the applicable prompt (select only one) from prompts A-C below that applies to the type of work your firm is self-performing to calculate amount to be counted towards achieving the MBE Participation Goal and Subgoal, if any.

A. Percentage amount of subcontract where the MBE Prime firm is being used for manufacturer, furnish and install, and/or services (excluding products / services from suppliers, wholesalers, regular dealers and brokers) ___**%**

B. Percentage amount for items of work where the MBE Prime firm is being used as supplier, wholesaler, and/or regular dealer (60% Rule).
Total percentage of Supplies/Products ___% x 60% = ___**%**

C. Percentage amount of fee where the MBE Prime firm is being used as broker (count reasonable fee/commission only) ___ **%**

Description of the work to be performed with MBE prime's own forces:
_____
_____

SECTION B: For all Contractors (including MBE Primes and MBE Primes in a Joint Venture)

MBE Firm Name:_____ MBE Certification Number: _____ (If dually certified, check only one box.) ☐ African American-Owned ☐ Hispanic American- Owned ☐ Asian American-Owned ☐ Women-Owned ☐ Other MBE Classification NAICS code: _____	**Please refer to Item #8 in Part 1- Instructions of this document for new MBE participation guidelines regarding materials and supplies.** ☐ Supplier, wholesaler and/or regular dealer (count 60%) ☐ Manufacturer (count 100%) ☐ Broker (count reasonable fee/commission only) ☐ Furnish and Install and other Services (count 100%) **Complete the applicable prompt (select only one) from prompts A-C below that applies to the type of work that the MBE firm named to the left will be performing to calculate the amount to be counted towards achieving the MBE Participation Goal and Subgoal, if any.** **A. Percentage of total contract amount where the MBE firm is being used for manufacturer, furnish and install, and/or services** (excluding products/services from suppliers, wholesalers, regular dealers and brokers) ___**%** **B. Percentage of total contract amount for items of work where the MBE firm is being used as supplier, wholesaler, and/or regular dealer** (60% Rule)**)**. Total percentage of Supplies/Products ___% X 60% = ___**%** **C. Percentage amount of fee where the MBE firm is being used as broker** (count reasonable fee/commission only) ___ **%** Description of the work to be performed: _____ _____
MBE Firm Name:_____ MBE Certification Number: _____ (If dually certified, check only one box.) ☐ African American-Owned ☐ Hispanic American- Owned ☐ Asian American-Owned ☐ Women-Owned ☐ Other MBE Classification NAICS code: _____	**Please refer to Item #8 in Part 1- Instructions of this document for new MBE participation guidelines regarding materials and supplies.** ☐ Supplier, wholesaler and/or regular dealer (count 60%) ☐ Manufacturer (count 100%) ☐ Broker (count reasonable fee/commission only) ☐ Furnish and Install and other Services (count 100%) **Complete the applicable prompt (select only one) from prompts A-C below that applies to the type of work that the MBE Firm named to the left will be performing to calculate the amount to be counted towards achieving the MBE Participation Goal and Subgoal, if any.** **A. Percentage of total contract amount where the MBE firm is being used for manufacturer, furnish and install, and/or services** (excluding products/services from suppliers, wholesalers, regular dealers and brokers) ___**%** **B. Percentage of total contract amount for items of work where the MBE firm is being used as supplier, wholesaler, and/or regular dealer** (60% Rule)**)**. Total percentage of Supplies/Products ___% X 60% = ___**%** **C. Percentage amount of fee where the MBE firm is being used as broker** (count reasonable fee/commission only) ___ **%** Description of the work to be performed: _____ _____

MBE Firm Name:_____ MBE Certification Number: _____ (If dually certified, check only one box.) ☐ African American-Owned ☐ Hispanic American- Owned ☐ Asian American-Owned ☐ Women-Owned ☐ Other MBE Classification NAICS code: _____	**Please refer to Item #8 in Part 1- Instructions of this document for new MBE participation guidelines regarding materials and supplies.** ☐ Supplier, wholesaler and/or regular dealer (count 60%) ☐ Manufacturer (count 100%) ☐ Broker (count reasonable fee/commission only) ☐ Furnish and Install and other Services (count 100%) **Complete the applicable prompt (select only one) from prompts A-C below that applies to the type of work that for the MBE firm named to the left will be performing to calculate the amount to be counted towards achieving the MBE Participation Goal and Subgoal, if any.** **A. Percentage of total contract amount where the MBE firm is being used for manufacturer, furnish and install, and/or services** (excluding products/services from suppliers, wholesalers, regular dealers and brokers) ___**%** **B. Percentage of the total contract amount for items of work where the MBE firm is being used as supplier, wholesaler, and/or regular dealer** (60% Rule). Total percentage of Supplies/Products ___% X 60% = ___**%** **C. Percentage amount of fee where the MBE firm is being used as broker** (count reasonable fee/commission only) ___ **%** Description of the work to be performed: _____ _____
MBE Firm Name:_____ MBE Certification Number: _____ (If dually certified, check only one box.) ☐ African American-Owned ☐ Hispanic American- Owned ☐ Asian American-Owned ☐ Women-Owned ☐ Other MBE Classification NAICS code: _____	**Please refer to Item #8 in Part 1- Instructions of this document for new MBE participation guidelines regarding materials and supplies.** ☐ Supplier, wholesaler and/or regular dealer (count 60%) ☐ Manufacturer (count 100%) ☐ Broker (count reasonable fee/commission only) ☐ Furnish and Install and other Services (count 100%) **Complete the applicable prompt (select only one) from prompts A-C below that applies to the type of work that the MBE firm named to the left will be performing to calculate the amount to be counted towards achieving the MBE Participation Goal and Subgoal, if any.** **A. Percentage of total contract amount where the MBE firm is being used for manufacturer, furnish and install, and/or services** (excluding products/services from suppliers, wholesalers, regular dealers and brokers) ___**%** **B. Percentage of total contract amount for items of work where the MBE firm is being used as supplier, wholesaler, and/or regular dealer** (60% Rule)**)**. Total percentage of Supplies/Products ___% X 60% = ___**%** **C. Percentage amount of fee where the MBE firm is being used as broker___ %** Description of the work to be performed: _____ _____

CONTINUE ON SEPARATE PAGE IF NEEDED

PART 4 – SIGNATURE PAGE

To complete Affidavit committing to MBE(s) or requesting waiver, Bidder/Offeror must sign below:

I solemnly affirm under the penalties of perjury that: (i) I have reviewed the instructions for the MBE Utilization & Fair Solicitation Affidavit and MBE Schedule, and (ii) the information contained in the MBE Utilization & Fair Solicitation Affidavit and MBE Schedule is true to the best of my knowledge, information and belief.

_____	_____
Bidder/Offeror Name *(PLEASE PRINT OR TYPE)*	Signature of Authorized Representative
_____	_____
Address	Printed Name and Title
_____	_____
City, State and Zip Code	Date

SUBMIT THIS AFFIDAVIT WITH BID/PROPOSAL

D-1B WAIVER GUIDANCE

GUIDANCE FOR DOCUMENTING GOOD FAITH EFFORTS TO MEET MBE PARTICIPATION GOALS

In order to show that it has made good faith efforts to meet the Minority Business Enterprise (MBE) participation goal (including any MBE subgoals) on a contract, the Offeror must either (1) meet the MBE Goal(s) and document its commitments for participation of MBE Firms, or (2) when it does not meet the MBE Goal(s), document its Good Faith Efforts to meet the goal(s).

I. Definitions

MBE Goal(s) – "MBE Goal(s)" refers to the MBE participation goal and MBE participation subgoal(s).

Good Faith Efforts - The "Good Faith Efforts" requirement means that when requesting a waiver, the Offeror must demonstrate that it took all necessary and reasonable steps to achieve the MBE Goal(s), which, by their scope, intensity, and appropriateness to the objective, could reasonably be expected to obtain sufficient MBE participation, even if those steps were not fully successful. Whether the Offeror that requests a waiver made adequate good faith efforts will be determined by considering the quality, quantity, and intensity of the different kinds of efforts that the Offeror has made. The efforts employed by the Offeror should be those that one could reasonably expect the Offeror to take if the Offeror were actively and aggressively trying to obtain MBE participation sufficient to meet the MBE contract goal and subgoals. Mere *pro forma* efforts are not good faith efforts to meet the MBE contract requirements. The determination concerning the sufficiency of the Offeror's good faith efforts is a judgment call; meeting quantitative formulas is not required.

Identified Firms – "Identified Firms" means a list of the MBEs identified by the procuring agency during the goal setting process and listed in the procurement as available to perform the Identified Items of Work. It also may include additional MBEs identified by the Offeror as available to perform the Identified Items of Work, such as MBEs certified or granted an expansion of services after the procurement was issued. If the procurement does not include a list of Identified Firms, this term refers to all of the MBE Firms (if State-funded) the Offeror identified as available to perform the Identified Items of Work and should include all appropriately certified firms that are reasonably identifiable.

Identified Items of Work – "Identified Items of Work" means the Proposal items identified by the procuring agency during the goal setting process and listed in the procurement as possible items of work for performance by MBE Firms. It also may include additional portions of items of work the Offeror identified for performance by MBE Firms to increase the likelihood that the MBE Goal(s) will be achieved. If the procurement does not include a list of Identified Items of Work, this term refers to all of the items of work the Offeror identified as possible items of work for performance by MBE Firms and should include all reasonably identifiable work opportunities.

MBE Firms – "MBE Firms" refers to firms certified by the Maryland Department of Transportation ("MDOT") under COMAR 21.11.03. Only MDOT-certified MBE Firms can participate in the State's MBE Program.

II. Types of Actions Agency will Consider

The Offeror is responsible for making relevant portions of the work available to MBE subcontractors and suppliers and select those portions of the work or material needs consistent with the available MBE subcontractors and suppliers, so as to facilitate MBE participation. The following is a list of types of actions the procuring agency will consider as part of the Offeror's Good Faith Efforts when the Offeror fails to meet the MBE Goal(s). This list is not intended to be a mandatory checklist, nor is it intended to be exclusive or exhaustive. Other factors or types of efforts may be relevant in appropriate cases.

A. Identify Proposal Items as Work for MBE Firms

1. Identified Items of Work in Procurements

   (a) Certain procurements will include a list of Proposal items identified during the goal setting process as possible work for performance by MBE Firms. If the procurement provides a list of Identified Items of Work, the Offeror shall make all reasonable efforts to solicit quotes from MBE Firms to perform that work.

   (b) Offerors may, and are encouraged to, select additional items of work to be performed by MBE Firms to increase the likelihood that the MBE Goal(s) will be achieved.

2. Identified Items of Work by Offerors

   (a) When the procurement does not include a list of Identified Items of Work or for additional Identified Items of Work, Offerors should reasonably identify sufficient items of work to be performed by MBE Firms.

(b) Where appropriate, Offerors should break out contract work items into economically feasible units to facilitate MBE participation, rather than perform these work items with their own forces. The ability or desire of a prime contractor to perform the work of a contract with its own organization does not relieve the Offeror of the responsibility to make Good Faith Efforts.

B. Identify MBE Firms to Solicit

1. MBE Firms Identified in Procurements

(a) Certain procurements will include a list of the MBE Firms identified during the goal setting process as available to perform the items of work. If the procurement provides a list of Identified MBE Firms, the Offeror shall make all reasonable efforts to solicit those MBE firms.

(b) Offerors may, and are encouraged to, search the MBE Directory to identify additional MBEs who may be available to perform the items of work, such as MBEs certified or granted an expansion of services after the solicitation was issued.

2. MBE Firms Identified by Offerors

(a) When the procurement does not include a list of Identified MBE Firms, Offerors should reasonably identify the MBE Firms that are available to perform the Identified Items of Work.

(b) Any MBE Firms identified as available by the Offeror should be certified to perform the Identified Items of Work.

C. Solicit MBEs

1. Solicit <u>all</u> Identified Firms for all Identified Items of Work by providing written notice. The Offeror should:

(a) provide the written solicitation at least 10 days prior to Proposal opening to allow sufficient time for the MBE Firms to respond;

(b) send the written solicitation by first-class mail, facsimile, or e-mail using contact information in the MBE Directory, unless the Offeror has a valid basis for using different contact information; and

(c) provide adequate information about the plans, specifications, anticipated time schedule for portions of the work to be performed by the MBE, and other requirements of the contract to assist MBE Firms in responding. (This information may be provided by including hard copies in the written solicitation or by <u>electronic means</u> as described in C.3 below.)

2. "<u>All</u>" Identified Firms includes the MBEs listed in the procurement and any MBE Firms you identify as potentially available to perform the Identified Items of Work, but it does not include MBE Firms who are no longer certified to perform the work as of the date the Offeror provides written solicitations.

3. "<u>Electronic Means</u>" includes, for example, information provided *via* a website or file transfer protocol (FTP) site containing the plans, specifications, and other requirements of the contract. If an interested MBE cannot access the information provided by electronic means, the Offeror must make the information available in a manner that is accessible to the interested MBE.

4. Follow up on initial written solicitations by contacting MBEs to determine if they are interested. The follow up contact may be made:

(a) by telephone using the contact information in the MBE Directory, unless the Offeror has a valid basis for using different contact information; or

(b) in writing *via* a method that differs from the method used for the initial written solicitation.

5. In addition to the written solicitation set forth in C.1 and the follow up required in C.4, use all other reasonable and available means to solicit the interest of MBE Firms certified to perform the work of the contract. Examples of other means include:

(a) attending any pre-Proposal meetings at which MBE Firms could be informed of contracting and subcontracting opportunities; and

(b) if recommended by the procurement, advertising with or effectively using the services of at least two minority focused entities or media, including trade associations, minority/women community organizations, minority/women contractors' groups, and local, state, and federal minority/women business assistance offices listed on the MDOT Office of Minority Business Enterprise website.

D. Negotiate with Interested MBE Firms

Offerors must negotiate in good faith with interested MBE Firms.

1. Evidence of negotiation includes, without limitation, the following:
   (a) the names, addresses, and telephone numbers of MBE Firms that were considered;
   (b) a description of the information provided regarding the plans and specifications for the work selected for subcontracting and the means used to provide that information; and
   (c) evidence as to why additional agreements could not be reached for MBE Firms to perform the work.
2. The Offeror using good business judgment would consider a number of factors in negotiating with subcontractors, including MBE subcontractors, and would take a firm's price and capabilities as well as contract goals into consideration.
3. The fact that there may be some additional costs involved in finding and using MBE Firms is not in itself sufficient reason for the Offeror's failure to meet the contract MBE goal(s), as long as such costs are reasonable. Factors to take into consideration when determining whether an MBE Firm's quote is excessive or unreasonable include, without limitation, the following:
   (a) dollar difference between the MBE subcontractor's quote and the average of the other subcontractors' quotes received by the Offeror;
   (b) percentage difference between the MBE subcontractor's quote and the average of the other subcontractors' quotes received by the Offeror;
   (c) percentage that the MBE subcontractor's quote represents of the overall contract amount;
   (d) number of MBE firms that the Offeror solicited for that portion of the work;
   (e) whether the work described in the MBE and Non-MBE subcontractor quotes (or portions thereof) submitted for review is the same or comparable; and
   (f) number of quotes received by the Offeror for that portion of the work.
4. The above factors are not intended to be mandatory, exclusive, or exhaustive, and other evidence of an excessive or unreasonable price may be relevant.
5. The Offeror may not use its price for self-performing work as a basis for rejecting an MBE Firm's quote as excessive or unreasonable.
6. The "average of the other subcontractors' quotes received" by the Offeror refers to the average of the quotes received from all subcontractors. Offeror should attempt to receive quotes from at least three subcontractors, including one quote from an MBE and one quote from a Non-MBE.
7. The Offeror shall not reject an MBE Firm as unqualified without sound reasons based on a thorough investigation of the firm's capabilities. For each certified MBE that is rejected as unqualified or that placed a subcontract quotation or offer that the Offeror concludes is not acceptable, the Offeror must provide a written detailed statement listing the reasons for this conclusion. The Offeror also must document the steps taken to verify the capabilities of the MBE and Non-MBE Firms quoting similar work.
   (a) The factors to take into consideration when assessing the capabilities of an MBE Firm, include, but are not limited to the following: financial capability, physical capacity to perform, available personnel and equipment, existing workload, experience performing the type of work, conduct and performance in previous contracts, and ability to meet reasonable contract requirements.
   (b) The MBE Firm's standing within its industry, membership in specific groups, organizations, or associations and political or social affiliations (for example union vs. non-union employee status) are not legitimate causes for the rejection or non-solicitation of Proposals in the efforts to meet the project goal.

E. Assisting Interested MBE Firms

When appropriate under the circumstances, the decision-maker will consider whether the Offeror Offeror made reasonable efforts to assist interested MBR Firms in obtaining:

1. The bonding, lines of credit, or insurance required by the procuring agency or the Offeror; and
2. Necessary equipment, supplies, materials, or related assistance or services.

III. Other Considerations

In making a determination of Good Faith Efforts the decision-maker may consider engineering estimates, catalogue prices, general market availability and availability of certified MBE Firms in the area in which the work is to be performed, other Proposals or offers and subcontract Proposals or offers substantiating significant variances between certified MBE and Non-MBE costs of participation, and their impact on the overall cost of the contract to the State and any other relevant factors.

The decision-maker may take into account whether the Offeror decided to self-perform subcontract work with its own forces, especially where the self-performed work is Identified Items of Work in the procurement. The decision-maker also may take into account the performance of other Offerors in meeting the contract. For example, when the apparent successful Offeror fails to meet the contract goal, but others meet it, this reasonably raises the question of whether, with additional reasonable efforts, the apparent successful Offeror could have met the goal. If the apparent successful Offeror fails to meet the goal, but meets or exceeds the average MBE participation obtained by other Offerors, this, when viewed in conjunction with other factors, could be evidence of the apparent successful Offeror having made Good Faith Efforts.

IV. Documenting Good Faith Efforts

At a minimum, the Offeror seeking a waiver of the MBE Goal(s) or a portion thereof must provide written documentation of its Good Faith Efforts, in accordance with COMAR 21.11.03.11, within 10 Business Days after receiving notice that it is the apparent awardee. The written documentation shall include the following:

A. Items of Work (Complete Good Faith Efforts Documentation Attachment D-1C, Part 1)

A detailed statement of the efforts made to select portions of the work proposed to be performed by certified MBE Firms in order to increase the likelihood of achieving the stated MBE Goal(s).

B. Outreach/Solicitation/Negotiation

1. The record of the Offeror's compliance with the outreach efforts prescribed by COMAR 21.11.03.09C(2)(a). **(Complete Outreach Efforts Compliance Statement - D-2)**.
2. A detailed statement of the efforts made to contact and negotiate with MBE Firms including:
   (a) the names, addresses, and telephone numbers of the MBE Firms who were contacted, with the dates and manner of contacts (letter, fax, e-mail, telephone, etc.) (**Complete Good Faith Efforts Attachment D-1C- Part 2, and submit letters, fax cover sheets, e-mails, etc. documenting solicitations**); and
   (b) a description of the information provided to MBE Firms regarding the plans, specifications, and anticipated time schedule for portions of the work to be performed and the means used to provide that information.

C. Rejected MBE Firms (Complete Good Faith Efforts Attachment D-1C, Part 3)

1. For each MBE Firm that the Offeror concludes is not acceptable or qualified, a detailed statement of the reasons for the Offeror's conclusion, including the steps taken to verify the capabilities of the MBE and Non-MBE Firms quoting similar work.
2. For each certified MBE Firm that the Offeror concludes has provided an excessive or unreasonable price, a detailed statement of the reasons for the Offeror's conclusion, including the quotes received from all MBE and Non-MBE firms proposing on the same or comparable work. **(Include copies of all quotes received.)**
3. A list of MBE Firms contacted but found to be unavailable. This list should be accompanied by an MBE Unavailability Certificate (see **D-1B - Exhibit A** to this Part 1) signed by the MBE contractor or a statement from the Offeror that the MBE contractor refused to sign the MBE Unavailability Certificate.

D. Other Documentation

1. Submit any other documentation requested by the Procurement Officer to ascertain the Offeror's Good Faith Efforts.
2. Submit any other documentation the Offeror believes will help the Procurement Officer ascertain its Good Faith Efforts.

D-1B - Exhibit A
MBE Subcontractor Unavailability Certificate

1. It is hereby certified that the firm of _____
(Name of Minority firm)

located at _____
(Number) (Street)

_____
(City) (State) (Zip)

was offered an opportunity to bid on Solicitation No. _____

in _____County by _____
(Name of Prime Contractor's Firm)

****

2. _____(Minority Firm), is either unavailable for the work/service or unable to prepare a Proposal for this project for the following reason(s):

_____

_____

_____

_____

****

_____

(Signature of Minority Firm's MBE Representative) (Title) (Date)

_____

(MDOT Certification #) (Telephone #)

****

3. To be completed by the prime contractor if Section 2 of this form is not completed by the minority firm.

To the best of my knowledge and belief, said Certified Minority Business Enterprise is either unavailable for the work/service for this project, is unable to prepare a Proposal, or did not respond to a request for a price Proposal and has not completed the above portion of this submittal.

_____

(Signature of Prime Contractor) (Title) (Date)

D-1C
GOOD FAITH EFFORTS DOCUMENTATION TO SUPPORT WAIVER REQUEST

Prime Contractor:	**Project Description:**	**PROJECT/CONTRACT**
Offeror Company Name, Street Address, Phone		**Solicitation #:**

Parts 1, 2, and 3 must be included with this certificate along with all documents supporting your waiver request.

I affirm that I have reviewed **Attachment D-1B**, Waiver Guidance. I further affirm under penalties of perjury that the contents of Parts 1, 2, and 3 of this **Attachment D-1C** Good Faith Efforts Documentation Form are true to the best of my knowledge, information, and belief.

Company:

_____

Company Name (please print or type)

By:

_____

Signature of Authorized Representative

Printed Name:

_____

Printed Name

Title:

_____

Title

Date:

_____

Date

Address:

_____

Company Address

GOOD FAITH EFFORTS DOCUMENTATION TO SUPPORT WAIVER REQUEST

PART 1 – IDENTIFIED ITEMS OF WORK OFFEROR MADE AVAILABLE TO MBE FIRMS

PAGE __ OF ___

Prime Contractor:	**Project Description:**	**PROJECT/CONTRACT**
Offeror Company Name, Street Address, Phone		**Solicitation #:**

Identify those items of work that the Offeror made available to MBE Firms. This includes, where appropriate, those items the Offeror identified and determined to subdivide into economically feasible units to facilitate the MBE participation. For each item listed, show the anticipated percentage of the total contract amount. It is the Offeror's responsibility to demonstrate that sufficient work to meet the goal was made available to MBE Firms, and the total percentage of the items of work identified for MBE participation equals or exceeds the percentage MBE goal set for the procurement. Note: If the procurement includes a list of Proposal items identified during the goal setting process as possible items of work for performance by MBE Firms, the Offeror should make all of those items of work available to MBE Firms or explain why that item was not made available. If the Offeror selects additional items of work to make available to MBE Firms, those additional items should also be included below.

Identified Items of Work	**Was this work listed in the procurement?**	**Does Offeror normally self-perform this work?**	**Was this work made available to MBE Firms? If no, explain why not.**
	□ Yes □ No	□ Yes □ No	□ Yes □ No
	□ Yes □ No	□ Yes □ No	□ Yes □ No
	□ Yes □ No	□ Yes □ No	□ Yes □ No
	□ Yes □ No	□ Yes □ No	□ Yes □ No
	□ Yes □ No	□ Yes □ No	□ Yes □ No
	□ Yes □ No	□ Yes □ No	□ Yes □ No
	□ Yes □ No	□ Yes □ No	□ Yes □ No

☐ Please check if Additional Sheets are attached.

GOOD FAITH EFFORTS DOCUMENTATION TO SUPPORT WAIVER REQUEST

PART 2 – IDENTIFIED MBE FIRMS AND RECORD OF SOLICITATIONS

PAGE __ OF ___

Prime Contractor:	**Project Description:**	**PROJECT/CONTRACT**
Offeror Company Name, Street Address, Phone		**Solicitation #:**

Identify the MBE Firms solicited to provide quotes for the Identified Items of Work made available for MBE participation. Include the name of the MBE Firm solicited, items of work for which quotes were solicited, date and manner of initial and follow-up solicitations, whether the MBE provided a quote, and whether the MBE is being used to meet the MBE participation goal. MBE Firms used to meet the participation goal must be included on the MBE Participation Schedule. Note: If the procurement includes a list of the MBE Firms identified during the goal setting process as potentially available to perform the items of work, the Offeror should solicit all of those MBE Firms or explain why a specific MBE was not solicited. If the Offeror identifies additional MBE Firms who may be available to perform Identified Items of Work, those additional MBE Firms should also be included below. Copies of all written solicitations and documentation of follow-up calls to MBE Firms must be attached to this form. This list should be accompanied by a Minority Contractor Unavailability Certificate signed by the MBE contractor or a statement from the Offeror that the MBE contractor refused to sign the Minority Contractor Unavailability Certificate (**Attachment D-1B - Exhibit A**). If the Offeror used a Non-MBE or is self-performing the identified items of work, Part 4 must be completed.

Name of Identified MBE Firm & MBE Classification	**Describe Item of Work Solicited**	**Initial Solicitation Date & Method**	**Follow-up Solicitation Date & Method**	**Details for Follow-up Calls**	**Quote Rec'd**	**Quote Used**	**Reason Quote Rejected**
Firm Name: MBE Classification (Check only if requesting waiver of MBE subgoal.) ☐ African American-Owned ☐ Hispanic American- Owned ☐ Asian American-Owned ☐ Women-Owned ☐ Other MBE Classification _____		Date: □ Mail □ Facsimile □ E-mail	Date: □ Phone □ Mail □ Facsimile □ E-mail	Time of Call: Spoke with: _____ □ Left Message	□ Yes □ No	□ Yes □ No	□ Used Other MBE □ Used Non-MBE □ Self-performing
Firm Name: MBE Classification (Check only if requesting waiver of MBE subgoal.) ☐ African American-Owned ☐ Hispanic American- Owned ☐ Asian American-Owned ☐ Women-Owned ☐ Other MBE Classification _____		Date: □ Mail □ Facsimile □ E-mail	Date: □ Phone □ Mail □ Facsimile □ E-mail	Time of Call: Spoke with: _____ □ Left Message	□ Yes □ No	□ Yes □ No	□ Used Other MBE □ Used Non-MBE □ Self-performing

☐ Please check if Additional Sheets are attached.

GOOD FAITH EFFORTS DOCUMENTATION TO SUPPORT WAIVER REQUEST

PART 3 – ADDITIONAL INFORMATION REGARDING REJECTED MBE QUOTES

PAGE __ OF ___

Prime Contractor:	**Project Description:**	**PROJECT/CONTRACT NUMBER:**
Offeror Company Name, Street Address, Phone		**Solicitation #:**

This form must be completed if Part 1 indicates that an MBE quote was rejected because the Offeror is using a Non-MBE or is self-performing the Identified Items of Work. Provide the Identified Items Work, indicate whether the work will be self-performed or performed by a Non-MBE, and if applicable, state the name of the Non-MBE. Also include the names of all MBE and Non-MBE Firms that provided a quote and the amount of each quote.

Describe Identified Items of Work Not Being Performed by MBE (Include spec/ section number from Proposal)	**Self-performing or Using Non-MBE (Provide name)**	**Amount of Non-MBE Quote**	**Name of Other Firms who Provided Quotes & Whether MBE or Non-MBE**	**Amount Quoted**	**Indicate Reason Why MBE Quote Rejected & Briefly Explain**
	□ Self-performing □ Using Non-MBE _____	$_____	_____ □ MBE □ Non-MBE	$_____	□ Price □ Capabilities □ Other
	□ Self-performing □ Using Non-MBE _____	$_____	_____ □ MBE □ Non-MBE	$_____	□ Price □ Capabilities □ Other
	□ Self-performing □ Using Non-MBE _____	$_____	_____ □ MBE □ Non-MBE	$_____	□ Price □ Capabilities □ Other
	□ Self-performing □ Using Non-MBE _____	$_____	_____ □ MBE □ Non-MBE	$_____	□ Price □ Capabilities □ Other
	□ Self-performing □ Using Non-MBE _____	$_____	_____ □ MBE □ Non-MBE	$_____	□ Price □ Capabilities □ Other
	□ Self-performing □ Using Non-MBE _____	$_____	_____ □ MBE □ Non-MBE	$_____	□ Price □ Capabilities □ Other

☐ Please check if Additional Sheets are attached.

D- 2
OUTREACH EFFORTS COMPLIANCE STATEMENT

Complete and submit this form within 10 Business Days of notification of apparent award or actual award, whichever is earlier.

In conjunction with the Proposal submitted in response to Solicitation No. _____, I state the following:

1. Offeror identified subcontracting opportunities in these specific work categories:

   _____

   _____

   _____

2. Attached to this form are copies of written solicitations (with Proposal instructions) used to solicit certified MBE firms for these subcontract opportunities.

3. Offeror made the following attempts to personally contact the solicited MDOT-certified MBE firms:

   _____

   _____

   _____

4. **Please Check One:**

   □ This project does not involve bonding requirements.

   □ Offeror assisted MDOT-certified MBE firms to fulfill or seek waiver of bonding requirements. (DESCRIBE EFFORTS):

   _____

   _____

   _____

5. **Please Check One:**

   _____ Offeror did attend the pre-Proposal conference.

   _____ No pre -Proposal meeting/conference was held.

   _____ Offeror did not attend the pre-Proposal conference.

PLEASE PRINT OR TYPE

Company:

Company Name (please print or type)

By:

Signature of Authorized Representative

Printed Name:

Printed Name

Title:

Title

Date:

Date

Address:

Company Address

D-3A
CERTIFED MBE SUBCONTRACTOR PARTICIPATION CERTIFICATION

INSTRUCTIONS:

PRIME CONTRACTOR: After completing SECTIONS A, B, and D, provide this form to ***each*** certified Minority Business Enterprise subcontractor (MBE) listed on the MBE Participation Schedule (Attachment D-1A) allowing sufficient time for the MBE to respond within the required timeframe.

CERTIFIED MBE SUBCONTRACTOR: Complete SECTION C to acknowledge and certify the information in SECTION A. Return the completed form directly to the Procurement Officer identified in SECTION D within 10 days after notice from the Prime Contractor of the State's intent to award the Contract. Provide a copy to the Prime Contractor.

IF THIS FORM IS NOT RETURNED WITHIN THE REQUIRED TIME, THE PROCUREMENT OFFICER MAY DETERMINE THAT THE PRIME CONTRACTOR IS NOT RESPONSIBLE AND THEREFORE NOT ELIGIBLE FOR CONTRACT AWARD.

SECTION A

Provided that (Prime Contractor) _____ is awarded the State contract in conjunction with Solicitation Number _____, (Prime Contractor) _____ intends to enter into a subcontract with (Certified MBE Subcontractor) _____ with MDOT Certification Number _____ committing to participation by (Certified MBE Subcontractor) _____ of at least $_____ which equals _____% of the Total Contract Value for the following products/services:

NAICS CODE	WORK ITEM, SPECIFICATION NUMBER, LINE ITEMS OR WORK CATEGORIES (IF APPLICABLE)	DESCRIPTION OF SPECIFIC PRODUCTS AND/OR SERVICES

The Contractor and certified MBE each acknowledge that, for purposes of determining the accuracy of the information provided herein, the Procurement Officer may request additional information, including, without limitation, copies of the subcontract agreements and quotes. The Contractor and certified MBE each solemnly affirms under the penalties of perjury that: (i) the information provided in this Certified MBE Subcontractor Participation Certification is true to the best of its knowledge, information and belief, and (ii) it has fully complied with the State Minority Business Enterprise law, State Finance and Procurement Article §14-308(a)(2), Annotated Code of Maryland which provides that, except as otherwise provided by law, a Contractor may not identify a certified MBE in a Bid/Proposal and:

(1) fail to request, receive, or otherwise obtain authorization from the MBE to identify the MBE in its Bid/Proposal;

(2) fail to notify the MBE before execution of the Contract of its inclusion of the Bid/Proposal;

(3) fail to use the MBE in the performance of the Contract; or

(4) pay the MBE solely for the use of its name in the Bid/Proposal.

SECTION B – Prime Contractor

Signature of Representative:

_____

Printed Name and Title:

_____

Prime Firm's Name: _____

Federal Identification Number: _____

Street Address, City, State, Zip Code:

_____

_____

Phone: _____

Date: _____

SECTION C – Certified MBE Subcontractor

Signature of Representative:

_____

Printed Name and Title:

_____

MBE Firm's Name: _____

Federal Identification Number: _____

Street Address, City, State, Zip Code:

_____

_____

Phone: _____

Date: _____

SECTION D

This completed form is due to the Procurement Officer on or before: _____

Solicitation #: _____ Solicitation Title: _____

Agency/Dept.: _____ Procurement Officer: _____

Phone: _____ Email: _____

Street Address, City, State, Zip Code:

_____

_____

D-3B
MBE PRIME PROJECT PARTICIPATION CERTIFICATION

Please complete and submit this form to attest to each specific item of work that your MBE firm has listed on the MBE Participation Schedule (Attachment D-1A) for purposes of meeting the MBE participation goals. This form must be submitted within 10 Business Days of notification of apparent award. If the Offeror fails to return this affidavit within the required time, the Procurement Officer may determine that Proposal is not susceptible of being selected for Contract award.

Provided that _____ (Prime Contractor's Name) with Certification Number _____ is awarded the State contract in conjunction with Solicitation No. _____, such MBE Prime Contractor intends to perform with its own forces at least $_____ which equals to___% of the Total Contract Amount for performing the following goods and services for the Contract:

NAICS CODE	WORK ITEM, SPECIFICATION NUMBER, LINE ITEMS OR WORK CATEGORIES (IF APPLICABLE) For Construction Projects, General Conditions must be listed separately	DESCRIPTION OF SPECIFIC PRODUCTS AND/OR SERVICES	VALUE OF THE WORK

MBE Prime Contractor

Company:

Company Name (please print or type)

FEIN:

Federal Identification Number

Company Address: _____

Phone:

Printed Name:

Title:

By:

Signature of Authorized Representative

Date:

D-4A
Minority Business Enterprise Participation
Prime Contractor Paid/Unpaid Invoice Report

Report #:	Contract #:
Reporting Period (Month/Year):	Contracting Unit:
Prime Contractor: Report is due to the MBE Liaison by the 10th of the month following the month the services were provided. **Note: Please number reports in sequence**	Contract Amount: MBE Subcontract Amt: Project Begin Date: Project End Date: Services Provided:

Prime Contractor:		Contact Person:	
Address:			
City:		State:	ZIP:
Phone:	FAX:	E-mail:	
MBE Subcontractor Name:		Contact Person:	
Phone:	FAX:	E-mail:	
Subcontractor Services Provided:			

List all payments made to MBE subcontractor named above during this reporting period:			**List dates and amounts of any outstanding invoices:**		
	Invoice #	**Amount**		**Invoice #**	**Amount**
1.			1.		
2.			2.		
3.			3.		
4.			4.		
Total Dollars Paid: $			**Total Dollars Unpaid: $**		

- If more than one MBE subcontractor is used for this contract, you must use separate **Attachment D-4A** forms. Information regarding payments that the MBE prime will use for purposes of meeting the MBE participation goals must be reported separately in **Attachment D-4B**.
- **Return one copy (hard or electronic) of this form to the following addresses (electronic copy with signature and date is preferred):**

Contract Monitor Name	Contracting Unit
Address	City, State Zip
Email	Phone Number
Signature (Required)	Date

D-4B
Minority Business Enterprise Participation
MBE Prime Contractor Report

MBE Prime Contractor:	Contract #:
Certification Number:	Contracting Unit:
Report #:	Contract Amount:
Reporting Period (Month/Year):	Total Value of the Work to the Self-Performed for purposes of Meeting the MBE participation goal/subgoals:
MBE Prime Contractor: Report is due to the MBE Liaison by the 10th of the month following the month the services were provided. **Note: Please number reports in sequence**	Project Begin Date:
	Project End Date:

Contact Person:			
Address:			
City:		State:	ZIP:
Phone:	FAX:	E-mail:	

Invoice Number	**Value of the Work**	**NAICS Code**	**Description of Specific Products and/or Services**

Return one copy (hard or electronic) of this form to the following addresses (electronic copy with signature and date is preferred):

Contract Monitor Name

Contracting Unit

Address

City, State Zip

Email

Phone Number

Signature (Required)

Date

D-5
Minority Business Enterprise Participation
MBE Subcontractor Paid/Unpaid Invoice Report

Report #:	Contract #:
Reporting Period (Month/Year):	Contracting Unit:
Report is due by the 10th of the month following the month the services were performed.	MBE Subcontract Amt:
	Project Begin Date:
	Project End Date:
	Services Provided:

MBE Subcontractor Name:					
MDOT Certification #:					
Contact Person:					
Address:					
City:			State:		ZIP:
Phone:	FAX:		E-mail:		
Subcontractor Services Provided:					
List all payments received from Prime Contractor during reporting period indicated above.			**List dates and amounts of any unpaid invoices over 30 days old.**		
	Invoice Amount	**Date**		**Invoice Amount**	**Date**
1.			1.		
2.			2.		
3.			3.		
4.			4.		
Total Dollars Paid: $			**Total Dollars Unpaid: $**		
Prime Contractor:			Contract Person:		

Return one copy of this form to the following addresses (electronic copy with signature and date is preferred):

Contract Monitor Name	Contracting Unit
Address	City, State Zip
Email	Phone Number
Signature (Required)	Date

Attachment E

CORPORATE PROFILE

Consultant Corporate Profile

Firm Contact Information

Firm Name: _____

Federal ID Number: _____

Point of Contact:_____ Phone Number: _____

Regional Office Address: _____

_____

Firm Background Information

Year Firm Founded: _____

Is the firm MDOT MBE Certified? Yes/No

If certified, provide the certification number and minority status.

_____

Primary Business / Service Provided: _____

Number of Years Performing Services: _____

Number Full Time Employees (Corporate / Regional Office):_____/_____
Provide a brief narrative outlining the firm's history.

_____
_____
_____
_____
_____
_____
_____

Provide a brief narrative outlining what services the firm intends to self-perform.

_____
_____
_____
_____
_____
_____

CONFIDENTIAL

Provide a brief narrative outlining what services the firm intends to subcontract to others.

_____
_____
_____
_____
_____
_____

Provide a brief narrative outlining the firm's familiarity with standards, laws and conditions as they apply to the work to be performed under this project.

_____
_____
_____
_____
_____
_____

Provide a brief narrative clarifying the firm's capacity to perform services as outlined in the RFP.

_____
_____
_____
_____
_____
_____

Provide sales volume and project completion data for the most recently completed three-year period. Note that information provided is to be for the regional / local office that would be responsible for completing work under this solicitation.

Volume	Annual Sales	Completed Projects	Largest Project
2018	_____	_____	_____
2019	_____	_____	_____
2020	_____	_____	_____
2021	_____	_____	_____

CONFIDENTIAL

Firm References

Provide three (3) references. Note that references are to be from different projects; that is, only one reference per project is allowed. MSA staff members cannot be considered as a firm's reference.

Project Name:_____

Name: _____
Title: _____
Company Name: _____
Phone Number and email: _____
Project Relationship: _____

Project Name:_____

Name: _____
Title: _____
Company Name: _____
Phone Number and email: _____
Project Relationship: _____

Project Name:_____

Name: _____
Title: _____
Company Name: _____
Phone Number and email: _____
Project Relationship: _____

CONFIDENTIAL

Disclosure of Contract Issues; Litigation; Criminal Investigations

In the last five years, list and discuss any alleged prior or ongoing contract failures (potential judgment/settlement in excess of $100,000), contract breaches (potential judgment/settlement in excess of $100,000), other significant civil litigation, and all criminal litigation or investigations, which involved your firm.

_____
_____
_____
_____

Failure to Complete

In the last five (5) years, disclose any projects that your firm was involved with that were not completed.

_____
_____
_____
_____

Insurance

Include current certificates of insurance showing the limits of liability maintained by your firm in each of the following categories: workers' compensation, employer's liability, commercial general liability, automobile liability, umbrella or excess liability, and property insurance.

_____
_____
_____
_____

CONFIDENTIAL

Prepared By:

Name:_____

Title: _____

Signature:_____

Date: _____

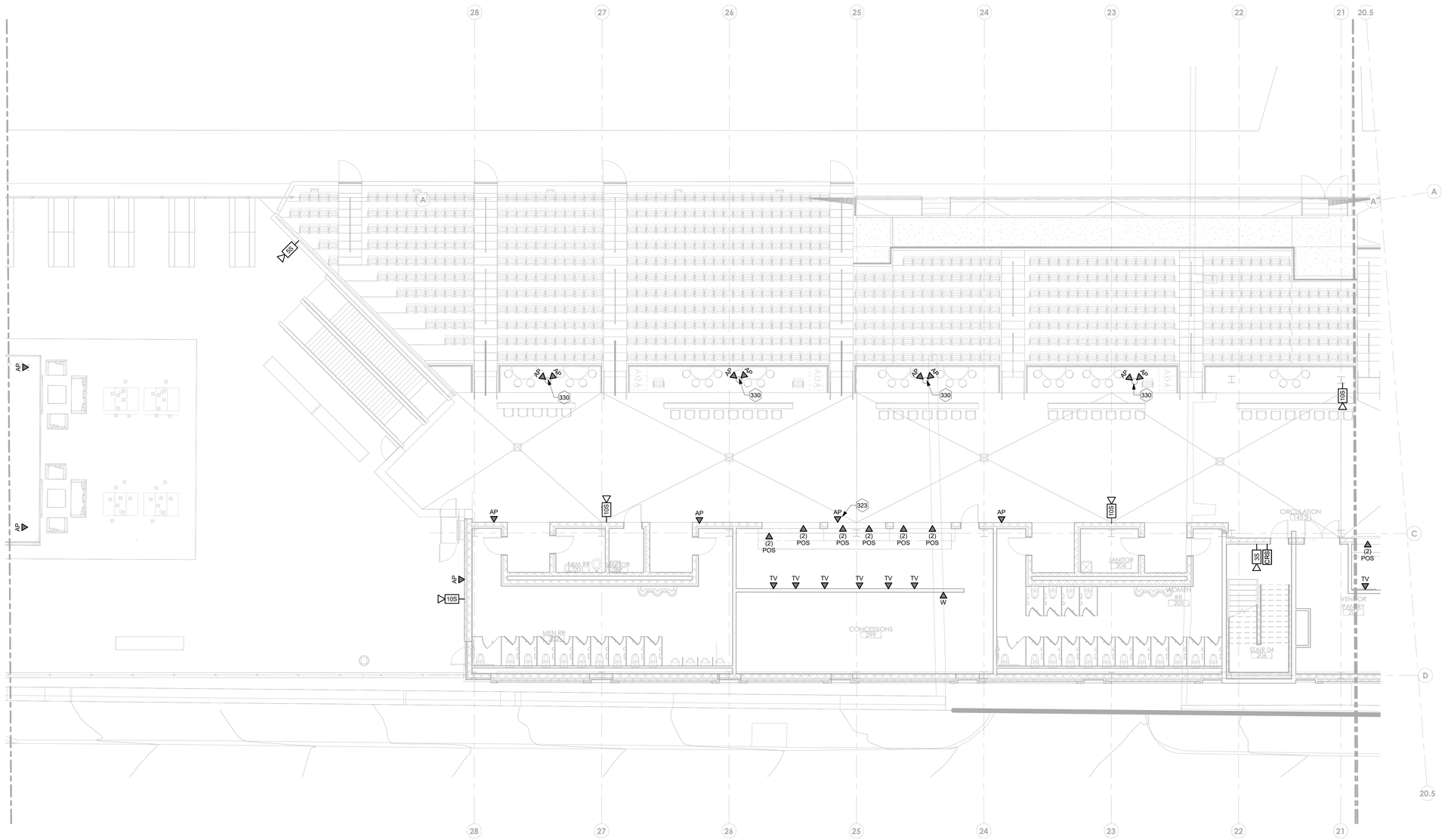
CONFIDENTIAL

Attachment F

DESIGN DEVELOPMENT DOCUMENTS

- **100% DD Drawings**
- **100% DD Specifications**

KEYNOTES	
323	MOUNT at 9'-0" AFF.
330	WIRELESS ACCESS POINTS POINTED TOWARD BOWL SEATING MOUNTED ON POLE 10' AFF.



PENDULUM

PROJECT

HAGERSTOWN BALLPARK

CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

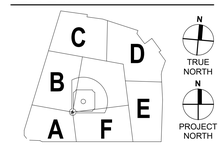
GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

Project **20220903_MSA**
Issued: 08/15/2022

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN



SHEET TITLE

QUADRANT PLAN

SHEET NUMBER

ES104.2

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A01 ES_MAIN CONCOURSE - THIRD BASE LINE

1/8" = 1'-0" | re: A01 / AV300

ARCH E1 30" x 42"

Project Management Initials:
Designer: Designer Checked: Checker Approved: Approver
Last Plotted: 8/15/2022 3:48:28 PM
Filename: Autodesk Docs:Hagerstown 22/Hagerstown_AV_R22.rvt

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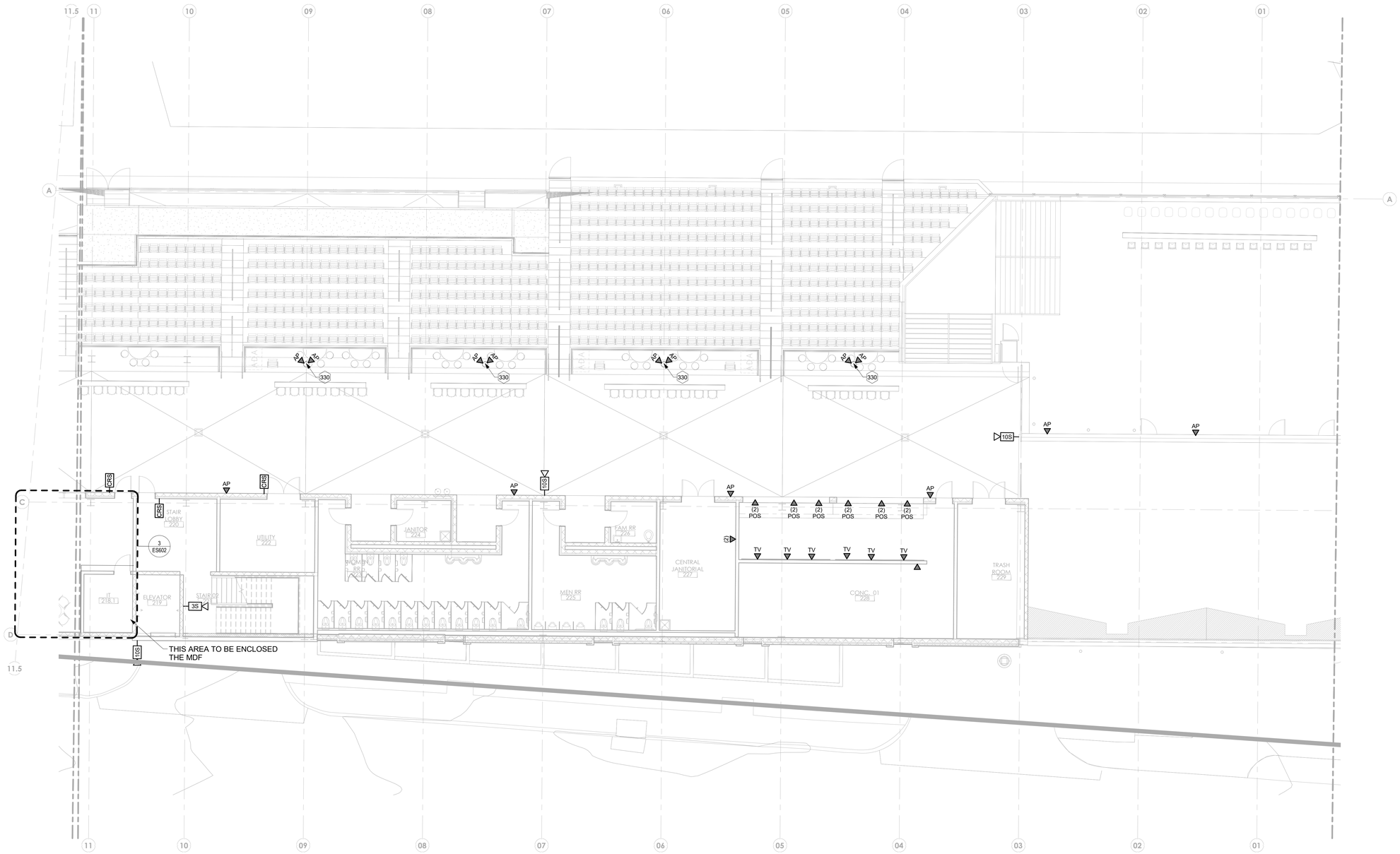
KEYNOTES	
330	WIRELESS ACCESS POINTS POINTED TOWARD BOWL SEATING MOUNTED ON POLE 10' AFF.



A01 ES_MAIN CONCOURSE - FIRST BASE LINE

1/8" = 1'-0" | re: A01 / AV300

PENDULUM

PROJECT

HAGERSTOWN BALLPARK

CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
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351 WEST CAMDEN ST., STE 300
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www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
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STRUCTURAL ENGINEER
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2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
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tel - 972-934-3700

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805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

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HILLIS CARNES
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Project **20220903_MSA**
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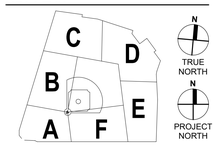
I/R	DATE	DESCRIPTION

KEY PLAN



SHEET TITLE

QUADRANT PLAN

SHEET NUMBER

ES104.8

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ARCH E1 30" x 42"

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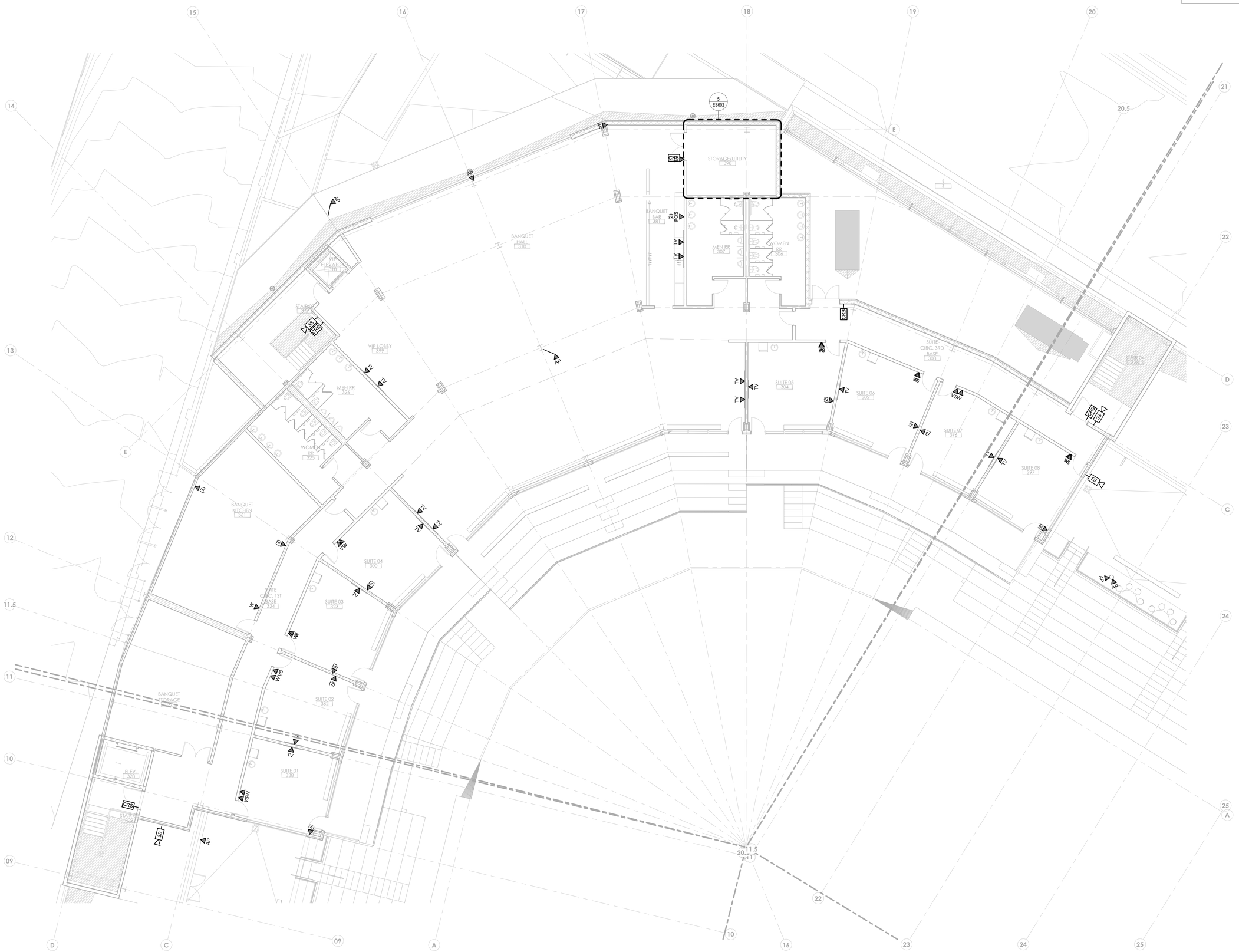
ARCH E1 30" x 42"

KEYNOTES



A01 ES_PREMIUM LEVEL - HOME PLATE

1/8" = 1'-0" re: A01 / AV300

Project Management Initials:
Designer: Designer Checked: Checker Approved: Approver
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PROJECT

HAGERSTOWN BALLPARK
CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

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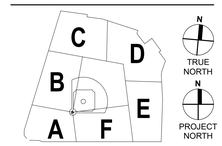
Project **20220903_MSA**
Issued: 08/15/2022

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN



SHEET TITLE

QUADRANT PLAN

SHEET NUMBER

ES105.1

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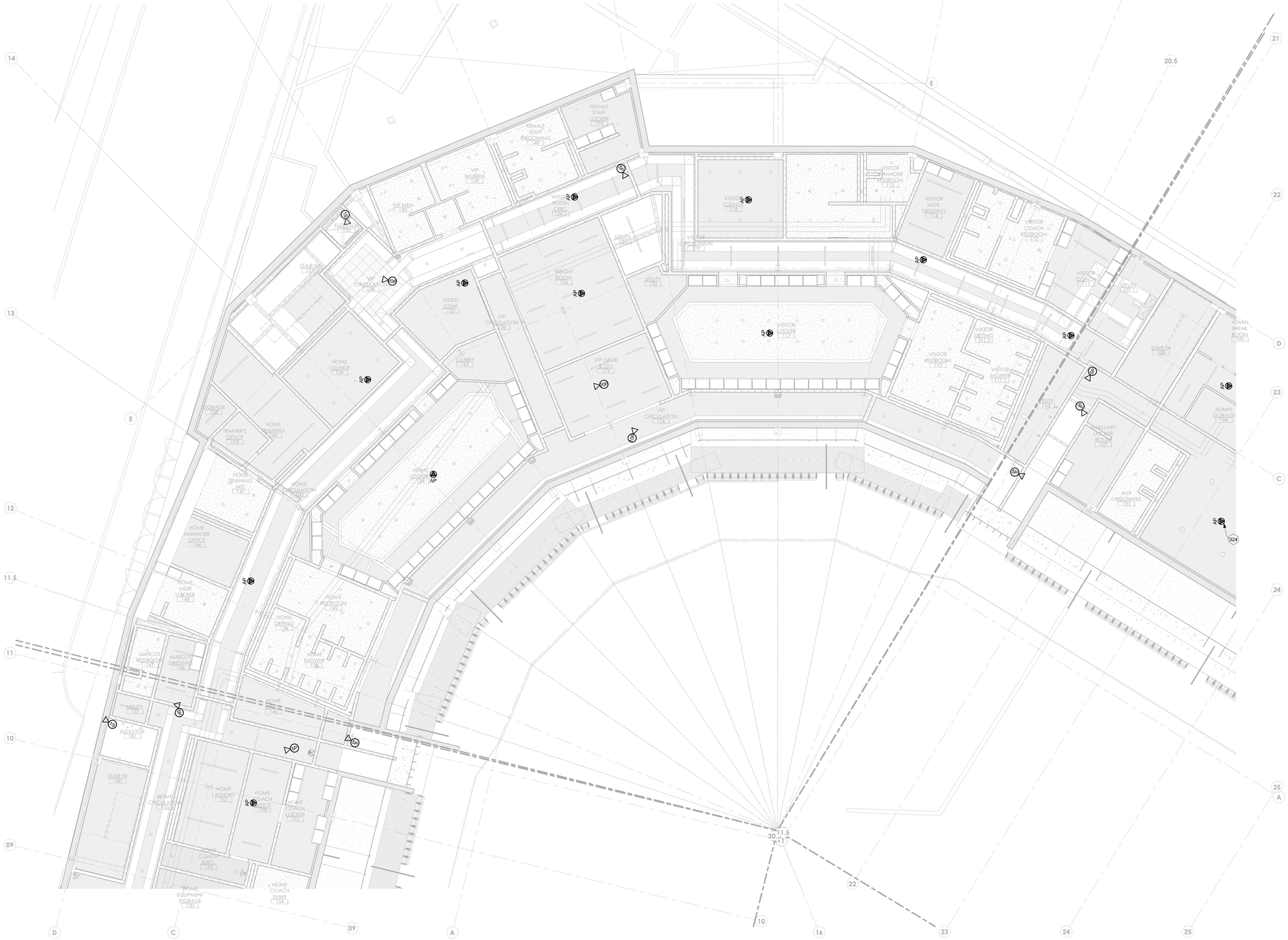
ARCH E1 30" x 42"



KEYNOTES	
324	PROVIDE AP COVER FOR PROTECTION AT THIS LOCATION

PENDULUM

PROJECT

HAGERSTOWN BALLPARK
CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
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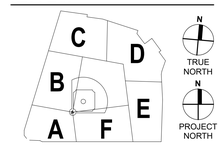
tel - 301-582-4662

Project **20220903_MSA**
Issued: 08/15/2022

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN



SHEET TITLE

FIELD LEVEL - HOME PLATE RCP

SHEET NUMBER

ES202.1

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A01 ES_FIELD LEVEL - HOME PLATE RCP

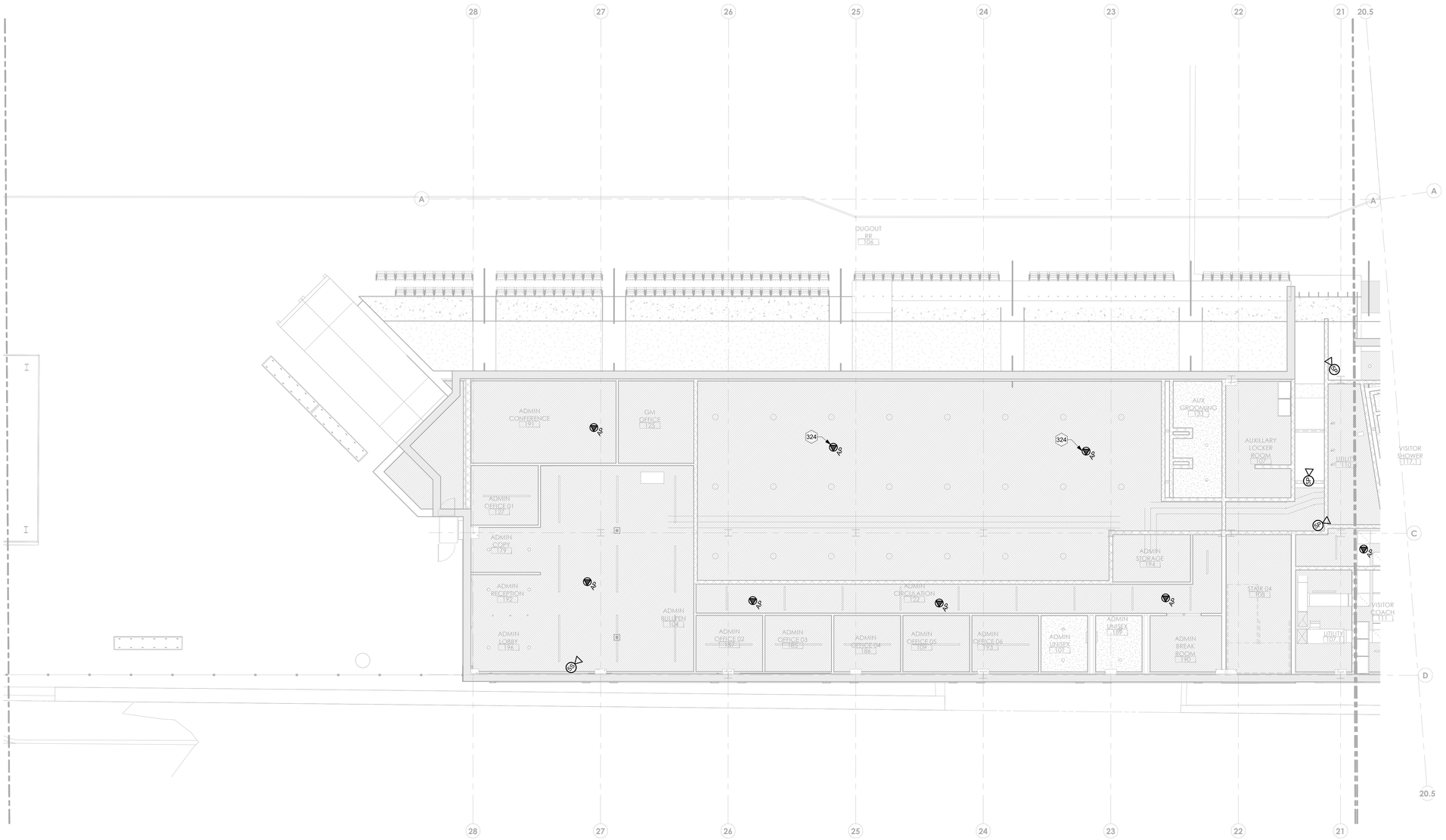
1/8" = 1'-0" re: A01 / AV301

Project Management Initials:
Designer: Designer Checked: Checker Approved: Approver
Last Plotted: 8/15/2022 3:48:49 PM
Filename: Autodesk Docs:Hagerstown 22/Hagerstown_AV_R22.rvt

Printed on Post-Consumer Recycled Content Paper

ARCH E1 30" x 42"

KEYNOTES	
324	PROVIDE AP COVER FOR PROTECTION AT THIS LOCATION



A01 ES_FIELD LEVEL - THIRD BASE LINE RCP

1/8" = 1'-0" | re: A01 / AV301

PENDULUM

PROJECT

HAGERSTOWN BALLPARK

CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

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CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
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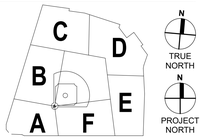

SHEET TITLE

FIELD LEVEL - THIRD BASE LINE RCP

SHEET NUMBER

ES202.2

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Project Management Initials:
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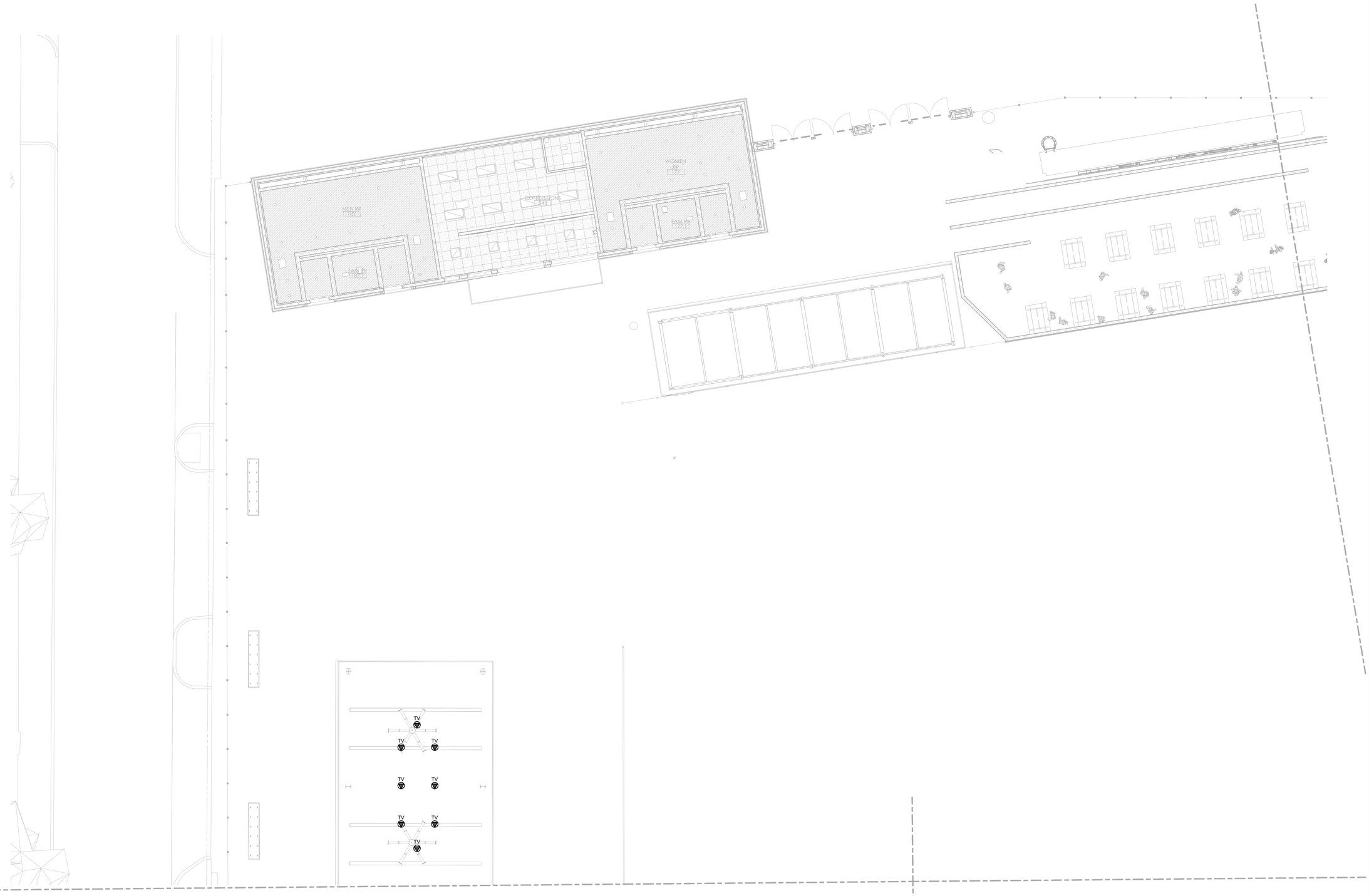
01 02 03 04 05 06 07 08 09 10

ARCH E1 30" x 42"

KEYNOTES



A01 ES_RCP - FIELD LEVEL - LEFT FIELD RCP

1/8" = 1'-0" re: A01 / AV301

Project Management Initials:
Designer: Designer Checked: Checker Approved: Approver
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HAGERSTOWN, MD

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PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
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CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
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MADISON, WI 53704
tel - 608-514-4373

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HILLIS CARNES
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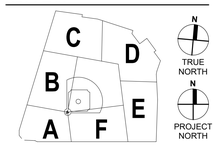

SHEET TITLE

FIELD LEVEL - LEFT FIELD RCP

SHEET NUMBER

ES202.3

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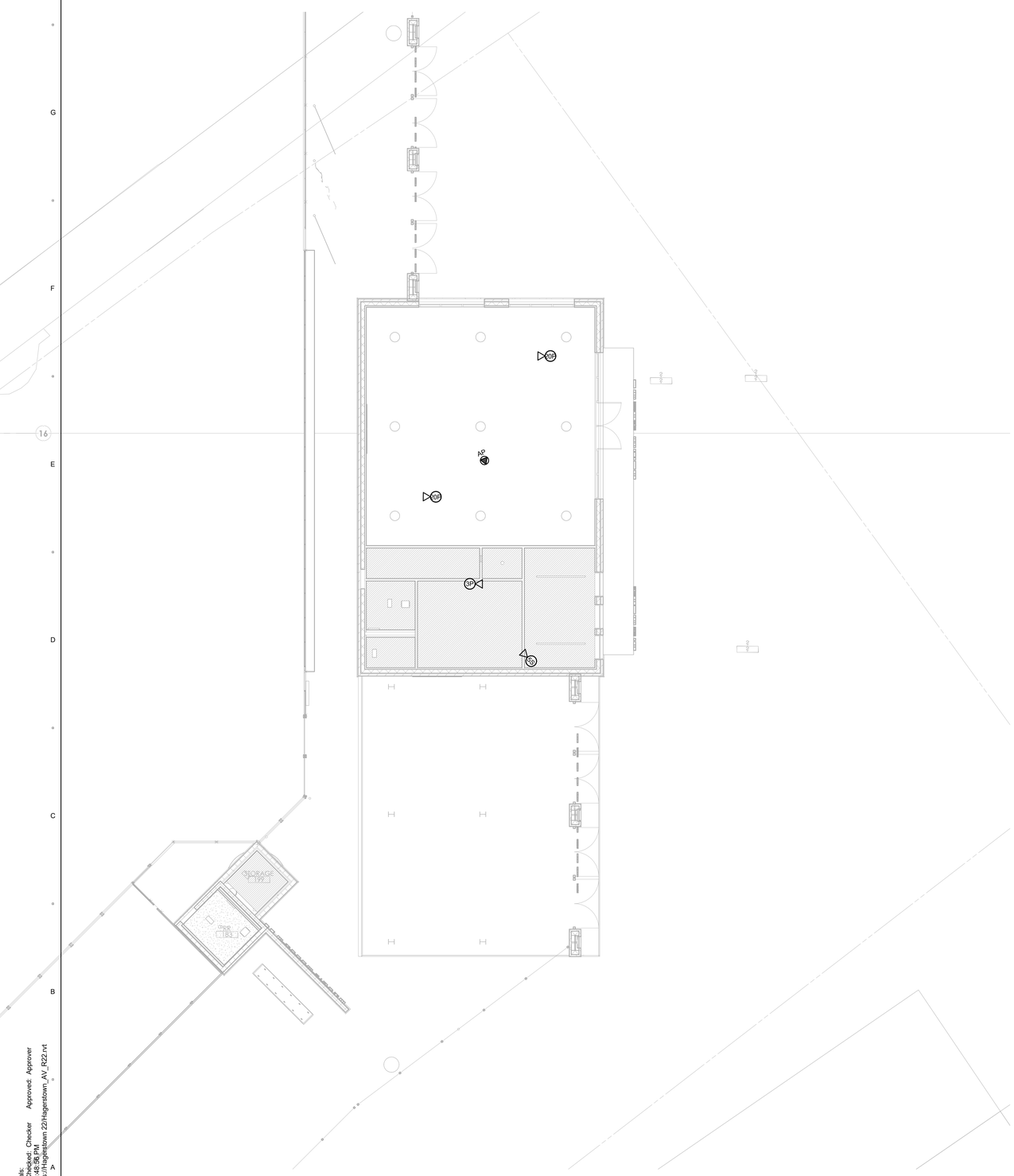
ARCH E1 30" x 42"

KEYNOTES



A01 ES_FIELD LEVEL - CENTER FIELD RCP

1/8" = 1'-0" | re: A01 / AV301

Project Management Initials:
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CORNER OF
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HAGERSTOWN, MD

ARCHITECT

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PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
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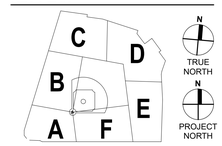

SHEET TITLE

FIELD LEVEL - CENTER FIELD RCP

SHEET NUMBER

ES202.5

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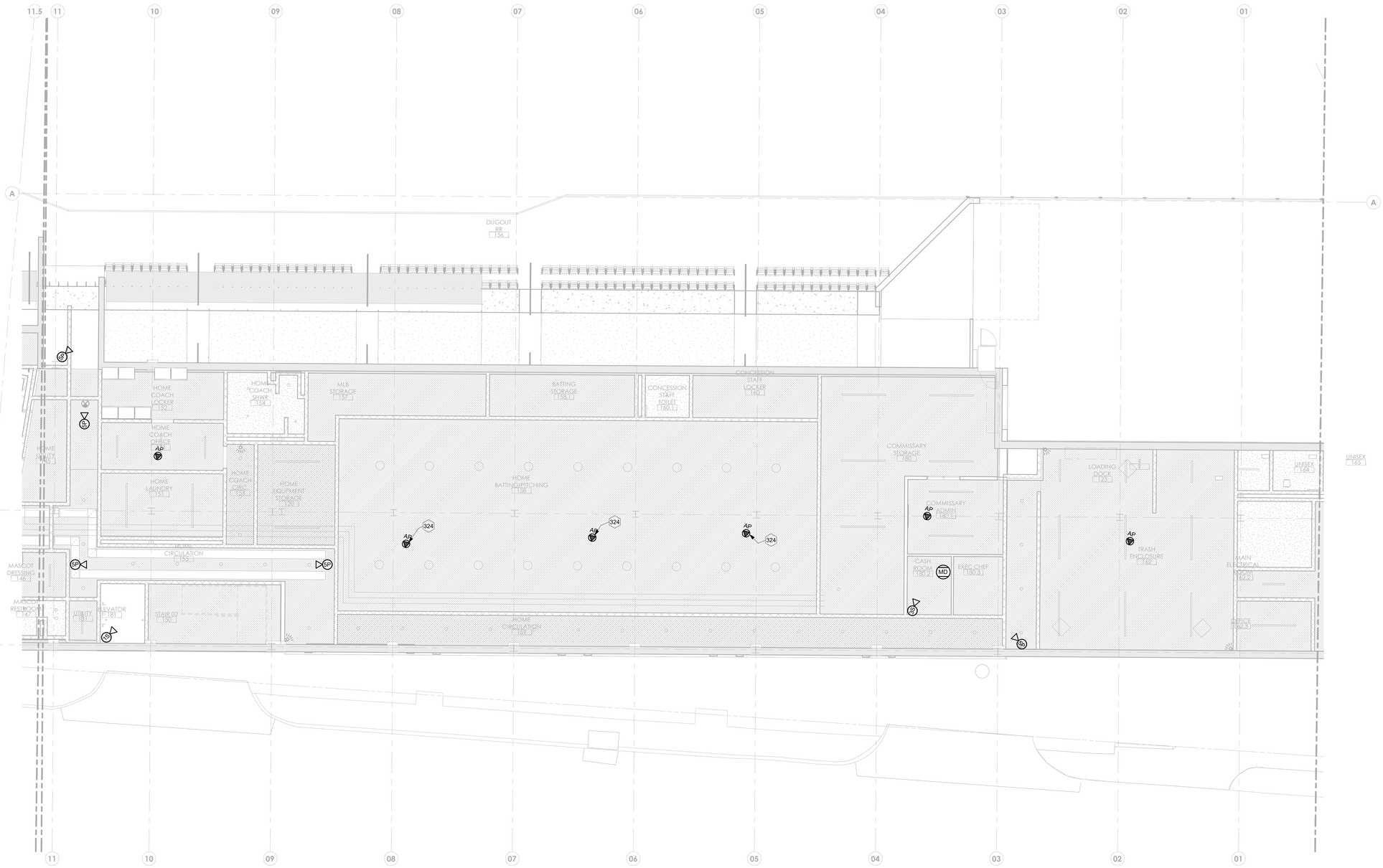
ARCH E1 30" x 42"

KEYNOTES	
324	PROVIDE AP COVER FOR PROTECTION AT THIS LOCATION



A01 ES_FIELD LEVEL - FIRST BASE LINE RCP

1/8" = 1'-0" re: A01 / AV301

Project Management Initials:
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PROJECT

HAGERSTOWN BALLPARK

CORNER OF
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HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
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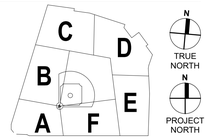

SHEET TITLE

FIELD LEVEL - FIRST BASE SIDE RCP

SHEET NUMBER

ES202.8

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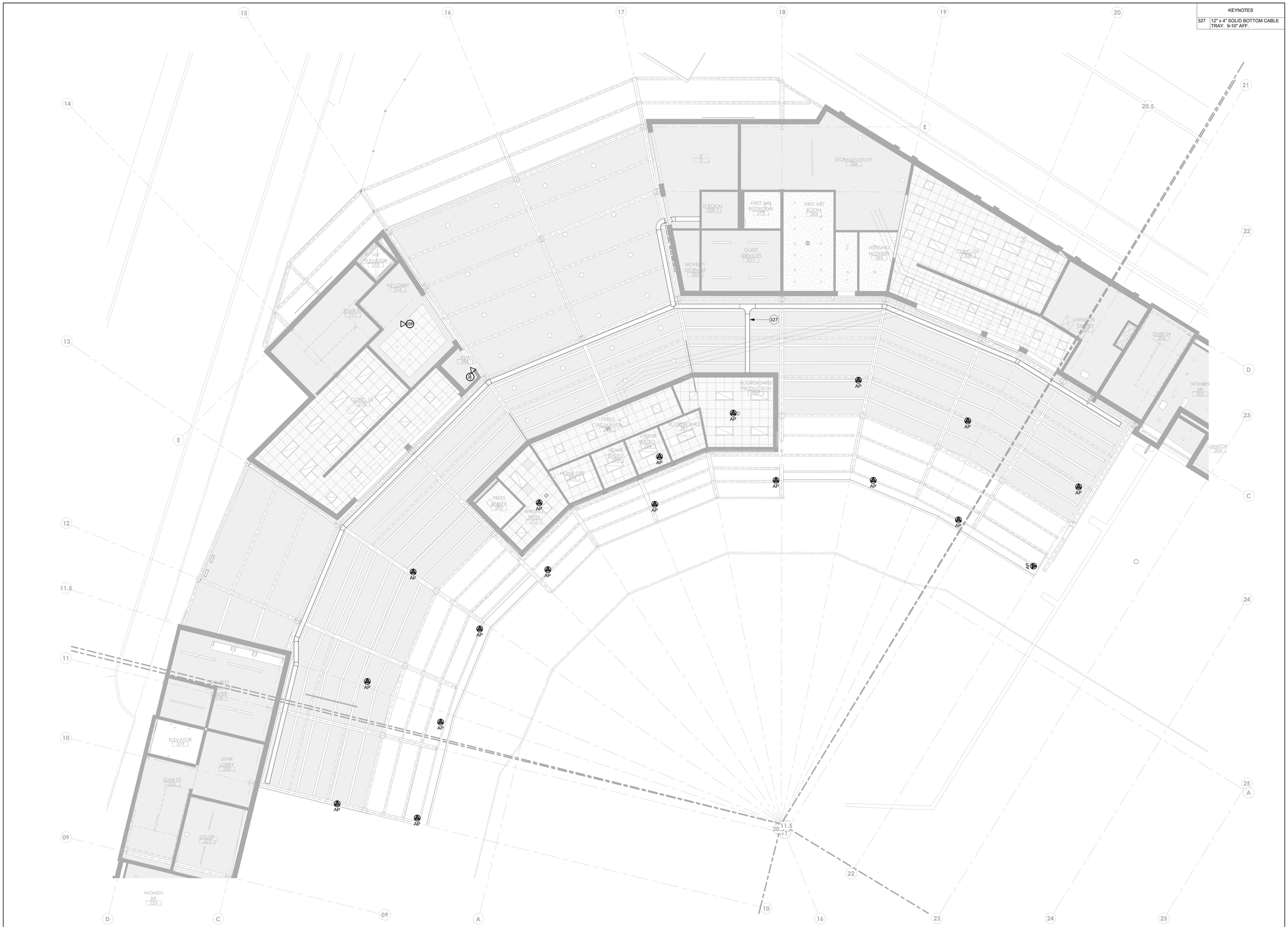
ARCH E1 30" x 42"



KEYNOTES	
327	12" x 4" SOLID BOTTOM CABLE TRAY. 9-10" AFF.

PENDULUM

PROJECT

HAGERSTOWN BALLPARK
CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY
CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

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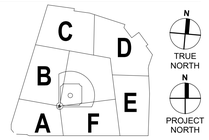

SHEET TITLE

MAIN CONCOURSE - HOME PLATE RCP

SHEET NUMBER

ES204.1

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A01 ES_MAIN CONCOURSE - HOME PLATE RCP

1/8" = 1'-0" re: A01 / AV300

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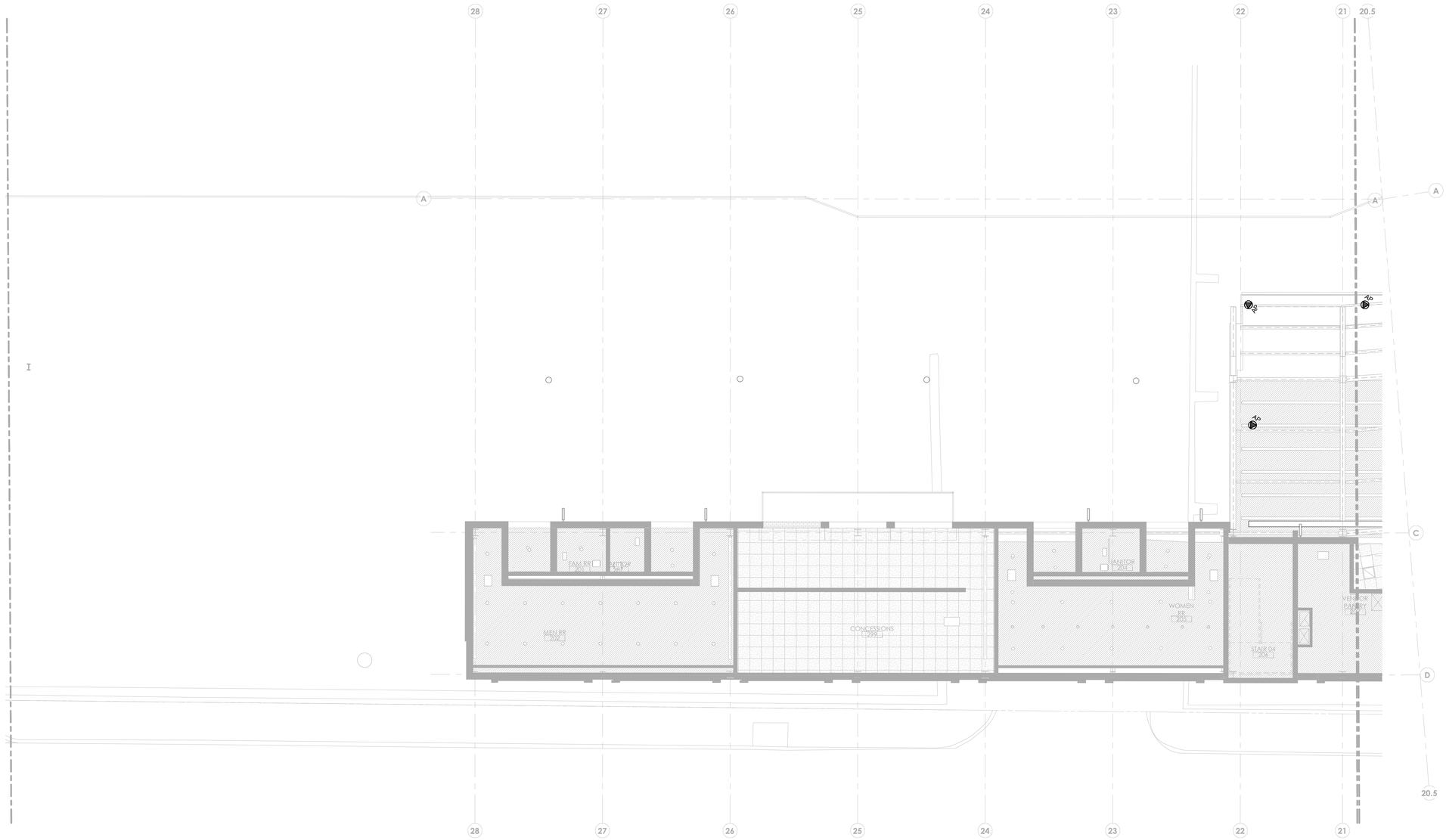
ARCH E1 30" x 42"

KEYNOTES



A01 ES_MAIN CONCOURSE - THIRD BASE LINE RCP

1/8" = 1'-0" | re: A01 / AV300

Project Management Initials:
Designer: Designer Checked: Checker Approved: Approver
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ARCHITECT

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PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
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WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
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KANSAS CITY, MO, 64105
tel - 913-318-8488

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HILLIS CARNES
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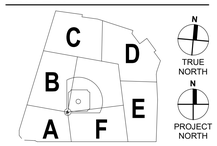

SHEET TITLE

MAIN CONCOURSE - THIRD BASE RCP

SHEET NUMBER

ES204.2

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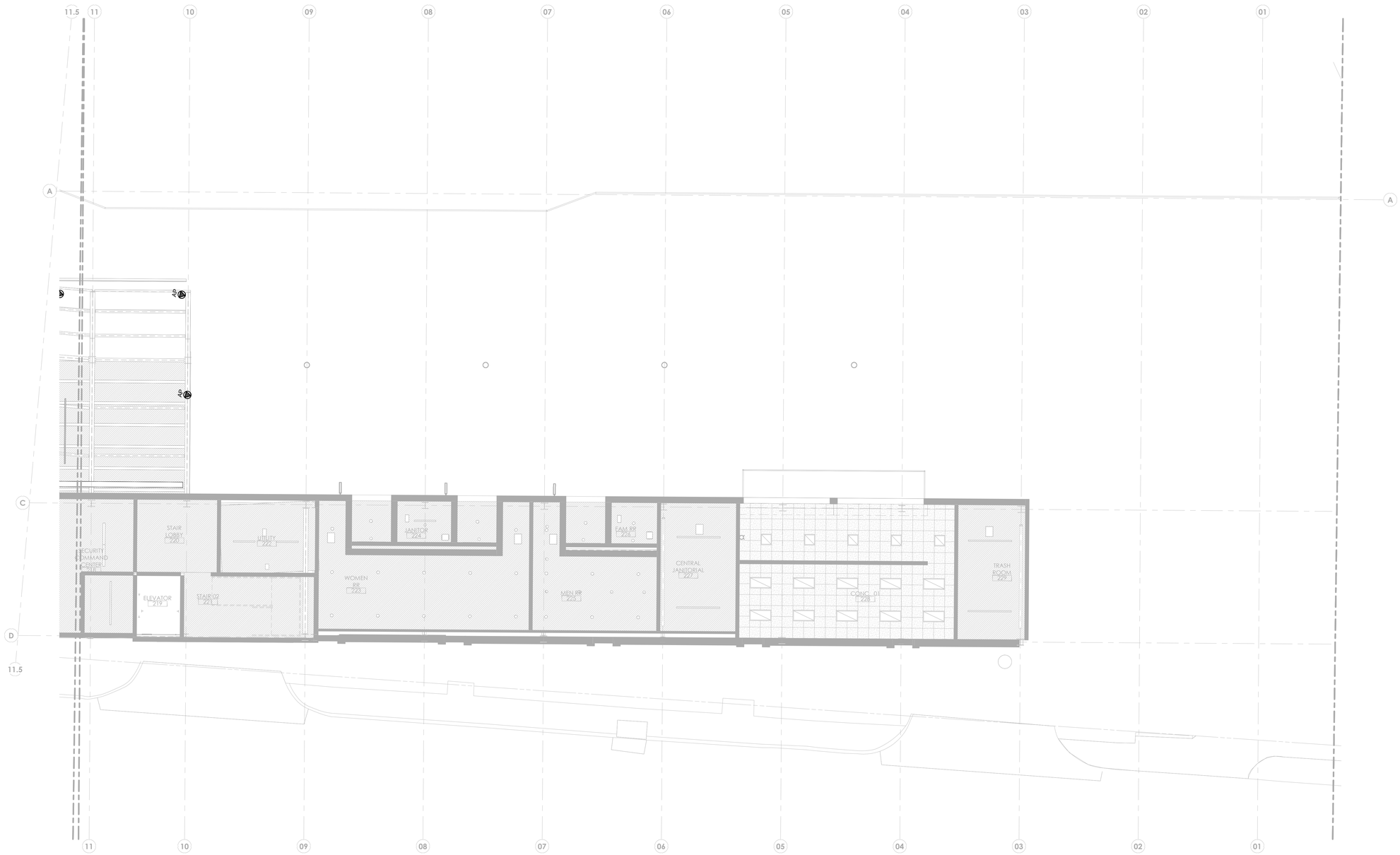
ARCH E1 30" x 42"

KEYNOTES



A01 ES_MAIN CONCOURSE - FIRST BASE LINE RCP

1/8" = 1'-0" re: A01 / AV300

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ARCHITECT

ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY
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www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
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CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
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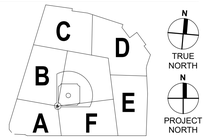

SHEET TITLE

MAIN CONCOURSE - FIRST BASE LINE RCP

SHEET NUMBER

ES204.8

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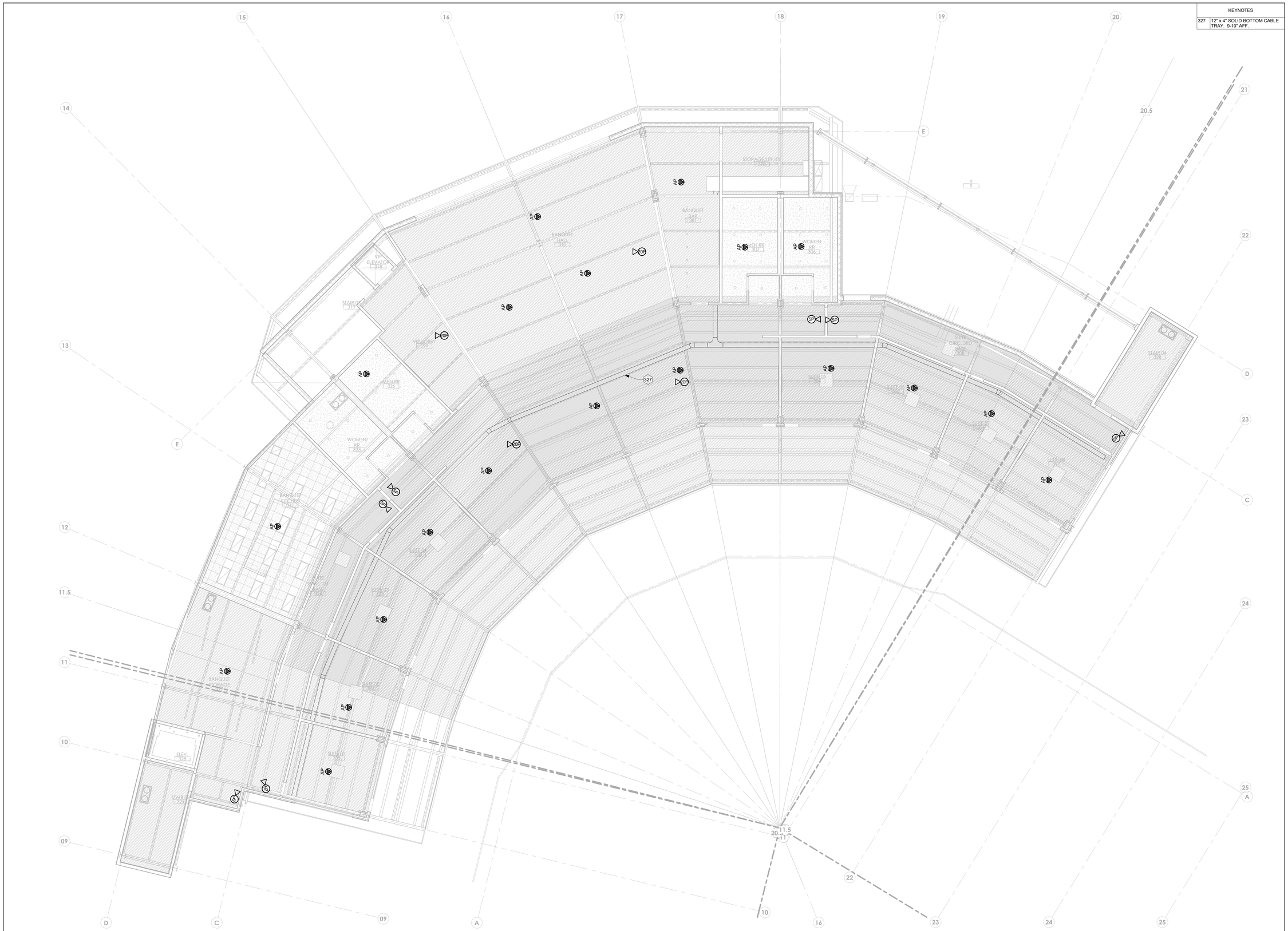
ARCH E1 30" x 42"



KEYNOTES

327	12" x 4" SOLID BOTTOM CABLE TRAY. 9-10" AFF.

A01 ES_SUITE LEVEL - HOME PLATE RCP

1/8" = 1'-0" | re: A01 / AV300

Project Management Initials:
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ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
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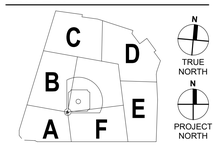
I/R	DATE	DESCRIPTION

KEY PLAN



SHEET TITLE

SUITE LEVEL - RCP

SHEET NUMBER

ES205.1

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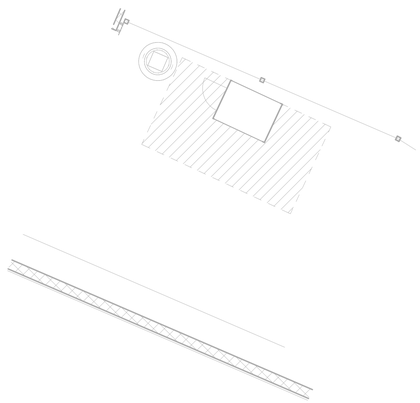
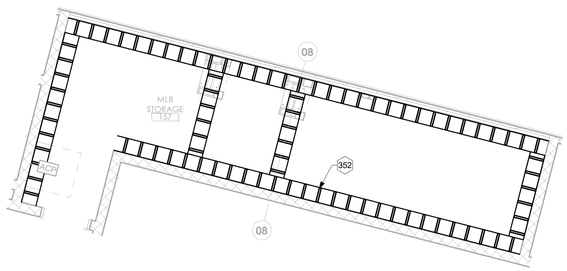
ARCH E1 30" x 42"

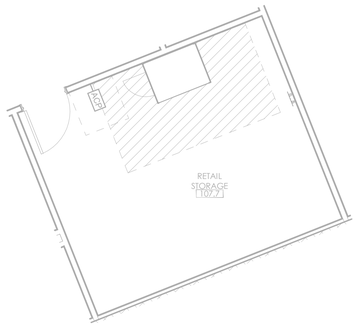
KEYNOTES	
351	SECONDARY BONDING BUSBAR (SBB) AT 6'-0" AFF.
352	12" CABLE RUNWAY (TYPICAL).
355	7' x 19" EQUIPMENT RACK.
357	7' x 6" VERTICAL CABLE MANAGER. (TYPICAL)
358	7' x 10.5" VERTICAL CABLE MANAGER.
362	3/4" FIRE RATED PLYWOOD WALL LINING. ALL WALLS
364	30" X 42" LAMINATED CAD FLOOR PLAN 5' AFF TO CENTER.
365	NETWORK EQUIPMENT CABINET.
366	4'-0" (W) WALL SPACE RESERVED FOR ELECTRICAL PANEL.
368	NEMA 4 ENVIRONMENTAL NETWORK CABINET



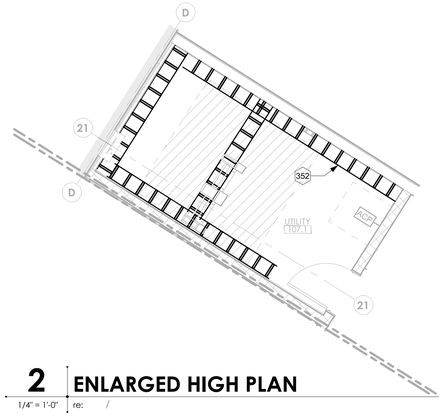
8 ENLARGED HIGH PLAN
1/4" = 1'-0" re: /



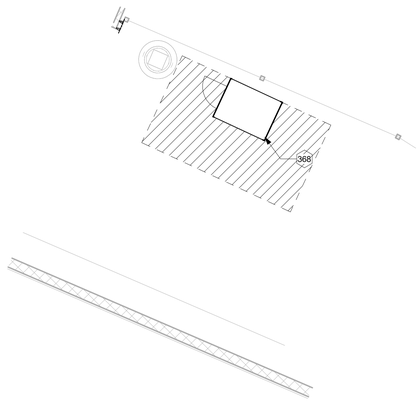
6 ENLARGED HIGH PLAN
1/4" = 1'-0" re: /



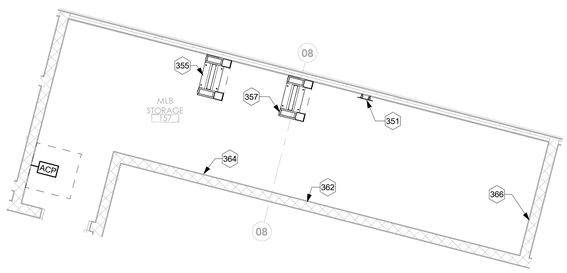
4 ENLARGED HIGH PLAN
1/4" = 1'-0" re: /



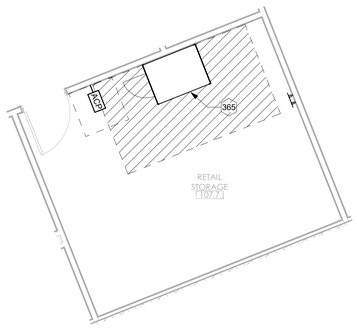
2 ENLARGED HIGH PLAN
1/4" = 1'-0" re: /



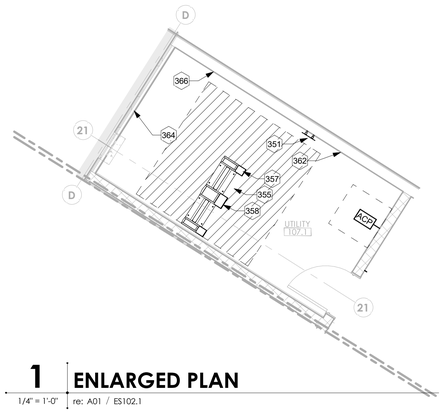
7 ENLARGED PLAN
1/4" = 1'-0" re: A01 / ES102.3



5 ENLARGED PLAN
1/4" = 1'-0" re: A01 / ES102.8



3 ENLARGED PLAN
1/4" = 1'-0" re: A01 / ES102.5



1 ENLARGED PLAN
1/4" = 1'-0" re: A01 / ES102.1

PENDULUM

PROJECT
HAGERSTOWN BALLPARK
CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT
ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT
MD STADIUM AUTHORITY
CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS
CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

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WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

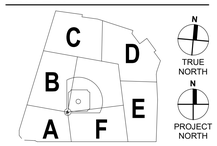
GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

Project **20220903_MSA**
Issued: 08/15/2022

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN



SHEET TITLE
ENLARGED PLANS

SHEET NUMBER
ES600

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Project Management Initials:
Designer: Designer Checked: Checker Approved: Approver
Last Plotted: 8/15/2022 3:49:20 PM
Filename: Autodesk Docs://Hagerstown 22/Hagerstown_AV_R22.rvt

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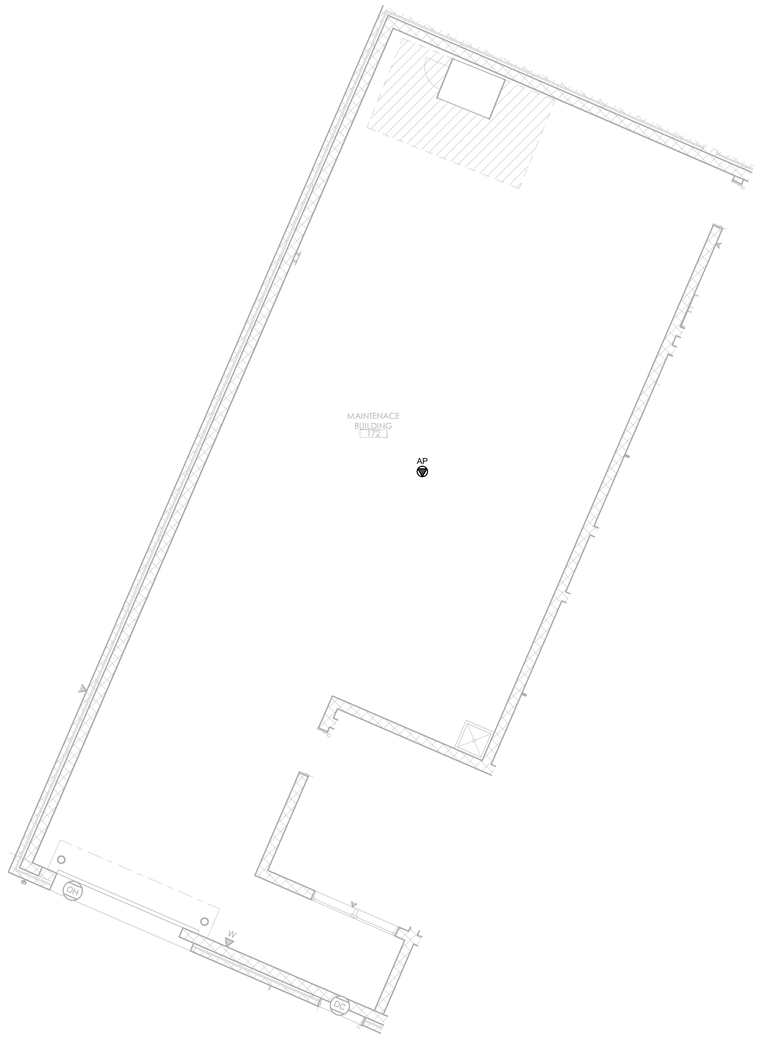
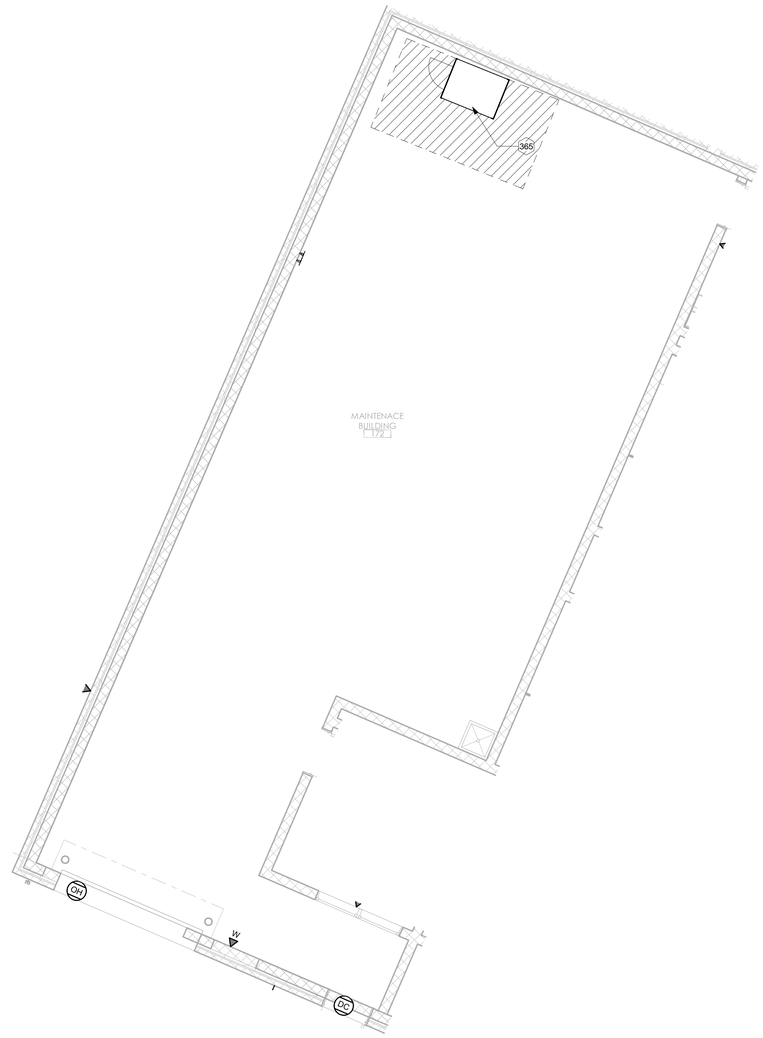
ARCH E1 30" x 42"

KEYNOTES	
365	NETWORK EQUIPMENT CABINET.



2 ENLARGED HIGH PLAN

1/4" = 1'-0" | re: A01 / ES102.7



1 ENLARGED PLAN

1/4" = 1'-0" | re: A01 / ES102.6

PENDULUM

PROJECT

HAGERSTOWN BALLPARK

CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

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CAPITAL FOODSERVICE DESIGN
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MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

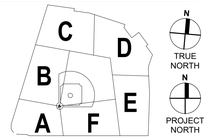
GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

Project **20220903_MSA**
Issued: 08/15/2022

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN



SHEET TITLE

ENLARGED PLANS

SHEET NUMBER

ES601

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Project Management Initials:
Designer: Designer Checked: Checker Approved: Approver
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Filename: Autodesk Docs://Hagerstown 22/Hagerstown_AV_R22.rvt

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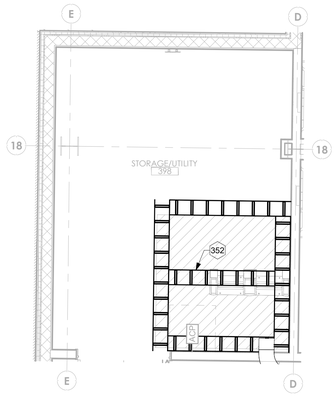
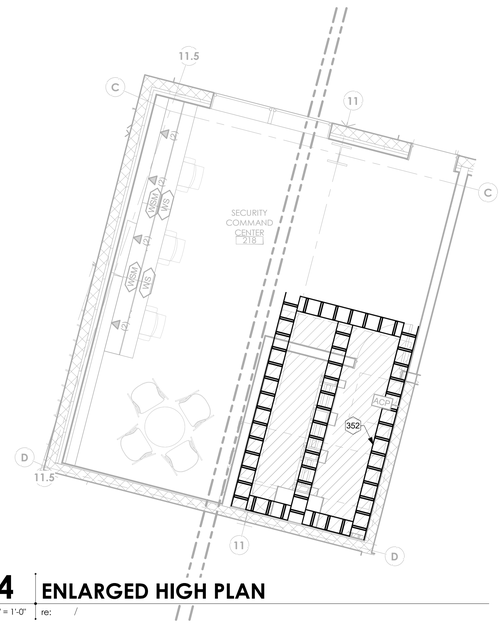
KEYNOTES	
350	PRIMARY BONDING BUSBAR (PBB) AT 2'-0" AFF.
351	SECONDARY BONDING BUSBAR (SBB) AT 6'-0" AFF.
352	12" CABLE RUNWAY (TYPICAL).
355	7' x 19" EQUIPMENT RACK.
357	7' x 6" VERTICAL CABLE MANAGER. (TYPICAL)
358	7' x 10.5" VERTICAL CABLE MANAGER.
362	3/4" FIRE RATED PLYWOOD WALL LINING. ALL WALLS.
364	30" X 42" LAMINATED CAD FLOOR PLAN 5' AFF TO CENTER.
365	NETWORK EQUIPMENT CABINET.
366	4'-0" (W) WALL SPACE RESERVED FOR ELECTRICAL PANEL.



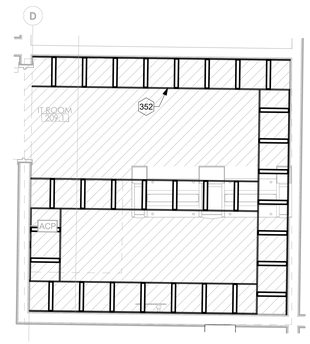
6 ENLARGED HIGH PLAN

1/4" = 1'-0" re: /



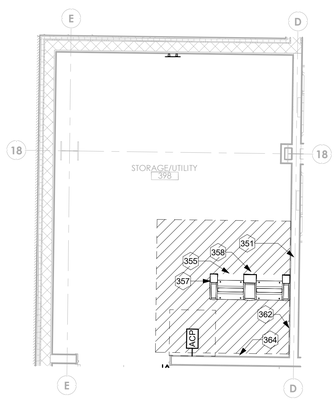
4 ENLARGED HIGH PLAN

1/4" = 1'-0" re: /



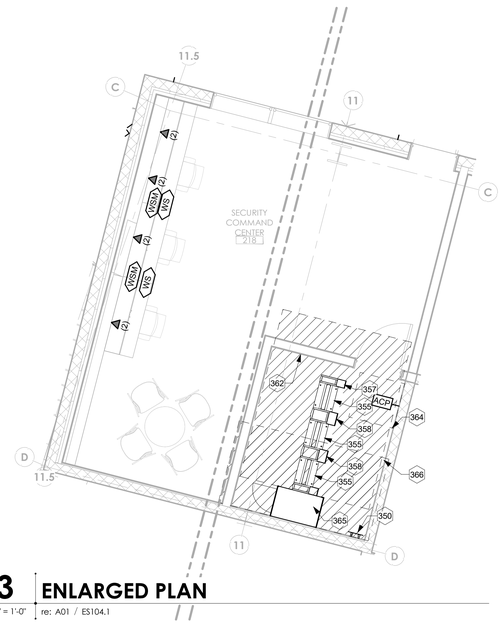
2 ENLARGED HIGH PLAN

1/2" = 1'-0" re: /



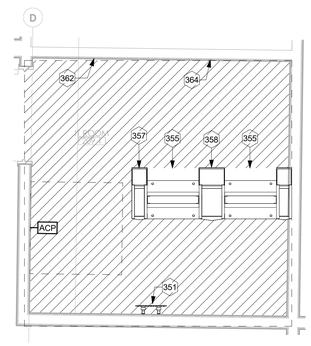
5 ENLARGED PLAN

1/4" = 1'-0" re: A01 / ES105.1



3 ENLARGED PLAN

1/4" = 1'-0" re: A01 / ES104.1



1 ENLARGED PLAN

1/2" = 1'-0" re: A01 / ES104.1

PENDULUM

PROJECT

HAGERSTOWN BALLPARK
CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY
CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

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WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

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KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
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tel - 301-582-4662

Project **20220903_MSA**
Issued: 08/15/2022

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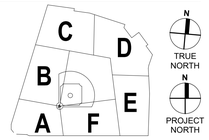
I/R	DATE	DESCRIPTION

KEY PLAN



SHEET TITLE

ENLARGED PLANS

SHEET NUMBER

ES602

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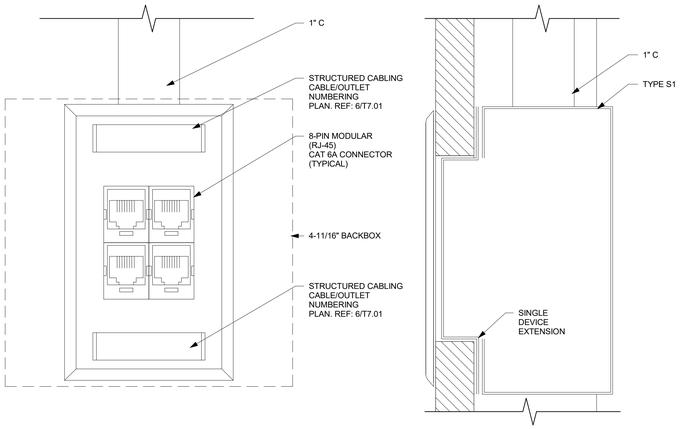
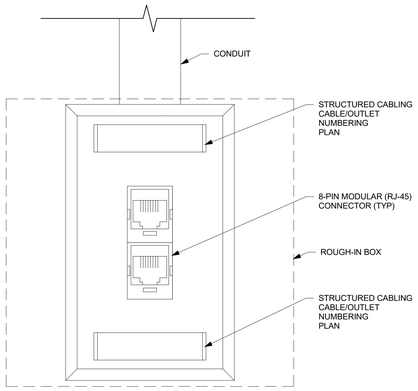
ARCH E1 30" x 42"
Project Management Initials:
Designer: Designer Checked: Checker Approved: Approver
Last Plotted: 8/15/2022 3:49:26 PM
Filename: Autodesk Docs:Hagerstown 22/Hagerstown_AV_R22.rvt
Printed on Post-Consumer Recycled Content Paper



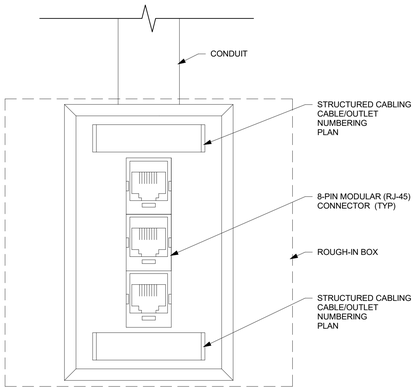
F04 TYPICAL FOUR-PORT OUTLET

NTS re: /



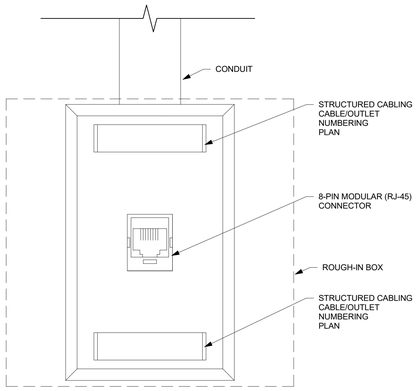
F08 TYPICAL TWO-PORT OUTLET

NTS re: /



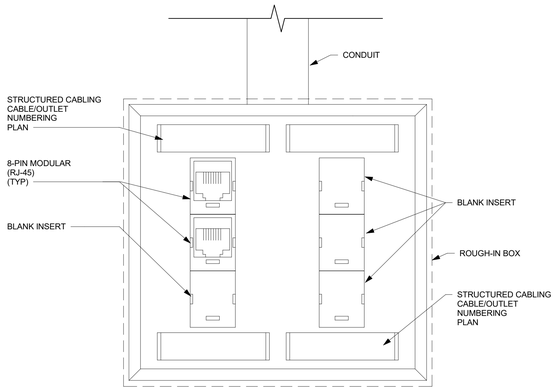
C04 TYPICAL THREE-PORT OUTLET

NTS re: /



C08 TYPICAL ONE-PORT OUTLET

NTS re: /



NOTES:

1. LOAD PORTS STARTING AT THE TOP LEFT TO MATCH ARRANGEMENT OF SINGLE GANG FACEPLATES. LEAVE BOTTOM (2) PORTS OPEN FOR FOUR PORT LCATIONS.
2. PROVIDED IN-USE COVER FOR OUTDOOR LOCATIONS.

A04 MASONRY WALL OR OUTDOOR SURFACE MOUNT LOCATIONS

NTS re: /

A08 STRUCTURED CABLING CABLE/OUTLET NUMBERING PLAN

NTS re: /

PENDULUM

PROJECT

HAGERSTOWN BALLPARK
CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

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PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
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CLIENT

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SITE RESOURCES
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PHOENIX, MD 21131-0249
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2001 K STREET, NW, STE 600 N
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Project **20220903_MSA**
Issued: 08/15/2022

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

SHEET TITLE

STRUCTURED CABLING PLATE DETAILS

SHEET NUMBER

ES1801

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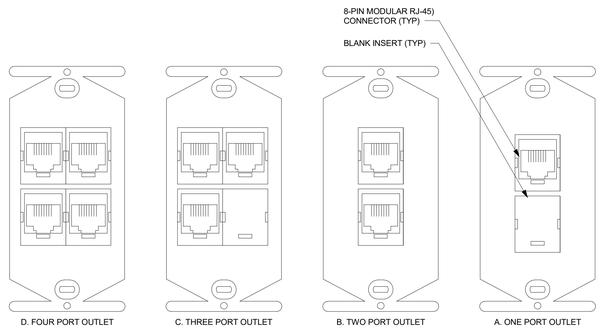
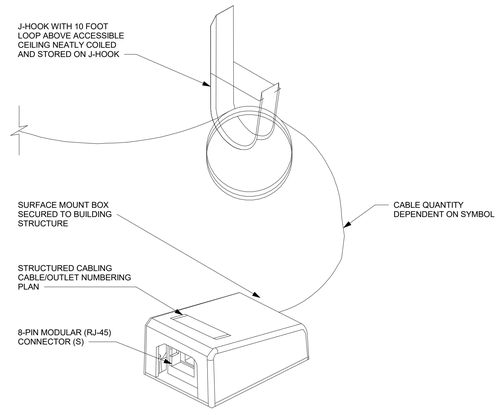
ARCH E1 30" x 42"
Project Management Initials:
Designer: Designer Checked: Checker Approved: Approver
Last Plotted: 8/15/2022 4:00:34 PM
Filename: Autodesk Docs://Hagerstown 22/Hagerstown_AV Functional_R22.rvt
Printed on Post-Consumer Recycled Content Paper



NOTES:
1. USE IN FLOOR BOXES, POKE THROUGHS, AND RACEWAYS.
2. LABEL USING STRUCTURED CABLING CABLE/OUTLET NUMBERING PLAN

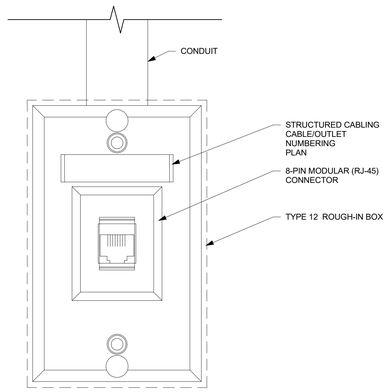
6 TYPICAL 106/DECORA FRAME OUTLET

NTS re: /



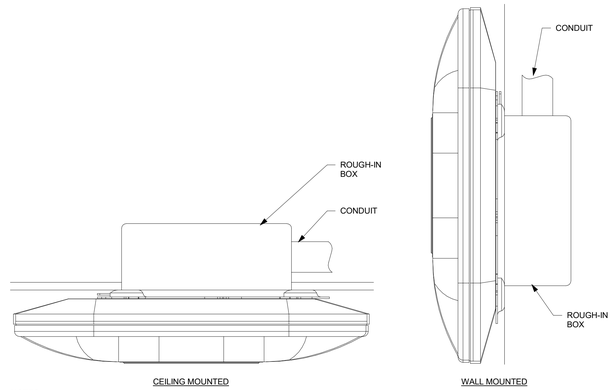
3 CEILING OUTLET IN ACCESSIBLE CEILING

NTS re: /



5 MASONRY WALL PHONE FACEPLATE

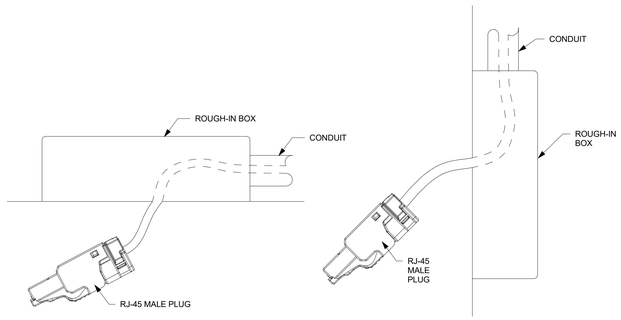
NTS re: /



NOTES:
1. WALL MOUNT DETAIL SHOWN WITH TYPE 10 ROUGH-IN BOX.
2. CEILING MOUNT DETAIL SHOWN WITH TYPE 10 ROUGH-IN BOX.
3. REFER TO GENERAL NOTES AND LEGENDS FOR REQUIREMENTS. PROVIDE OR INSTALL ACCESS POINTS.

2 WIRELESS ACCESS POINT ON WALL OR INACCESSIBLE CEILING

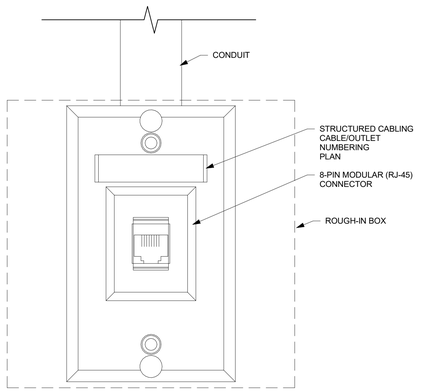
NTS re: /



NOTES:
1. LEAVE NO MORE THAN 1'-0" OF CABLE SLACK EXTENDING FROM BEYOND THE ROUGH-IN BOX.

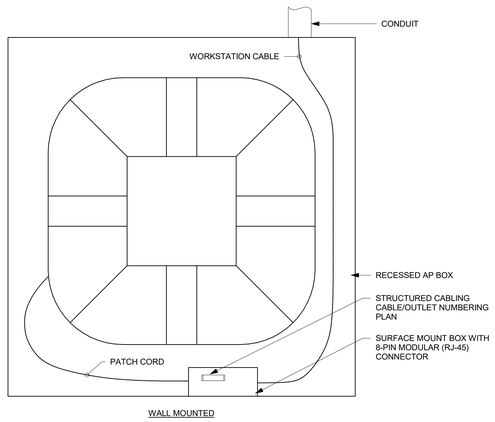
7 DIRECT CONNECT DETAIL

NTS re: /



4 TYPICAL WALL PHONE OUTLET

NTS re: /



1 WIRELESS ACCESS POINT IN RECESSED BOX

NTS re: /

PENDULUM

PROJECT
HAGERSTOWN BALLPARK
CORNER OF
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HAGERSTOWN, MD

ARCHITECT
ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT
MD STADIUM AUTHORITY
CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS
CIVIL ENGINEERING
SITE RESOURCES
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PHOENIX, MD 21131-0249
tel - 410-683-3388
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Project **20220903_MSA**
Issued: 08/15/2022

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I/R	DATE	DESCRIPTION

KEY PLAN

SHEET TITLE
STRUCTURED CABLING PLATE DETAILS

SHEET NUMBER
ES1802

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ARCH E1 30" x 42"
Approved: Approver
Checked: Checker
Designer: Designer
Last Plotted: 8/15/2022 4:00:35 PM
Filename: Autodesk Docs://Hagerstown 22/Hagerstown_AV Functional_R22.rvt
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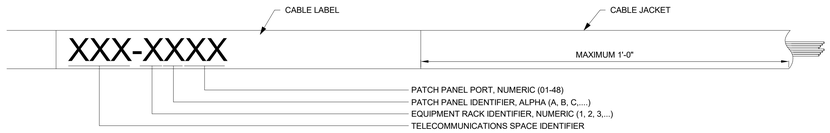
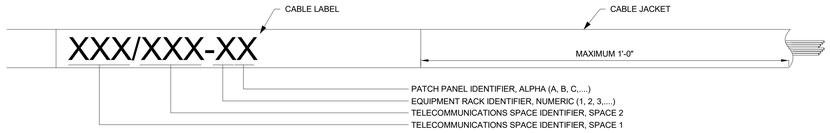


NOTES:
1. DETAIL SHOWN REPRESENTS A 4-PAIR HORIZONTAL LINK TERMINATING IN A TELECOMMUNICATIONS SPACE ON A RACK MOUNT PATCH PANEL OR AT THE WORKSTATION.

6 HORIZONTAL LINK CABLE LABEL DETAIL

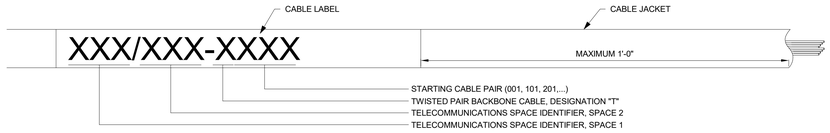
NTS re: /



NOTES:
1. DETAIL SHOWN REPRESENTS A 25-PAIR BACKBONE EXTENSION CABLE WITHIN A TELECOMMUNICATIONS SPACE TERMINATED ON A TERMINATION BLOCK ON ONE END AND ON A PATCH PANEL ON THE OTHER END.

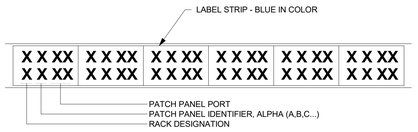
5 TWISTED PAIR BACKBONE EXTENSION CABLE LABEL DETAIL

NTS re: /

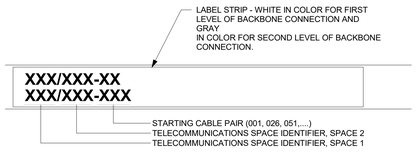


4 INTRA-BUILDING TWISTED PAIR BACKBONE CABLE LABEL DETAIL

NTS re: /



DETAIL B



DETAIL A

NOTES:
1. DETAIL "A" REPRESENTS A 110 STYLE TERMINATION BLOCK LABEL STRIP FOR USE WITH TWISTED PAIR BACKBONE CABLE TERMINATIONS.
2. DETAIL "B" REPRESENTS A 110 STYLE TERMINATION BLOCK LABEL FOR 25 PAIR EXTENSION TO RACK MOUNT PATCH PANELS.

8 TWISTED PAIR TERMINATION BLOCK LABEL DETAIL

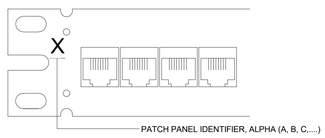
NTS re: /

3 INTRA-BUILDING FIBER OPTIC BACKBONE CABLE LABEL DETAIL

NTS re: /

2 INTER-BUILDING COPPER BACKBONE CABLE LABEL DETAIL

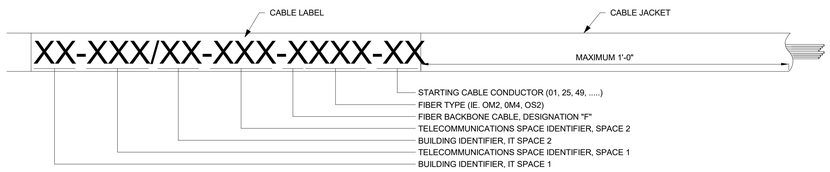
NTS re: /



NOTES:
1. DETAIL SHOWN REPRESENTS A SINGLE RACK SPACE PATCH PANEL TERMINATING HORIZONTAL LINK CABLING IN A TELECOMMUNICATIONS SPACE.

7 PATCH PANEL LABEL DETAIL

NTS re: /



1 INTER-BUILDING FIBER OPTIC BACKBONE CABLE LABEL DETAIL

NTS re: /

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PROJECT
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ARCHITECT
ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

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Project **20220903_MSA**
Issued: 08/15/2022

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I/R	DATE	DESCRIPTION

KEY PLAN

SHEET TITLE
STRUCTURED CABLING LABELING DETAILS

SHEET NUMBER
ES1804

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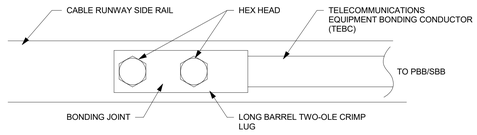
Last Plotted: 8/15/2022 4:00:36 PM
Filename: Autodesk Docs://Hagerstown 22/Hagerstown_AV Functional_R22.rvt
Printed on Post-Consumer Recycled Content Paper

TBB/BBC linear length m (ft)	Conductor size (AWG)
less than 4 (13)	6
4 - 6 (14 - 20)	4
6 - 8 (21 - 26)	3
8 - 10 (27 - 33)	2
10 - 13 (34 - 41)	1
13 - 16 (42 - 52)	1/0
16 - 20 (53 - 66)	2/0
20 - 26 (67 - 84)	3/0
26 - 32 (85 - 105)	4/0
32 - 38 (106 - 125)	250 kcmil
38 - 46 (126 - 150)	300 kcmil
46 - 53 (151 - 175)	350 kcmil
53 - 76 (176 - 250)	500 kcmil
76 - 91 (251 - 300)	600 kcmil
Greater than 91 (301)	750 kcmil

7 TBB AND BBC CONDUCTOR SIZE CHART

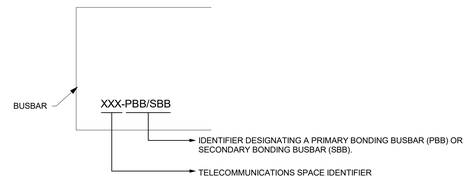
NTS re: /



NOTES:
1. REMOVE PAINT FROM CABLE RUNWAY AT BONDING POINT. UTILIZE JOINT COMPOUND WHEN ATTACHING THE CRIMP LUG TO THE CABLE RUNWAY.

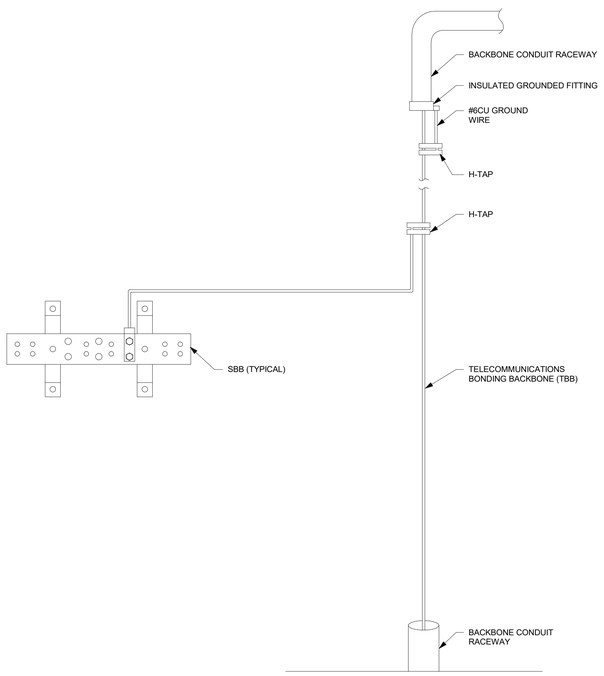
5 CABLE RUNWAY BONDING DETAIL

NTS re: /



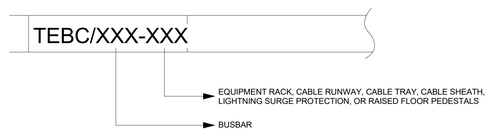
3 BONDING BUSBAR LABEL DETAIL

NTS re: /

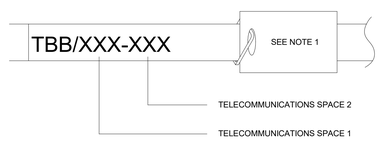


6 TELECOMMUNICATIONS BONDING BACKBONE (TBB) CONNECTION TO SECONDARY BONDING BUSBAR (SBB) DETAIL

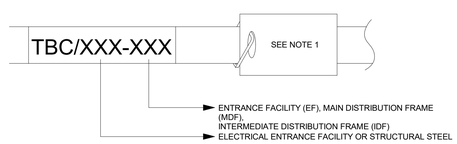
NTS re: /



DETAIL C - TELECOMMUNICATIONS EQUIPMENT BONDING CONDUCTOR



DETAIL B - TELECOMMUNICATIONS BONDING BACKBONE

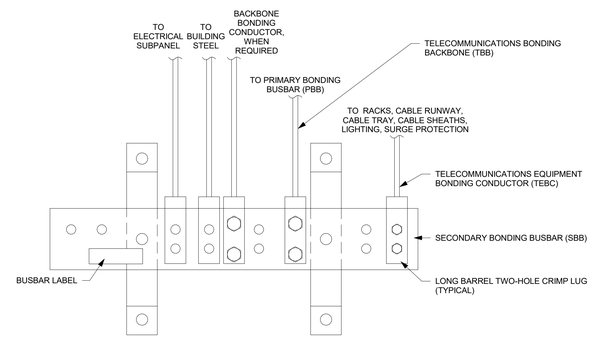


DETAIL A - TELECOMMUNICATIONS BONDING CONDUCTOR

4 BONDING CONDUCTOR LABEL DETAIL

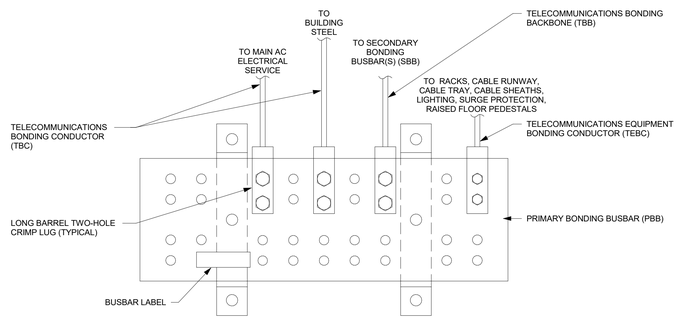
NTS re: /

NOTES:
1. IN ADDITION TO THE CABLE LABEL, PROVIDE A PERMANENT TAG ON EACH END OF EACH GROUND WIRE STATING "IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER". PANDUIT #LTYK.



2 SECONDARY BONDING BUSBAR (SBB) DETAIL

NTS re: /



1 PRIMARY BONDING BUSBAR (PBB) DETAIL

NTS re: /

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PROJECT
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CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT
ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT
MD STADIUM AUTHORITY
CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
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CIVIL ENGINEERING
SITE RESOURCES
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PHOENIX, MD 21131-0249
tel - 410-683-3388
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WILLIAMSPORT, MD, 21795
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Project 20220903_MSA
Issued: 08/15/2022

ISSUE/REVISION

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KEY PLAN

SHEET TITLE
STRUCTURED CABLING GROUNDING AND BONDING DETAILS

SHEET NUMBER
ES1805

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ARCH E1 30" x 42"
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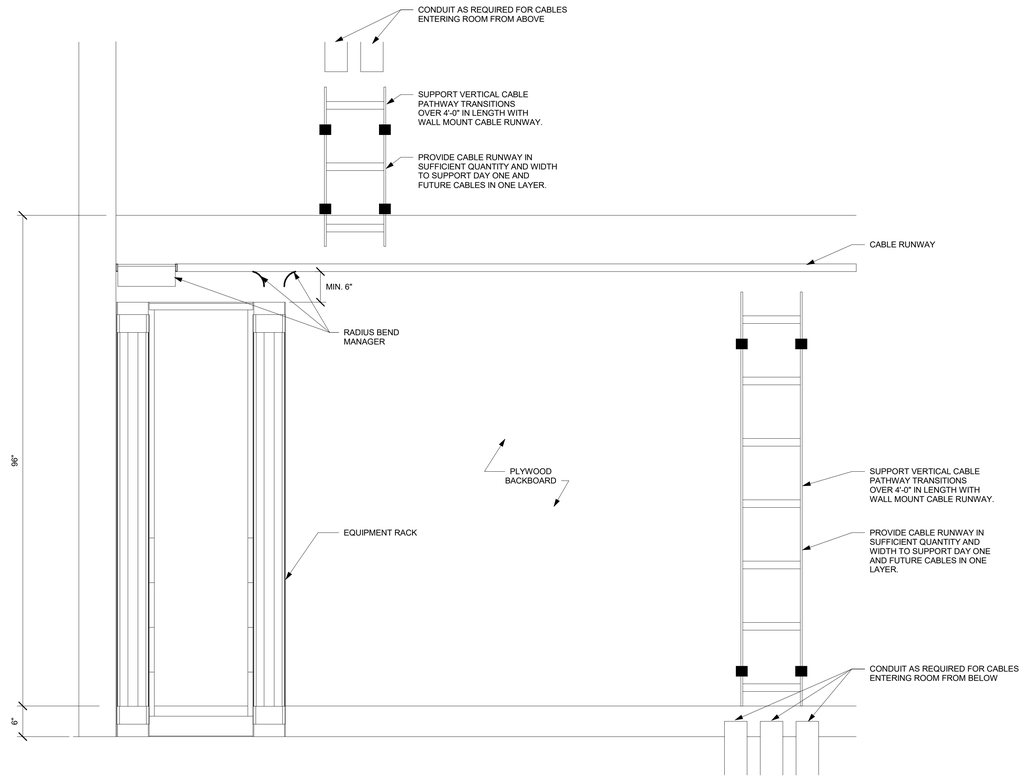
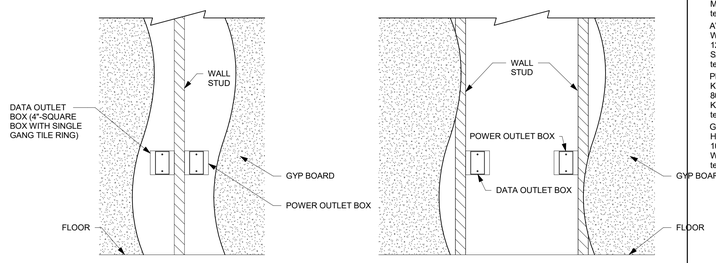


5 IT CLOSET VERTICAL PATHWAYS, TYPICAL

NTS re: /



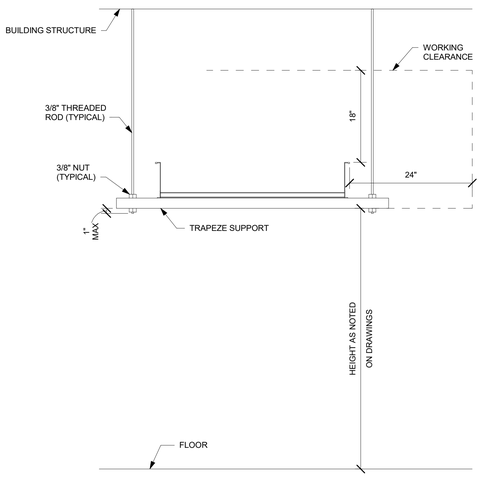
SHARED STUD TYPE

ADJACENT STUD TYPE

NOTES:
1. ALL DATA OUTLETS REQUIRE AN ADJACENT POWER OUTLET TO SUPPORT DATA EQUIPMENT.

2 TYPICAL POWER WALL OUTLET REQUIRMENTS TO SUPPORT DATA EQUIPMENT

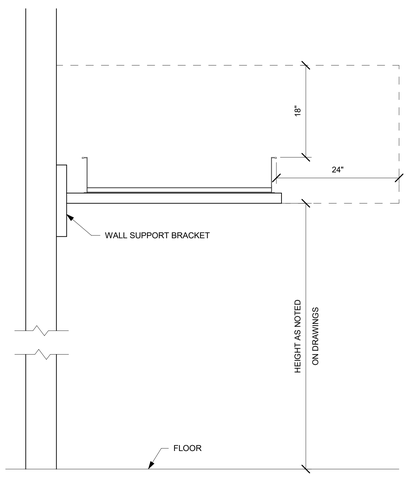
NTS re: /



NOTES:
1. SPACE BETWEEN TRAPEZE SUPPORT BRACKETS MUST NOT EXCEED MANUFACTURER'S RECOMMENDATIONS.
2. IN ACCESSIBLE CEILING SPACE, NO LESS THAN 3" ABOVE CEILING.
3. WORKING CLEARANCE INDICATED CAN BE ON EITHER SIDE.
4. PROVIDE THREADED ANCHORS OR APPROPRIATE CLAMPS TO ATTACH THREADED ROD TO BUILDING STRUCTURE.

4 CABLE TRAY SECTION - TRAPEZE SUPPORT

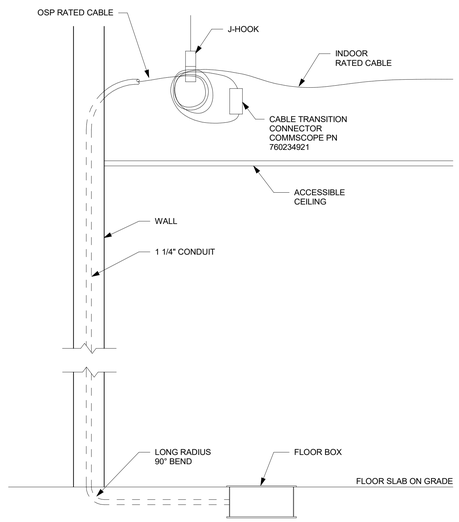
NTS re: /



NOTES:
1. SPACE BETWEEN WALL SUPPORT BRACKETS MUST NOT EXCEED MANUFACTURER'S RECOMMENDATIONS.
2. IN ACCESSIBLE CEILING SPACE, NO LESS THAN 3" ABOVE CEILING.

3 CABLE TRAY SECTION - WALL SUPPORT

NTS re: /



NOTES:
1. FOR INACCESSIBLE CEILING AN ACCESS PANEL IS REQUIRED TO PROVIDE ACCESS TO J1 BOX.
2. PROVIDE LABEL WITH 1/2" LETTERS ON CEILING GRID WITH OUTLET OR FIRST PORT NUMBER.

1 CABLE TRANSITION FOR FLOOR BOXES IN SLAB ON GRADE INSTALLATIONS (TYP)

NTS re: /

PENDULUM

PROJECT

HAGERSTOWN BALLPARK
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ARCHITECT

ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
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SHEET NUMBER

ES1806

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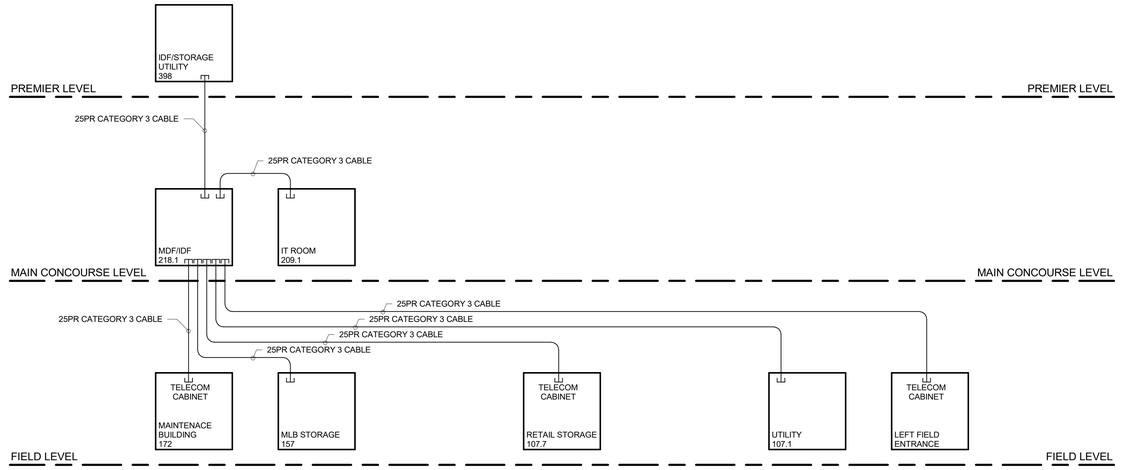
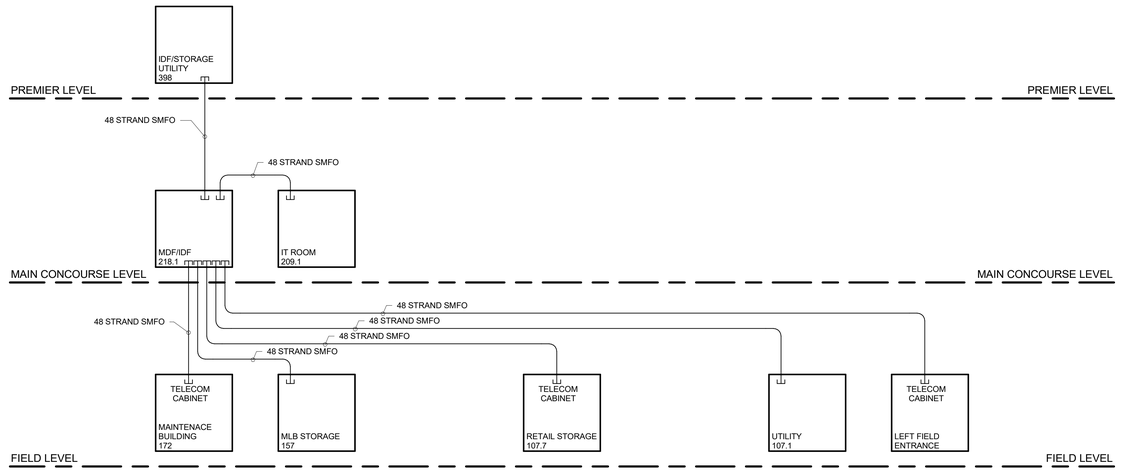


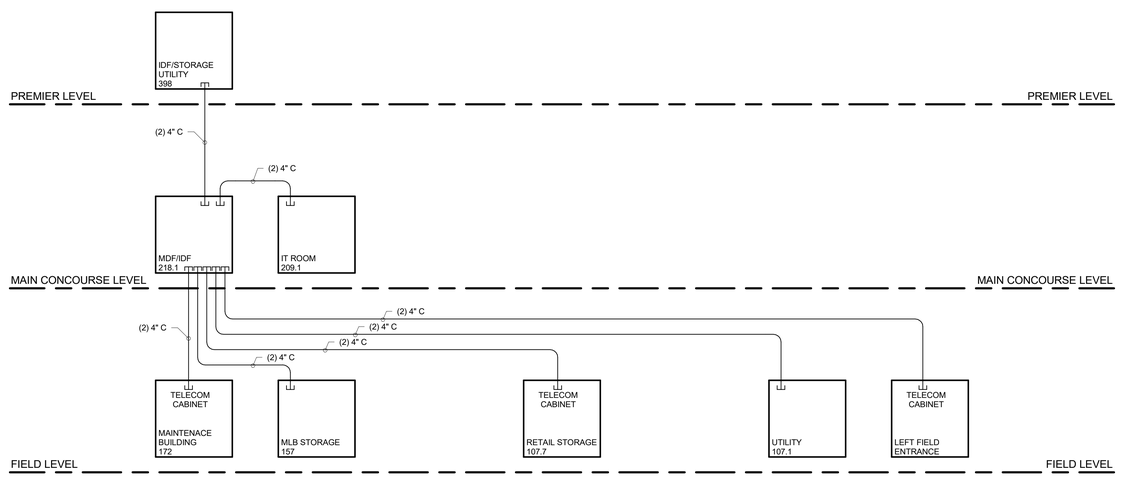
A03 COPPER RISER DIAGRAM

12" = 1'-0" re: /



A02 FIBER RISER DIAGRAM

12" = 1'-0" re: /



A01 CONDUIT RISER DIAGRAM

12" = 1'-0" re: /

PENDULUM

PROJECT

HAGERSTOWN BALLPARK
CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY
CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

Project **20220903_MSA**
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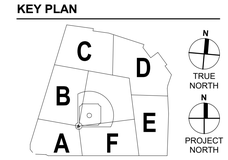
KEY PLAN



SHEET TITLE

RISER DIAGRAMS

SHEET NUMBER

ES1810

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ARCH E1 30" x 42"
Project Management Initials:
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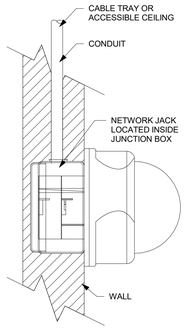
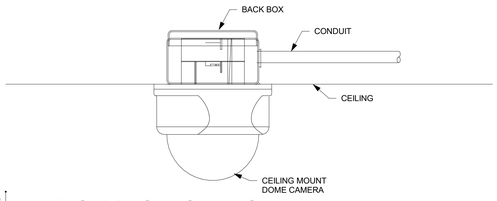


C08 FIXED WALL/CEILING MOUNT CAMERA

3" = 1'-0" | re: /



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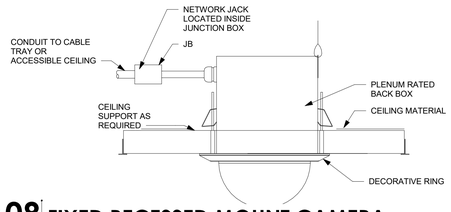

A08 FIXED RECESSED MOUNT CAMERA

3" = 1'-0" | re: /

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HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

Project **20220903_MSA**
Issued: 08/15/2022

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I/R	DATE	DESCRIPTION

KEY PLAN

SHEET TITLE

SECURITY CAMERA DETAILS

SHEET NUMBER

ES1971

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ARCH E1 30" x 42"
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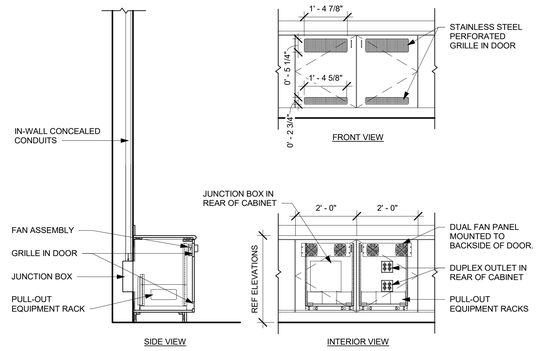
ARCH E1 30" x 42"

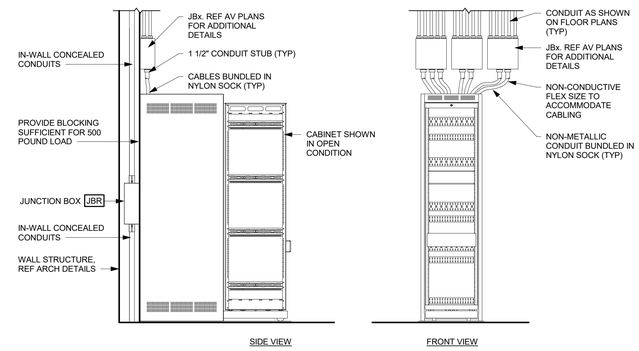
AV RACK SCHEDULE

RACK DESIGNATOR	ROOM	RACK STYLE	TYPE #	RACK MOUNTING HEIGHT (AFF TO BOTTOM OF RACK)	JBR MOUNTING HEIGHT (AFF TO CENTER OF JBR)		DETAIL (SEE BELOW)	NOMINAL SIZE (RU)	NOMINAL DEPTH	OPTIONS	NOTES
					WALL RACK	FLOOR RACK					
		FREE STANDING							36"		



E05 CREDENZA RACK DETAIL

1/2" = 1'-0" re: /



E08 ROLL OUT PIVOTING RACK DETAIL

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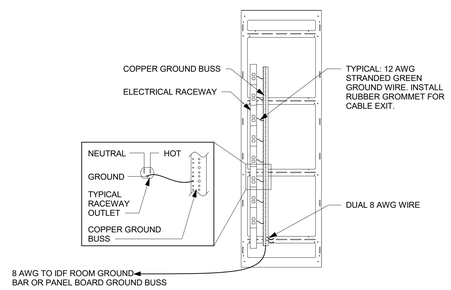

B02 RACK GROUND BAR DETAIL

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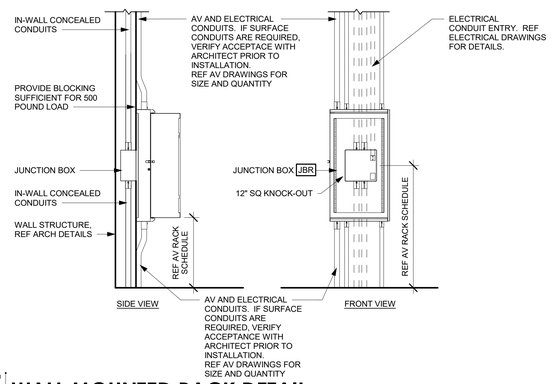

B05 WALL MOUNTED RACK DETAIL

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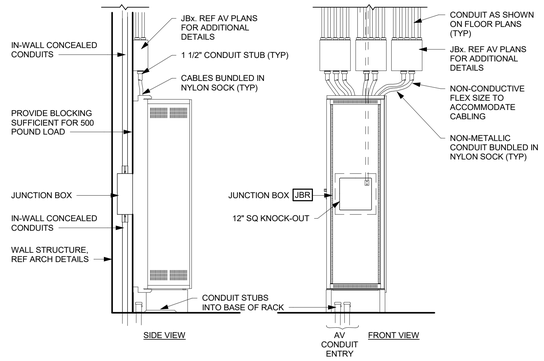
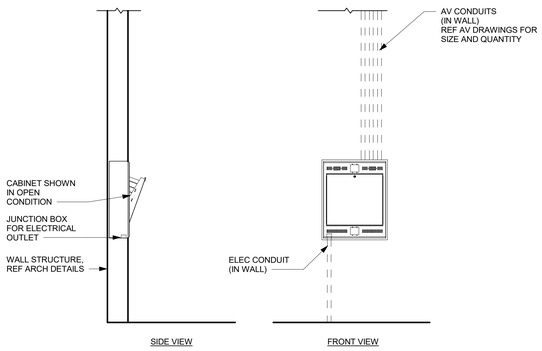


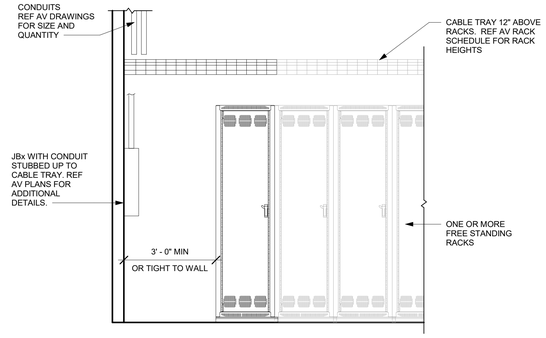
B08 FLOOR SUPPORTED WALL RACK MOUNTING DETAIL

1/2" = 1'-0" re: /



A02 TILT OUT WALL CABINET

1/2" = 1'-0" re: /



A05 FREE STANDING/GANGED RACK DETAIL

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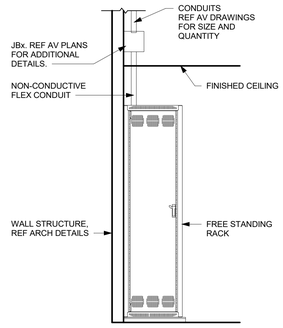

A08 FREE STANDING RACK DETAIL

1/2" = 1'-0" re: /

PENDULUM

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Project **20220903_MSA**
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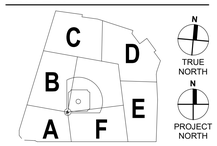

SHEET TITLE

AUDIO-VIDEO EQUIPMENT RACK DETAILS

SHEET NUMBER

AV000.9

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ARCH E1 30" x 42"

GENERAL ABBREVIATIONS

--	NOT APPLICABLE
@	AT
3DC	3D CONTROLLER
A/C	AIR CONDITIONING
ABV	ABOVE
AC	ALTERNATING CURRENT
ADA	AMERICANS WITH DISABILITIES ACT
ADJ	ADJUSTABLE
AFC	ABOVE FINISHED CEILING
AFF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
AHJ	AUTHORITY HAVING JURISDICTION
ALT	ALTERNATE
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
ARCH	ARCHITECT, ARCHITECTURAL
ASME	AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AUX	AUXILIARY
AWG	AMERICAN WIRE GAUGE
BFC	BELOW FINISHED CEILING
BFF	BELOW FINISHED FLOOR
BLDG	BUILDING
BOH	BACK OF HOUSE
BOP	BOTTOM OF PIPE
BOS	BOTTOM OF STRUCTURE
C	CONDUIT
CAT	CATEGORY CABLE
CKT	CIRCUIT
CL	CENTER LINE
CLG	CEILING
CMU	CONCRETE MASONRY UNIT
COL	COLUMN
CTRL	CONTROL
D	DEPTH, DEEP
DC	DIRECT CURRENT
DC	DOWNSTAGE CENTER
DEG	DEGREES
DEMO	DEMOLITION
DFP	DIRECTOR'S FLOOR POCKET
DIA	DIAMETER
DIM	DIMENSION
DIV	DIVISION
DS	DOWNSTAGE
DSL	DOWNSTAGE LEFT
DSR	DOWNSTAGE RIGHT
DWG	DRAWING
EA	EACH
EC	ELECTRICAL CONTRACTOR
EL	ELEVATION
ELEC	ELECTRICAL
ENCL	ENCLOSURE
EQ	EQUAL
EQUIP	EQUIPMENT
ER	EQUIPMENT RACK
ESW	ETHERNET SWITCH
EXIST	EXISTING
FA	FIRE ALARM
FB	FLOOR BOX
FLEX	FLEXIBLE
FLR	FLOOR
FO	FINISHED OPENING
FOH	FRONT OF HOUSE
FPB	FIBER OPTIC PATCHBAY
FPM	FEET PER MINUTE
FT	FOOT, FEET
FV	FIELD VERIFY
GND	GROUND
GA	GAUGE
H	HEIGHT
HL	HOUSE LEFT
HMP	HOUSE MANAGER POSITION
HOR	HORIZONTAL
HP	HORSEPOWER
HR	HOUSE RIGHT
HZ	HERTZ
I/O	INPUT/OUTPUT
ID	INSIDE DIAMETER
IDF	INTERMEDIATE DISTRIBUTION FRAME
IG	ISOLATED GROUND
ISO	ISOLATED
JB	JUNCTION BOX
JBD	JUNCTION BOX - DATA
JP	JUNCTION BOX - SYSTEM POWER
KPD	KEYPAD
KW	KILOWATT
L	LENGTH, LEFT
L/R	LEFT/RIGHT
LAN	LOCAL AREA NETWORK
LB	POUNDS
LF	LINEAR FEET
LTG	LIGHTING
MAX	MAXIMUM
MDF	MAIN DISTRIBUTION FRAME
MECH	MECHANICAL
MIN	MINIMUM
MMFO	MULTIMODE FIBER OPTIC CABLE
MTD	MOUNTED
NA	NOT APPLICABLE
NC	NORMALLY CLOSED
NEC	NATIONAL ELECTRICAL CODE
NEMA	NATIONAL ELECTRICAL MANUFACTURER'S ASSOC. NETWORK
NIC	NOT IN CONTRACT
NO	NORMALLY OPEN
NTS	NOT TO SCALE
OC	ON CENTER
OD	OUTSIDE DIAMETER
OFCI	OWNER FURNISHED CONTRACTOR INSTALLED
OFE	OWNER FURNISHED EQUIPMENT
OFOI	OWNER FURNISHED OWNER INSTALLED
P	PRIMARY
P/O	PART OF
PC	PERSONAL COMPUTER
PDU	POWER DISTRIBUTION UNIT
PGM	PROGRAM
PH	PHASE
PNL	PANEL
PROC	PROCESSOR
PRH	PROJECT RECEPTACLE HEIGHT
PRX	PROXIMITY SENSOR
PS	POWER SUPPLY
PSF	POUNDS PER SQUARE FOOT
PSH	PROJECT SWITCH HEIGHT
PSI	POUNDS PER SQUARE INCH
PT	PASS THROUGH
PVC	POLYVINYL CHLORIDE
PWR	POWER
QTY	QUANTITY
R	RIGHT
RCP	REFLECTED CEILING PLAN
REF	REFERENCE, REFER
REINF	REINFORCING
REQD	REQUIRED
REV	REVISION, REVISE
RM	ROOM
RO	ROUGH OPENING
RPM	REVOLUTIONS PER MINUTE
S	SURFACE, SECONDARY
SQFT	SQUARE FEET
SIM	SIMILAR
SL	STAGE LEFT
SMFO	SINGLE MODE FIBER OPTIC CABLE
SMP	STAGE MANAGER POSITION
SPEC	SPECIFICATION
SQ	SQUARE
SR	STAGE RIGHT
STD	STANDARD
STP	SHIELDED TWISTED PAIR
SURF	SURFACE
SUSP	SUSPEND
TBD	TO BE DETERMINED
THRU	THROUGH
TYP	TYPICAL
UC	UPSTAGE CENTER
UL	UNDERWRITERS LABORATORIES, INC.
UNO	UNLESS NOTED OTHERWISE
UPS	UNINTERRUPTIBLE POWER SUPPLY
US	UPSTAGE
USL	UPSTAGE LEFT
USR	UPSTAGE RIGHT
USB	UNIVERSAL SERIAL BUS
UTP	UNSHIELDED TWISTED PAIR
V	VOLT
VA	VOLT-AMPERE
VERT	VERTICAL
VIF	VERIFY IN FIELD
W/	WITH
W/O	WITHOUT
WP	WEATHERPROOF
WT	WEIGHT

AUDIO VISUAL ABBREVIATIONS

--	NOT APPLICABLE
ADA	AUDIO DISTRIBUTION AMPLIFIER
AES	AUDIO ENGINEERING SOCIETY
ALS	ASSISTED LISTENING SYSTEM
AMP	AMPLIFIER, AMPERES
ANT	ANTENNAE
ANT DA	ANTENNA DISTRIBUTION AMPLIFIER
APB	AUDIO PATCH BAY
AV	AUDIO VIDEO
AVS	AUDIO VIDEO SWITCHER
BR	BLU-RAY DISC PLAYER
BDR	BLU-RAY DISC RECORDER
BGM	BACKGROUND MUSIC PLAYER
CAM	CAMERA
CATV	CABLE TELEVISION
CCTV	CLOSED CIRCUIT TELEVISION
CCU	CAMERA CONTROL UNIT
CDP	COMPACT DISC PLAYER
CG	CHARACTER GENERATOR
CONV	CONVERTER
CU	COLLABORATION UNIT
DA	DISTRIBUTION AMPLIFIER
DAN	DIGITAL AUDIO NETWORK
DM	DIGITAL MEDIA
DM-MTX	DIGITAL MEDIA MATRIX
DMP	DIGITAL MEDIA PLAYER
DMPS	DIGITAL MEDIA PRESENTATION SWITCHER
DMR	DIGITAL MEDIA RECORDER
DMRX	DIGITAL MEDIA RECEIVER / DECODER
DMTX	DIGITAL MEDIA TRANSMITTER / ENCODER
DMU	DIGITAL MESSAGE UNIT
DOC CAM	DOCUMENT CAMERA
DP	DISPLAY PORT
DPDT	DOUBLE-POLE, DOUBLE-THROW
DPST	DOUBLE-POLE, SINGLE-THROW
DSP	DIGITAL SIGNAL PROCESSOR
DVE	DIGITAL VIDEO EFFECTS
DVR	DIGITAL VIDEO RECORDER
EBU	EUROPEAN BROADCASTING UNION
EQ	EQUALIZER
FC	FORMAT CONVERTER
FPM	FLAT PANEL MONITOR
FORX	FIBER OPTIC RECEIVER
FOTX	FIBER OPTIC TRANSMITTER
HDMI	HIGH DEFINITION MULTIMEDIA INTERFACE
HDRX	HDMI RECEIVER
HDSDI	HD SERIAL DIGITAL INTERFACE
HDTX	HDMI TRANSMITTER
ICOM	INTERCOM
IFB	INTERRUPTED FOLDBACK
IPTV	INTERNET PROTOCOL TELEVISION
JBA	JUNCTION BOX - AUDIO
JBC	JUNCTION BOX - CONTROL
JBE	JUNCTION BOX - ENG TRUCKS
JBL	JUNCTION BOX - AUDIO LINE LEVEL
JBM	JUNCTION BOX - AUDIO MIC LEVEL
JBR	JUNCTION BOX - RADIO
JBS	JUNCTION BOX - SPEAKER
JBT	JUNCTION BOX - BROADCAST
JBV	JUNCTION BOX - VIDEO
KVM	KEYBOARD VIDEO MOUSE
LA	LINE AMPLIFIER
LIM	LIMITER
LL	LINE LEVEL
MATV	MASTER ANTENNA TELEVISION
MIC	MICROPHONE
MICPRE	MICROPHONE PREAMP
MIX	MIXER
ML	MICROPHONE LEVEL
MOD	MODULATOR
MON	MONITOR / VIDEO DISPLAY
MTR	MULTITRACK PLAYER/RECORDER
MTX	MATRIX
NG	NOISE GENERATOR
PA	PUBLIC ADDRESS
PAD	AUDIO ATTENUATOR
PEQ	PARAMETRIC EQUALIZER
PSP	POWERED SPEAKER
PTZ	PAN/TILT/ZOOM
REC	RECORDER
SATRX	SATELLITE RECEIVER
SB	SCOREBOARD
SC	SCAN CONVERTER
SDI	SERIAL DIGITAL INTERFACE
SPDT	SINGLE POLE DOUBLE THROW
SPG	SYNC PULSE GENERATOR
SPL	SPLITTER
SPK	SPEAKER
SPLIT	MICROPHONE SPLITTER
SPST	SINGLE POLE SINGLE THROW
STREAM	DIGITAL VIDEO STREAMING
SUM	AUDIO SUMMING DEVICE
SW	SWITCHER
TD	THROW DISTANCE
TP	TOUCH PANEL
TV	TELEVISION
VBS	VIDEO BURST SYNC
VC	VOLUME CONTROL
VCA	VOLTAGE CONTROLLED AMPLIFIER
VDA	VIDEO DISTRIBUTION AMPLIFIER
VGA	VIDEO GRAPHICS ARRAY
VP	VIDEO PROJECTOR
VPB	VIDEO PATCH BAY
VS	VECTOR SCOPE
VSG	VIDEO SYNC GENERATOR
VSR	VIDEO SERVER
VSW	VIDEO SWITCH
VTC	VIDEO TELECONFERENCING SYSTEM
VWP	VIDEO WALL PROCESSOR
WFM	WAVEFORM MONITOR
WMS	WIRELESS MICROPHONE SYSTEM
WTX	WIRELESS TRANSMITTER
XFMR	TRANSFORMER
XOVR	CROSSOVER

ROUGH-IN BOX SCHEDULE

TYPE 1

RECESSED: 1-GANG BOX. 2 1/8" DEEP WITH KNOCKOUTS. PROVIDE DEVICE EXTENSION AS REQUIRED TO ACCOMMODATE DEVICE COVER SIZE. DEVICE COVER/RING EDGE TO BE FLUSH WITH FINISHED WALL.

MASONRY: 1-GANG BOX. 2 1/2" DEEP WITH KNOCKOUTS IN 4" CMU/BRICK/CONCRETE; 3 1/2" DEEP WITH KNOCKOUTS IN 6" OR 8" CMU/CONCRETE. COVER EDGE TO BE FLUSH WITH FINISHED WALL.

SURFACE MOUNTED: 1-GANG DIE CAST BOX. 2 5/8" DEEP WITH THREADED OUTLETS.

TYPE 2

RECESSED: 4 11/16" SQUARE BOX. 2 1/8" DEEP WITH KNOCKOUTS. PROVIDE DEVICE EXTENSION AS REQUIRED TO ACCOMMODATE DEVICE COVER SIZE. DEVICE COVER/ RING EDGE TO BE FLUSH WITH FINISHED WALL.

MASONRY: 2-GANG BOX. 2 1/2" DEEP WITH KNOCKOUTS IN 4" CMU/BRICK/CONCRETE; 3 1/2" DEEP WITH KNOCKOUTS IN 6" OR 8" CMU/CONCRETE. COVER EDGE TO BE FLUSH WITH FINISHED WALL.

SURFACE MOUNTED: 2-GANG DIE CAST BOX. 2 5/8" DEEP WITH THREADED OUTLETS.

TYPE 3

RECESSED: 3-GANG BOX. 2 1/2" DEEP WITH KNOCKOUTS. PROVIDE DEVICE EXTENSION AS REQUIRED TO ACCOMMODATE DEVICE COVER SIZE. DEVICE COVER/RING EDGE TO BE FLUSH WITH FINISHED WALL.

MASONRY: 3-GANG BOX. 2 1/2" DEEP WITH KNOCKOUTS IN 4" CMU/BRICK/CONCRETE; 3 1/2" DEEP WITH KNOCKOUTS IN 6" OR 8" CMU/CONCRETE. COVER EDGE TO BE FLUSH WITH FINISHED WALL.

SURFACE MOUNTED: 3-GANG DIE CAST BOX. 2 5/8" DEEP WITH THREADED OUTLETS.

TYPE 4

RECESSED: 4-GANG BOX. 2 1/2" DEEP WITH KNOCKOUTS. PROVIDE DEVICE EXTENSION AS REQUIRED TO ACCOMMODATE DEVICE COVER SIZE. DEVICE COVER/RING EDGE TO BE FLUSH WITH FINISHED WALL.

MASONRY: 4-GANG BOX. 2 1/2" DEEP WITH KNOCKOUTS IN 4" CMU/BRICK/CONCRETE; 3 1/2" DEEP WITH KNOCKOUTS IN 6" OR 8" CMU/CONCRETE. COVER EDGE TO BE FLUSH WITH FINISHED WALL.

SURFACE MOUNTED: 4-GANG DIE CAST BOX. 2 5/8" DEEP WITH THREADED OUTLETS.

TYPE 5

RECESSED: 5" SQUARE BOX. 2 1/2" DEEP WITH KNOCKOUTS. PROVIDE DEVICE EXTENSION AS REQUIRED TO ACCOMMODATE DEVICE COVER SIZE. DEVICE COVER/RING EDGE TO BE FLUSH WITH FINISHED WALL.

TYPE 12

RECESSED: 4 11/16" SQUARE BOX. 2 1/8" DEEP WITH KNOCKOUTS. PROVIDE DEVICE EXTENSION AS REQUIRED TO ACCOMMODATE DEVICE COVER SIZE. DEVICE COVER/ RING EDGE TO BE FLUSH WITH FINISHED WALL.

MASONRY: 1-GANG BOX. 2 1/2" DEEP WITH KNOCKOUTS IN 4" CMU/BRICK/CONCRETE; 3 1/2" DEEP WITH KNOCKOUTS IN 6" OR 8" CMU/CONCRETE. COVER EDGE TO BE FLUSH WITH FINISHED WALL.

SURFACE MOUNTED: 1-GANG DIE CAST BOX. 2 5/8" DEEP WITH THREADED OUTLETS.

TYPE A

JUNCTION BOX (HxWxD) WITH SCREW COVER. PROVIDE NEMA TYPE 1 AT INDOOR LOCATIONS; PROVIDE NEMA TYPE 3R AT OUTDOOR LOCATIONS. PAINTED AT EXPOSED LOCATIONS.

TYPE B

JUNCTION BOX (HxWxD) WITH HINGED COVER. PROVIDE NEMA TYPE 1 AT INDOOR LOCATIONS; PROVIDE NEMA TYPE 3R AT OUTDOOR LOCATIONS. PAINTED AT EXPOSED LOCATIONS.

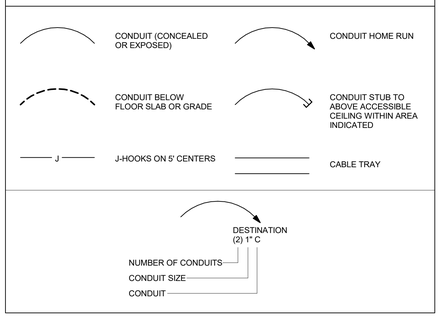
TYPE C

JUNCTION BOX (HxWxD) WITH LOCKING HINGED COVER. PROVIDE NEMA TYPE 1 AT INDOOR LOCATIONS; PROVIDE NEMA TYPE 3R AT OUTDOOR LOCATIONS. PAINTED AT EXPOSED LOCATIONS

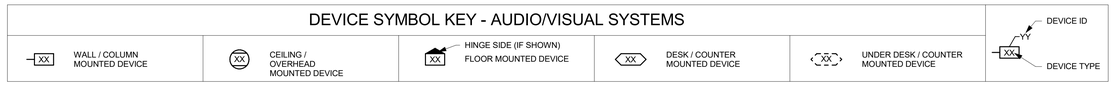
CONDUIT AND PATHWAY NOTES

1. COORDINATE LOCATION OF EQUIPMENT, JUNCTION BOXES, OUTLETS, CONDUIT, ETC. ACCORDING TO THE PROJECT GENERAL CONDITIONS.
2. PROVIDE A COMPLETE RACEWAY SYSTEM TO CONSIST OF METALLIC CONDUIT (EXCLUDING IN-GROUND PATHWAY), JUNCTION BOXES, DEVICE BACK BOXES, AND FITTINGS UNLESS NOTED OTHERWISE.
3. THE DRAWINGS INDICATE ONE ROUTING METHOD OF THE CABLING PATHWAY. CHANGES MAY BE MADE TO THE PATHWAY SYSTEM ROUTING TO ACCOMMODATE SITE CONDITIONS OR TO SIMPLIFY INSTALLATION PROVIDING THAT NOTED CONDUIT SIZE OR LARGER IS MAINTAINED AND DISTANCE LIMITATIONS LISTED BELOW ARE NOT EXCEEDED.
4. CONDUIT STUBS FROM DEVICES TO THE NEAREST CABLE TRAY, ACCESSIBLE CEILING, OR OTHER DESTINATIONS SHALL BE CONTINUOUS.
5. UNLESS NOTED OTHERWISE, CONDUIT IS 3/4 INCH TRADE SIZE.
6. SHOULD ROUGH-IN BOX DEVICE EXIST WITH NO CONDUIT INDICATED TO OR FROM, PROVIDE ¾ INCH TRADE SIZE CONDUIT FROM DEVICE TO ACCESSIBLE CEILING.
7. CONDUIT BODIES (LB'S) ARE NOT PERMITTED.
8. CONDUITS SHALL BE REAMED TO ELIMINATE SHARP EDGES. METALLIC CONDUITS SHALL BE TERMINATED WITH AN INSULATED BUSHING. PULL STRINGS WITH A MINIMUM PULL RATING OF 400 POUNDS SHALL BE PROVIDED.
9. FOR CONDUIT WITH AN INTERNAL DIAMETER GREATER THAN 2 INCHES, MAINTAIN A BEND RADIUS OF AT LEAST 10 TIMES THE INTERNAL CONDUIT DIAMETER.
10. BENDS IN THE CONDUIT SHALL NOT CONTAIN ANY KINKS OR OTHER DISCONTINUITIES. FLEX IS NOT PERMITTED UNLESS NOTED OTHERWISE.
11. NO SECTION OF CONDUIT SHALL EXCEED 100 FEET. RUNS IN EXCESS OF 100 FEET REQUIRE A PULL BOX / HANDHOLE / VAULT.
12. NO SECTION OF CONDUIT SHALL CONTAIN MORE THAN TWO 90 DEGREE BENDS, OR EQUIVALENT 180 DEGREES, BETWEEN PULL BOXES.
13. PULL BOX SHALL NOT BE USED IN LIEU OF A BEND. CONDUITS MUST RUN STRAIGHT THROUGH A PULL BOX WITH THE BEND LOCATED EITHER BEFORE OR AFTER THE PULL BOX.
14. PULL BOX LENGTH TO BE NO LESS THAN 8 TIMES THE DIAMETER OF THE LARGEST TERMINATING CONDUIT. PULL BOX WIDTH TO BE NO LESS ¼ THE LENGTH.
15. PROVIDE COVERS WITH LABELING FOR JUNCTION BOXES, BACK BOXES AND PULL BOXES WITHOUT FACEPLATES. LABELING MATCHES DEVICE NAME AS INDICATED ON DRAWINGS, FOR EXAMPLE "AV1", "ML".
16. ALL CONDUITS ENTERING OR EXITING EQUIPMENT RACKS TO BE ISOLATED WITH A NON-METALLIC SPACER OR FITTING.
17. PROVIDE CONDUIT TO CROSS INACCESSIBLE CEILINGS OR IN AREAS WITHOUT CEILINGS UNLESS NOTED OTHERWISE
18. PROVIDE CONDUIT IN EXPOSED AREAS, MECHANICAL SPACES, FOOD SERVICES AREAS, AND ELEVATOR CONTROL ROOMS.
19. REGARDLESS OF PATHWAY TYPE, ALL CABLING SHALL BE SUPPORTED AT 5 FEET MAXIMUM INTERVALS. CABLES SHALL NOT BE LAID DIRECTLY ON THE CEILING TILE OR RAILS OR STRAPPED TO CONDUIT.
20. ROUTE CONDUIT WITH OTHER BUILDING SERVICES AND CONCEAL WHENEVER POSSIBLE. GROUP AND RUN PARALLEL ALONG A SINGLE BUILDING COLUMN LINE, HOLD TIGHT TO STRUCTURE AND PAINT AS DIRECTED BY THE ARCHITECT.
21. IF AV AND POWER CONDUITS MUST CROSS, CROSS AT RIGHT ANGLES.
22. FOR IN-SLAB OR UNDERGROUND CONDUIT ENTERING A BUILDING, TRANSITION BACK TO METALLIC CONDUIT WITHIN 3 FEET OF THE ENTRY POINT.
23. REFER TO PROJECT MANUAL FOR FIRE STOPPING REQUIREMENTS.
24. REFER TO ELECTRICAL DRAWINGS AND PROJECT MANUAL FOR ADDITIONAL REQUIREMENTS.

PATHWAY DISTRIBUTION



DEVICE SYMBOL KEY - AUDIO/VISUAL SYSTEMS



SYMBOL LEGEND - AUDIO/VISUAL SYSTEMS

SIZES, DIMENSIONS AND NOTES DESCRIBE TYPICAL REQUIREMENTS. IF APPLICABLE, VARIATIONS AND/OR ADDITIONAL REQUIREMENTS WILL BE NOTED ON THE DRAWINGS.
UNLESS NOTED OTHERWISE, MOUNTING HEIGHTS ARE TO CENTER OF ROUGH-IN BOX.

TYPE	DEVICE	ROUGH-IN BOX (H"xW"xD")	DEVICE COVER SIZE	MOUNTING HEIGHT			DEVICE NOTES	CONDUIT NOTES
				WALL/COLUMN	CEILING/OVERHEAD	FLOOR		
AV3	AV PLATE	TYPE 3	3-GANG	BUILDING OUTLET HEIGHT	FLUSH IN CEILING	--	--	REF PLANS
AVF	FIELD AV PANEL	TYPE A (10"x10"x4")	--	1'-6" AFF UNLESS NOTED OTHERWISE	--	--	REQUIRES WEATHER PROOF COVER	REF PLANS
DB	DISPLAY LOCATION	--	--	COORDINATE WITH ARCHITECT	<varies>	--	REF DETAILS IN AV11 SERIES	REF PLANS AND DETAILS
DB1	DISPLAY LOCATION	--	--	COORDINATE WITH ARCHITECT	--	--	REF DETAILS IN AV11 SERIES	REF PLANS AND DETAILS
DB2	DISPLAY LOCATION	--	--	COORDINATE WITH ARCHITECT	--	--	REF DETAILS IN AV11 SERIES	REF PLANS AND DETAILS
DTV NODE	HFC NODE	--	--	4'-0" AFF	--	--	WALL MOUNT ON 4' x 4' PLYWOOD BACKBOARD; REF DETAIL	(1) 2" C TO CABLE TRAY
JB	JUNCTION BOX	TYPE A (12"x12"x4")	--	REF ELEVATIONS/DETAILS	--	--	--	REF PLANS
JBT	NETWORK BROADCAST CONNECTION JUNCTION BOX	--	--	--	--	--	REF BROADCAST BOX SCHEDULE AND DETAILS	REF PLANS
SB	SCOREBOARD JUNCTION BOX	TYPE 2	2-GANG	REF PLANS/ELEVATIONS	--	--	--	REF PLANS
TP	TOUCH PANEL	TYPE 2	--	BUILDING SWITCH HEIGHT	--	--	--	REF PLANS
VS	VOLUME SELECT PLATE	TYPE 12	1-GANG	BUILDING SWITCH HEIGHT	--	--	--	REF PLANS

LEGEND NOTES - AUDIO/VIDEO SYSTEMS

1 PROVIDE HOFFMAN PAINTED STEEL TYPE 1 SCREW COVER PULL BOX NO LESS THAN 12" W X 12" H X 4" D UNLESS NOTED OTHERWISE. SIZE JUNCTION BOX TO NUMBER AND SIZE OF CONDUIT. PROVIDE 3/4" VOID FREE AC PLYWOOD WITH TWO COATS FIRE RETARDANT WHITE PAINT ON BACK WALL OF JUNCTION BOX FROM SIDEWALL TO SIDEWALL. A SINGLE WIRING THROUGH WILL NOT BE ACCEPTEDABLE AS A REPLACEMENT TO/FOR INDIVIDUAL JUNCTION BOXES.

2 CRITICAL DIMENSIONS ARE NOTED IN DOCUMENTATION. FOR ANY DIMENSION THAT IS NOT PROVIDED, FILED COORDINATE FINAL LOCATION.

3 FIELD COORDINATE PLANT/PANEL COVER SIZE BASED ON MOUNTING CONDITIONS. SURFACE MOUNTED ROUGH-IN PLATE/PANEL SHOULD NOT EXTEND BEYOND THE ROUGH-IN BOX.

DEVICE SYMBOL KEY - SPEAKER SYSTEMS

SYMBOL LEGEND - SPEAKER SYSTEMS

SIZES, DIMENSIONS AND NOTES DESCRIBE TYPICAL REQUIREMENTS. IF APPLICABLE, VARIATIONS AND/OR ADDITIONAL REQUIREMENTS WILL BE NOTED ON THE DRAWINGS.
UNLESS NOTED OTHERWISE, MOUNTING HEIGHTS ARE TO CENTER OF ROUGH-IN BOX.

TYPE	DEVICE	ROUGH-IN BOX (H"xW"xD")	DEVICE COVER SIZE	MOUNTING HEIGHT			DEVICE NOTES	CONDUIT NOTES
				WALL/COLUMN	CEILING/OVERHEAD	FLOOR		
1	SPEAKER	TYPE 2	--	--	--	--	--	REF PLANS
2	SPEAKER	TYPE 2	--	--	--	--	--	REF PLANS
3	SPEAKER	TYPE 2	--	--	--	--	--	REF PLANS
4	SPEAKER	TYPE 2	--	--	--	--	--	REF PLANS
5	SPEAKER	TYPE 2	--	--	--	--	--	REF PLANS
6	SPEAKER	TYPE 2	--	--	--	--	--	REF PLANS
7	SPEAKER	TYPE 2	--	--	--	--	--	REF PLANS
8	SPEAKER	TYPE 2	--	--	--	--	--	REF PLANS
9	SPEAKER	TYPE 2	--	--	--	--	--	REF PLANS
10	SPEAKER	TYPE 2	--	--	--	--	--	REF PLANS
11	SPEAKER	TYPE 2	--	--	--	--	--	REF PLANS
12	SPEAKER	TYPE 2	--	--	--	--	--	REF PLANS
13	SPEAKER	TYPE 2	--	--	--	--	--	REF PLANS
14	SPEAKER	TYPE 2	--	--	--	--	--	REF PLANS
15	SPEAKER	TYPE 2	--	--	--	--	--	REF PLANS
16	SPEAKER	TYPE 2	--	--	--	--	--	REF PLANS
17	SPEAKER	TYPE 2	--	--	--	--	--	REF PLANS
18	SPEAKER	TYPE 2	--	--	--	--	--	REF PLANS
19	SPEAKER	TYPE 2	--	--	--	--	--	REF PLANS
20	SPEAKER	TYPE 2	--	--	--	--	--	REF PLANS

LEGEND NOTES - SPEAKER SYSTEMS

1 NOTE 1

2 NOTE 2

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PROJECT
HAGERSTOWN BALLPARK
CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT
ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT
MD STADIUM AUTHORITY
CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS
CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388
STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348
MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
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tel - 972-934-3700
PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488
GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
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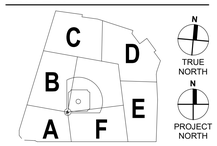

SHEET TITLE
GENERAL NOTES AND LEGENDS

SHEET NUMBER
AV000

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ARCH E1 30" x 42"

KEYNOTES

A01 AV_SITE PLAN

1" = 30'-0" re: A01 / AV301

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CORNER OF
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HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

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CAPITAL FOODSERVICE DESIGN
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MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
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WILLIAMSPORT, MD, 21795
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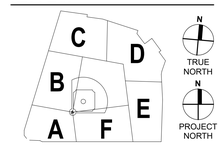

SHEET TITLE

SITE PLAN

SHEET NUMBER

AV001

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KEYNOTES	
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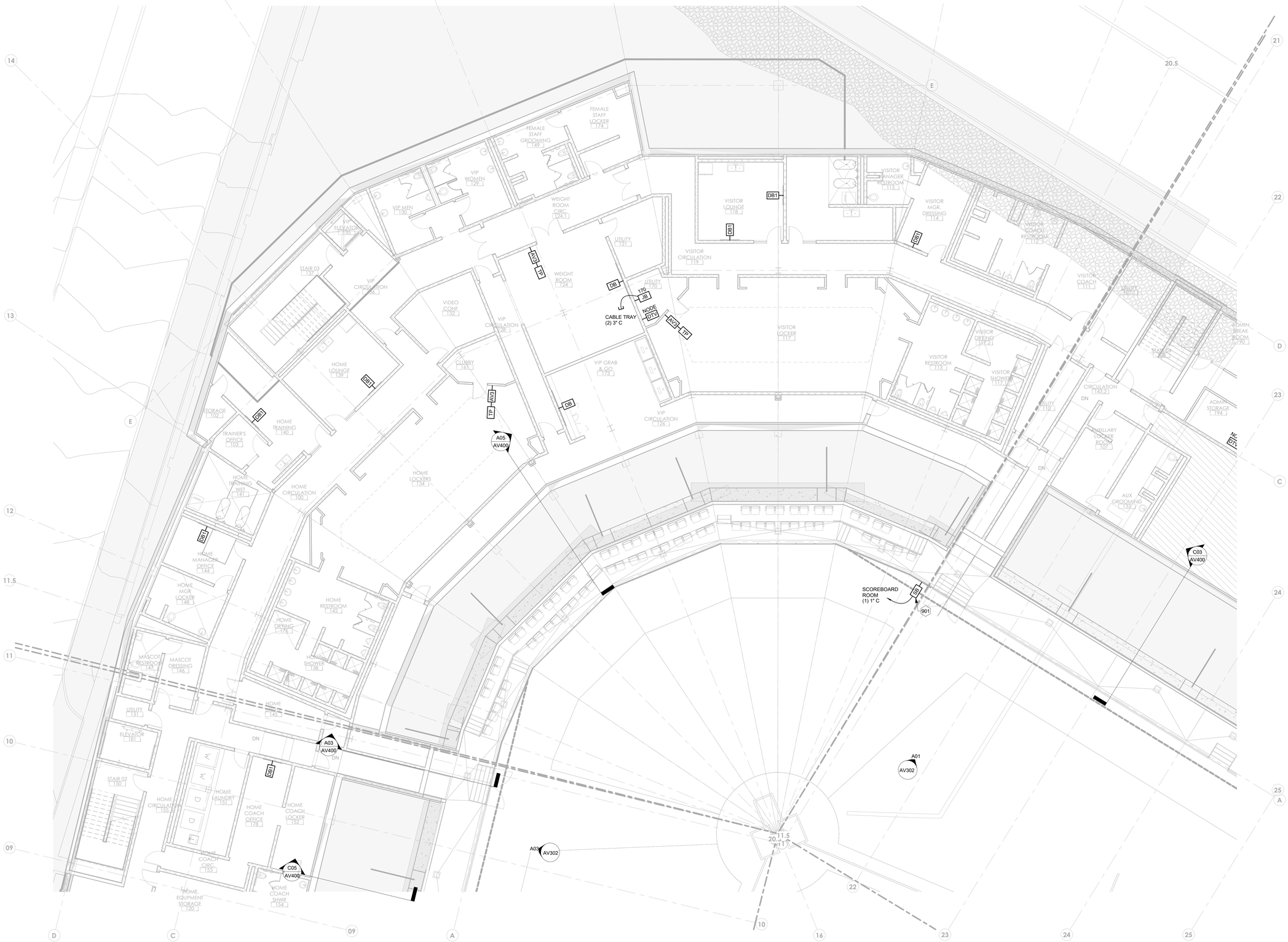

A01 AV_FIELD LEVEL - HOME PLATE

1/8" = 1'-0" | re: A01 / AV301

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HAGERSTOWN BALLPARK

CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
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CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
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10228 GOVERNOR LANE, STE 3007
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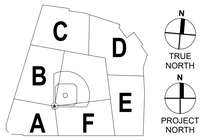

SHEET TITLE

QUADRANT PLAN

SHEET NUMBER

AV102.1

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ARCH E1 30" x 42"

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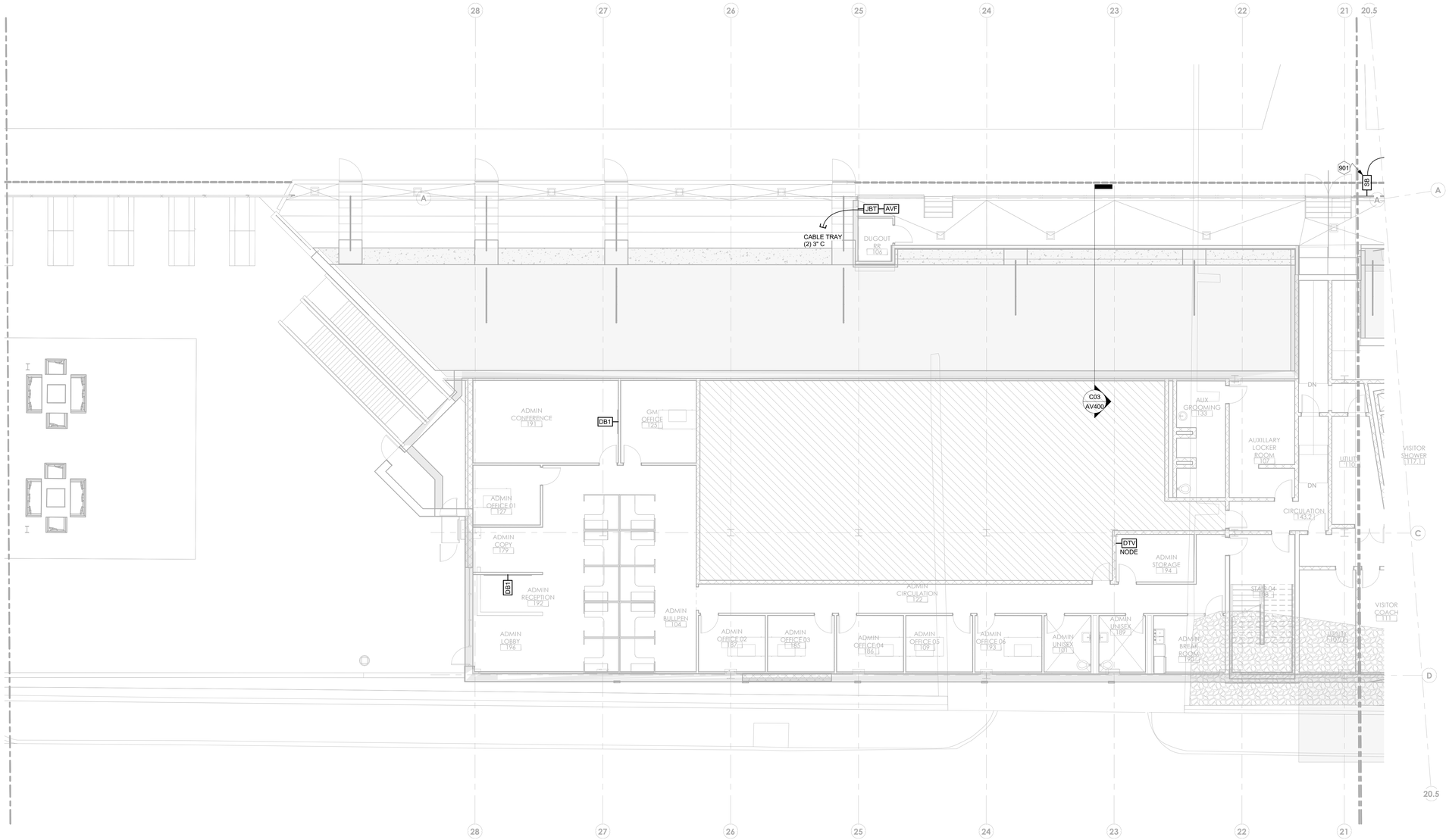
KEYNOTES	
901	PACE OF PLAY CLOCK.



A01 AV_FIELD LEVEL - THIRD BASE LINE

1/8" = 1'-0" | re: A01 / AV301

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PROJECT

HAGERSTOWN BALLPARK

CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
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MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
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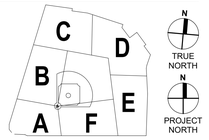

SHEET TITLE

QUADRANT PLAN

SHEET NUMBER

AV102.2

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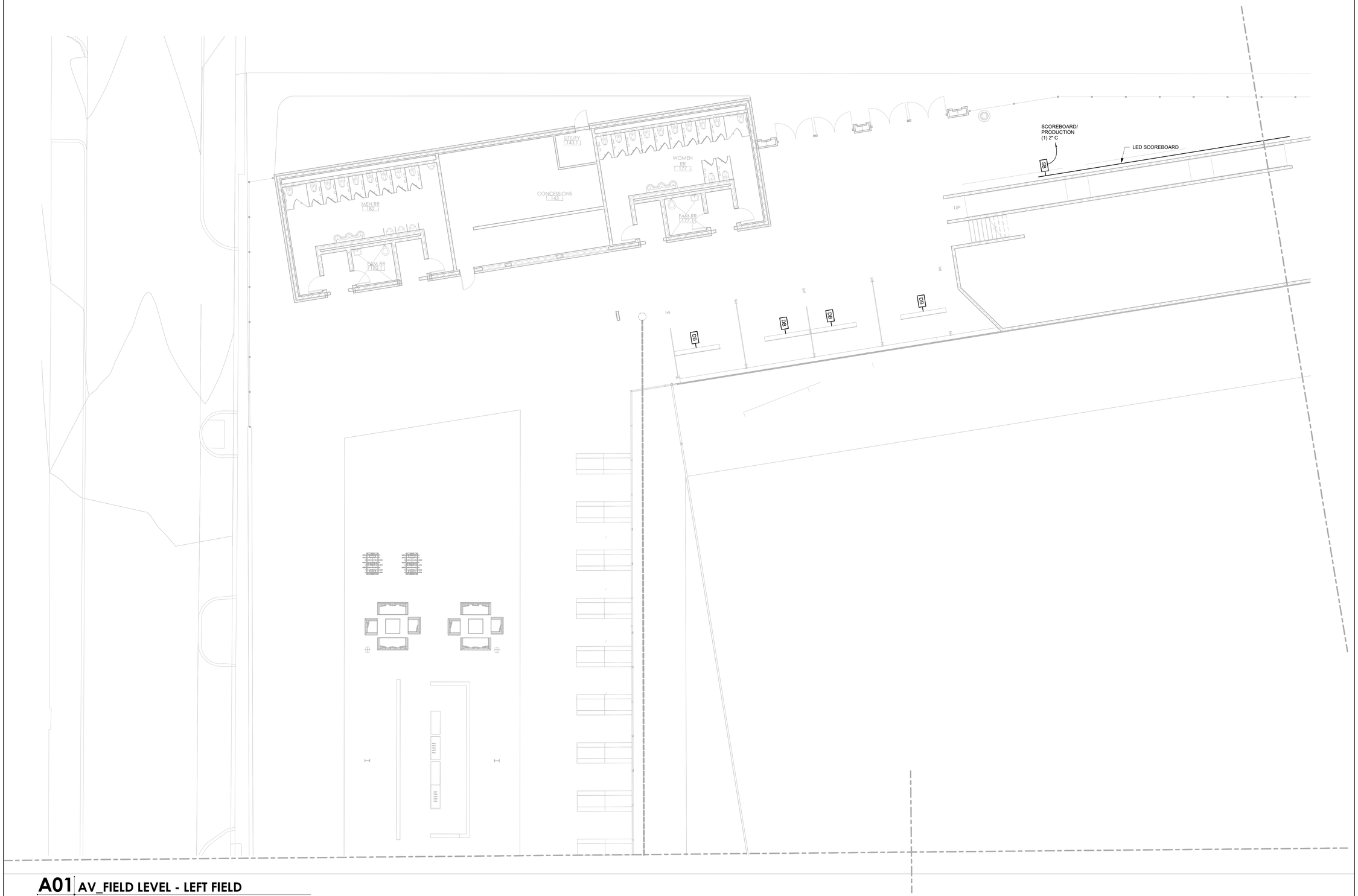
ARCH E1 30" x 42"

ARCH E1 30" x 42"

KEYNOTES



A01 AV_FIELD LEVEL - LEFT FIELD

1/8" = 1'-0" | re: A01 / AV301

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CORNER OF
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HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

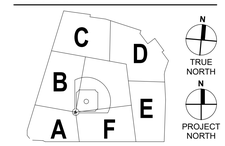
GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

Project **20220903_MSA**
Issued: 08/15/2022

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN



SHEET TITLE

QUADRANT PLAN

SHEET NUMBER

AV102.3

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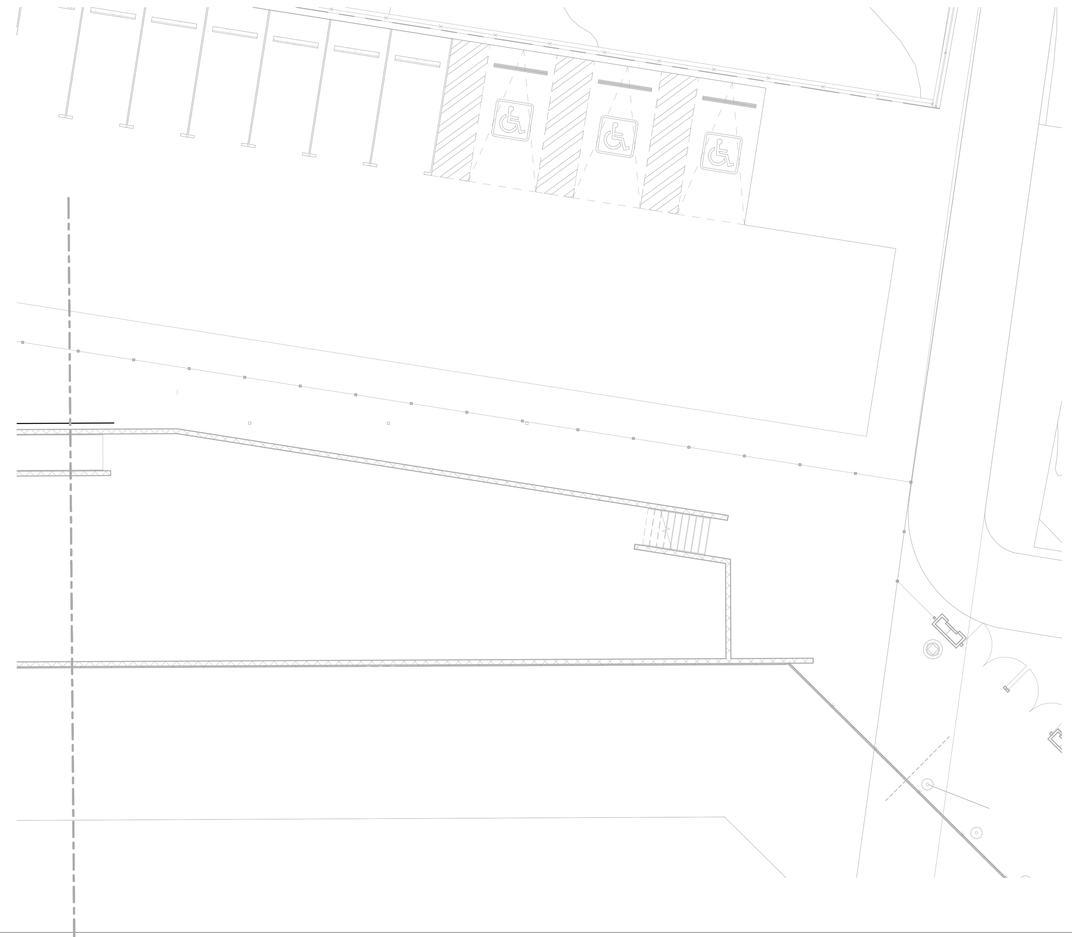
ARCH E1 30" x 42"

KEYNOTES



A01 AV_FIELD LEVEL - LEFT CENTER FIELD

1/8" = 1'-0" | re: A01 / AV301

PENDULUM

PROJECT

HAGERSTOWN BALLPARK
CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY
CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

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HILLIS CARNES
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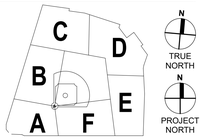

SHEET TITLE

QUADRANT PLAN

SHEET NUMBER

AV102.4

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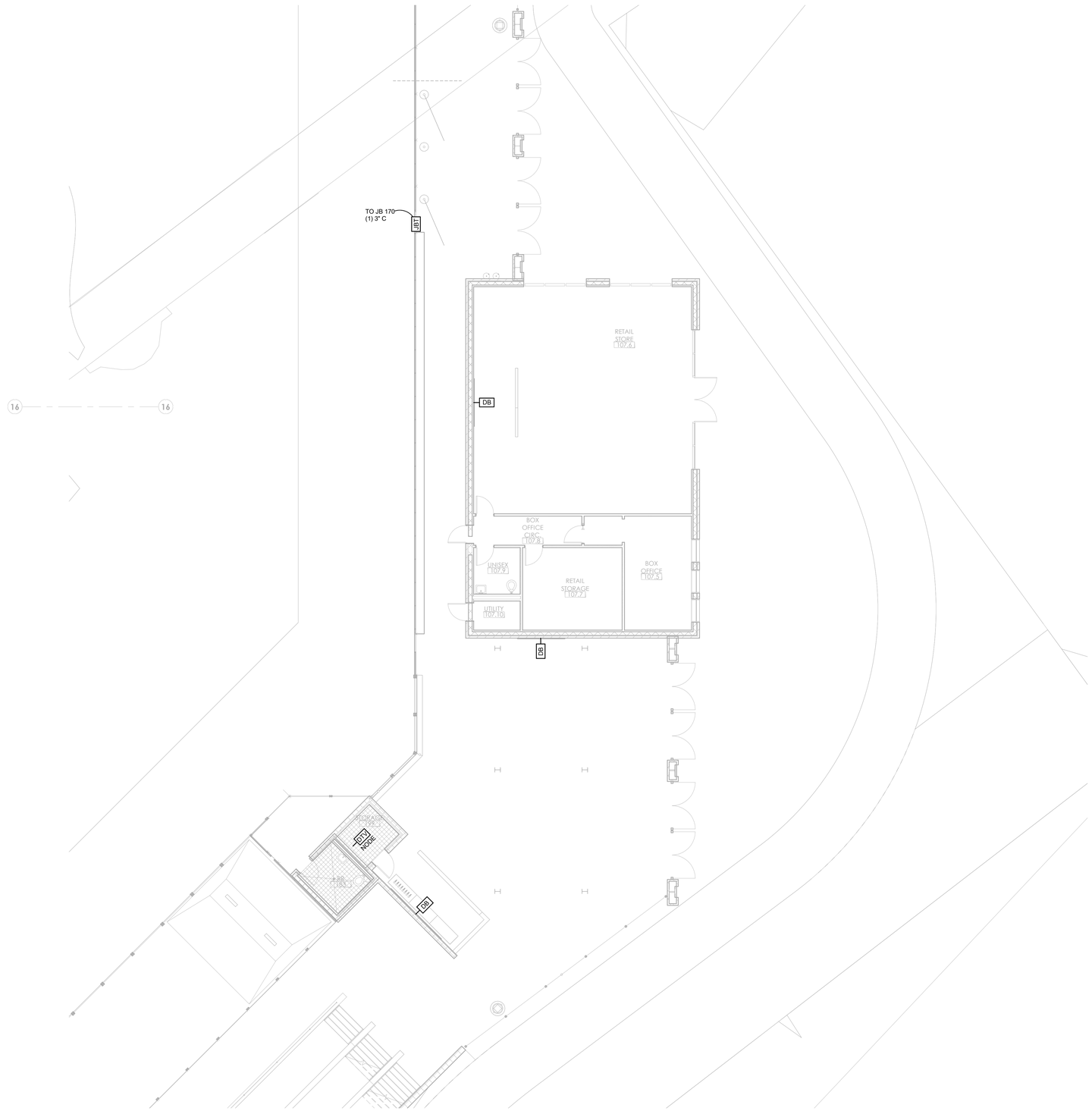
ARCH E1 30" x 42"

KEYNOTES



A01 AV_FIELD LEVEL - CENTER FIELD

1/8" = 1'-0" | re: A01 / AV301

PENDULUM

PROJECT

HAGERSTOWN BALLPARK
CORNER OF
SUMMIT AVE AND BALTIMORE ST
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ARCHITECT

ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
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CLIENT

MD STADIUM AUTHORITY
CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
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CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
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PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
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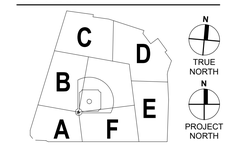

SHEET TITLE

QUADRANT PLAN

SHEET NUMBER

AV102.5

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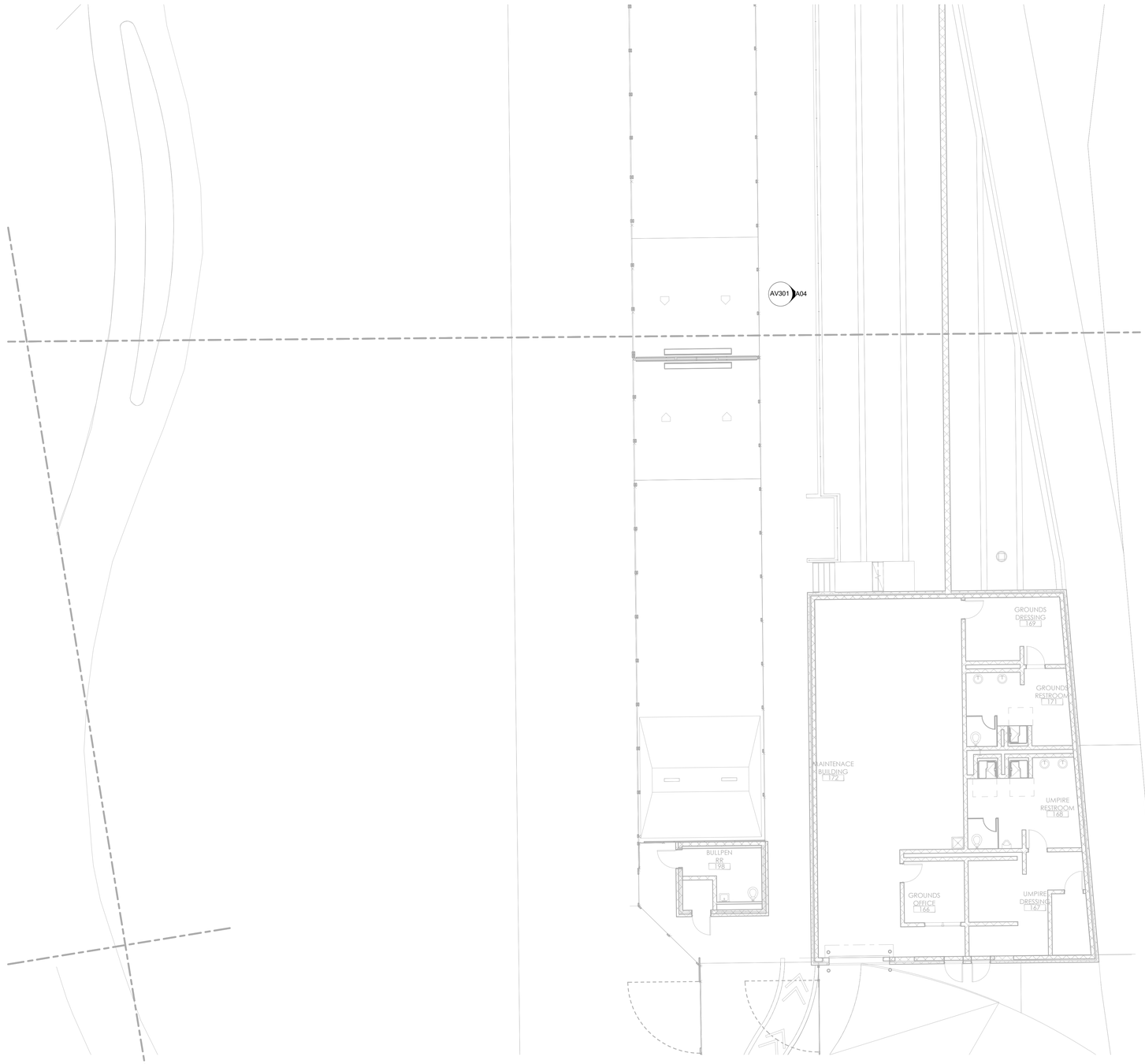
ARCH E1 30" x 42"

KEYNOTES



A01 AV_FIELD LEVEL - RIGHT CENTER FIELD

1/8" = 1'-0" | re: A01 / AV301

PENDULUM

PROJECT

HAGERSTOWN BALLPARK

CORNER OF
SUMMIT AVE AND BALTIMORE ST
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ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

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CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
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AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
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KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
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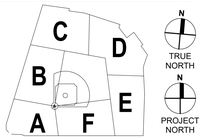

SHEET TITLE

QUADRANT PLAN

SHEET NUMBER

AV102.6

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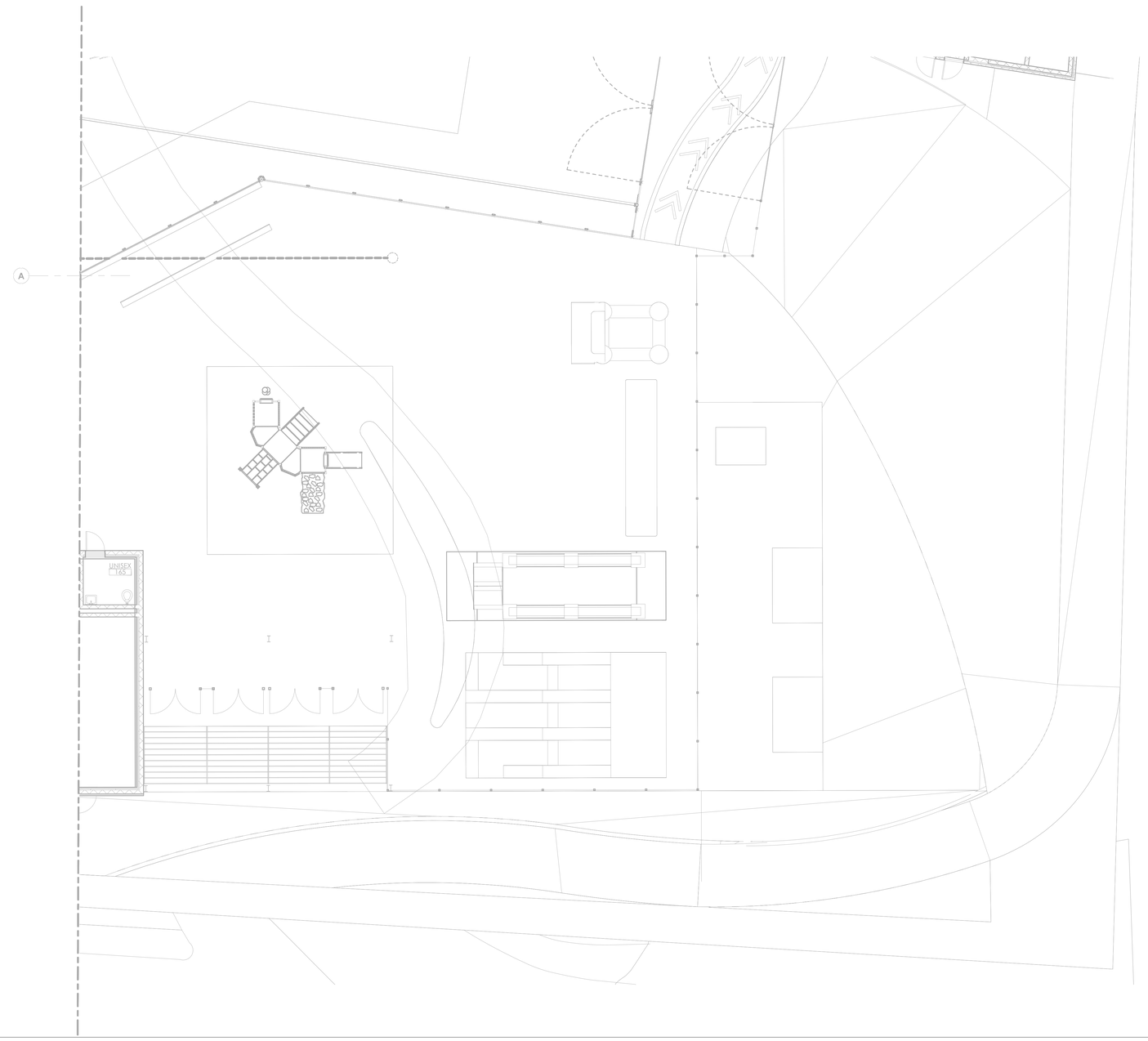
01 02 03 04 05 06 07 08 09 10

ARCH E1 30" x 42"

KEYNOTES



A01 AV_FIELD LEVEL - RIGHT FIELD

1/8" = 1'-0" | re: A01 / AV301

PENDULUM

PROJECT

HAGERSTOWN BALLPARK

CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
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Project **20220903_MSA**
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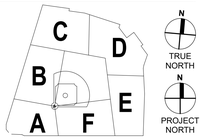

SHEET TITLE

QUADRANT PLAN

SHEET NUMBER

AV102.7

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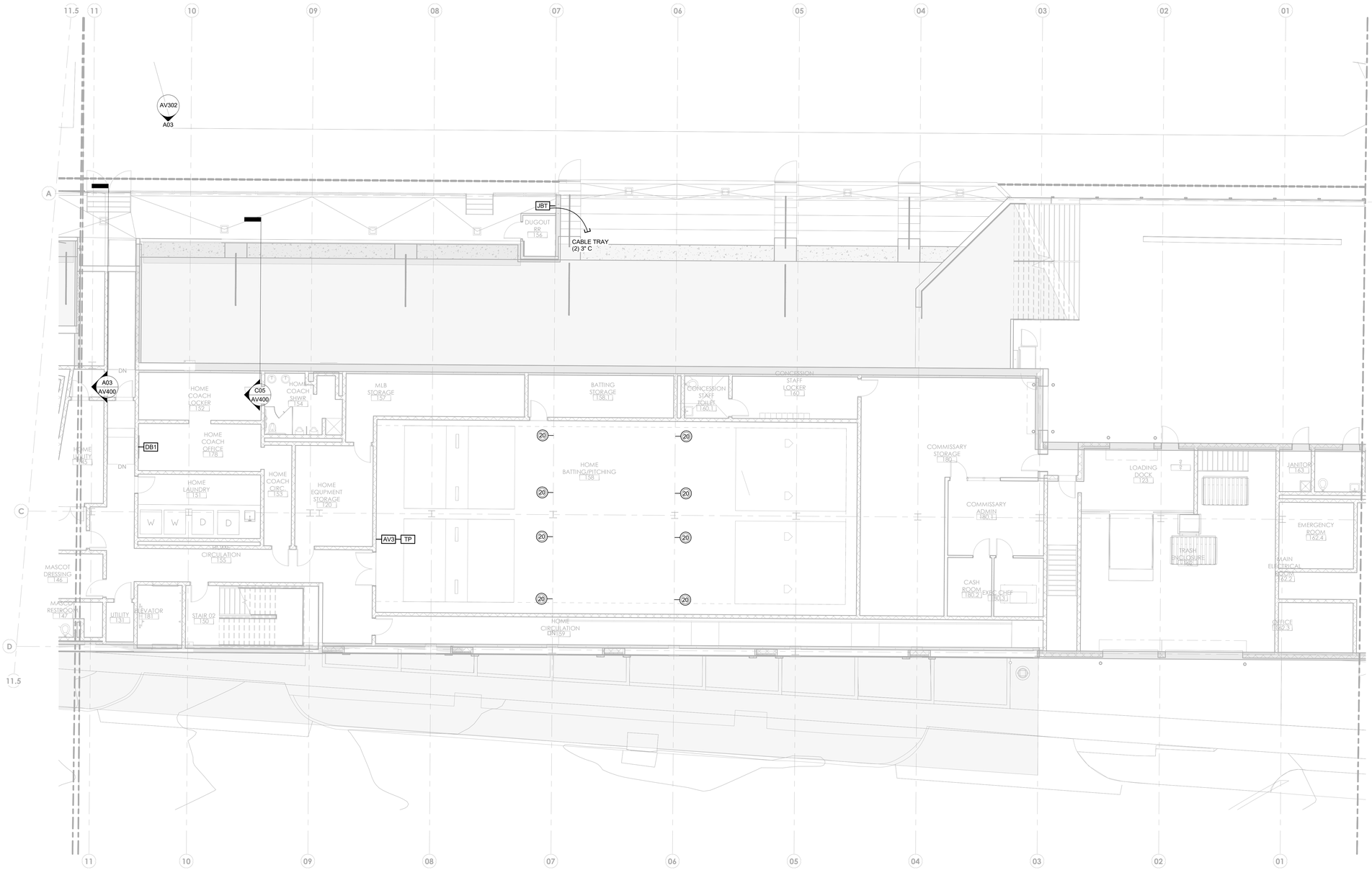
ARCH E1 30" x 42"

KEYNOTES



A01 AV_FIELD LEVEL - FIRST BASE LINE

1/8" = 1'-0" | re: A01 / AV301

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PENDULUM

PROJECT

HAGERSTOWN BALLPARK

CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

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MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
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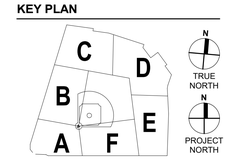

SHEET TITLE

QUADRANT PLAN

SHEET NUMBER

AV102.8

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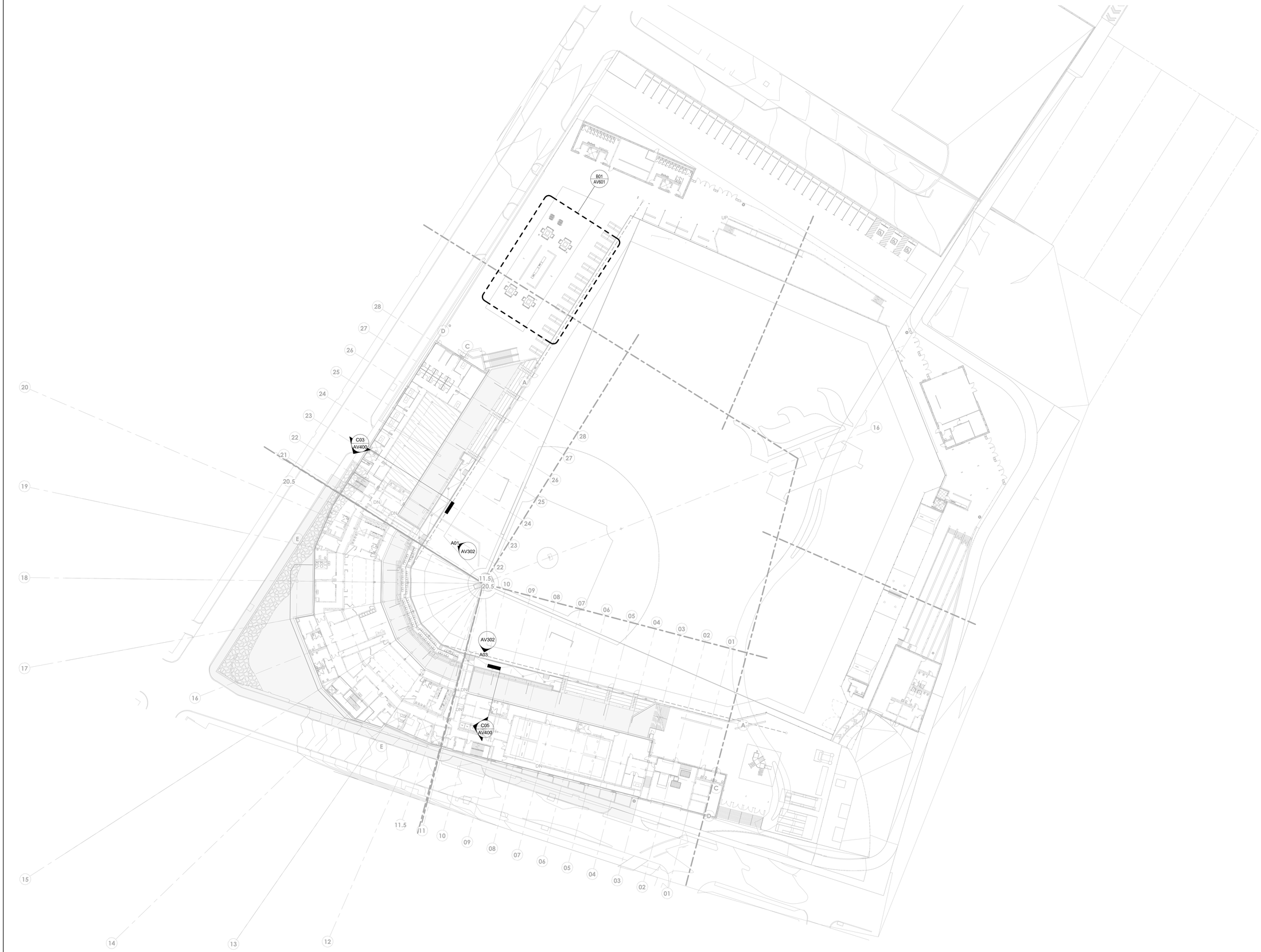
ARCH E1 30" x 42"

KEYNOTES



A01 AV_FIELD LEVEL

1" = 30'-0" | re: A01 / AV301

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PENDULUM

PROJECT

HAGERSTOWN BALLPARK

CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
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AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
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KIMLEY HORN
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KANSAS CITY, MO, 64105
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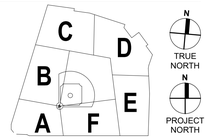

SHEET TITLE

FIELD LEVEL REFERENCE PLAN

SHEET NUMBER

AV102

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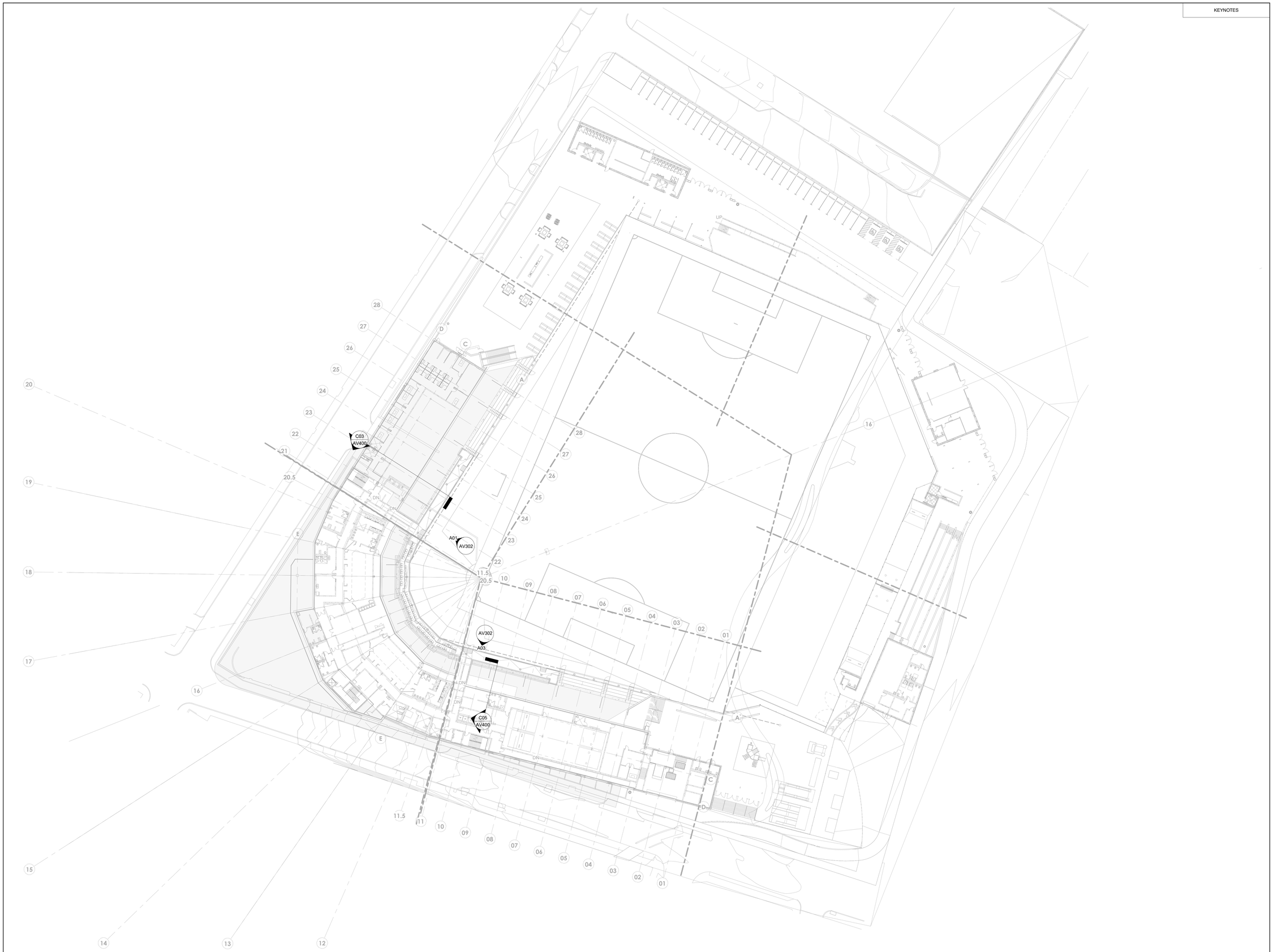
ARCH E1 30" x 42"

KEYNOTES



A01 AV_SOCCER PITCH LAYOUT

1" = 30'-0" re: A01 / AV301

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PENDULUM

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ARCHITECT

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PENDULUM STUDIO LLC
1512 Holmes
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CLIENT

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CONSULTANTS

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SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
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STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
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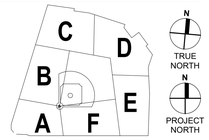

SHEET TITLE

FIELD LEVEL REFERENCE PLAN - SOCCER

SHEET NUMBER

AV103

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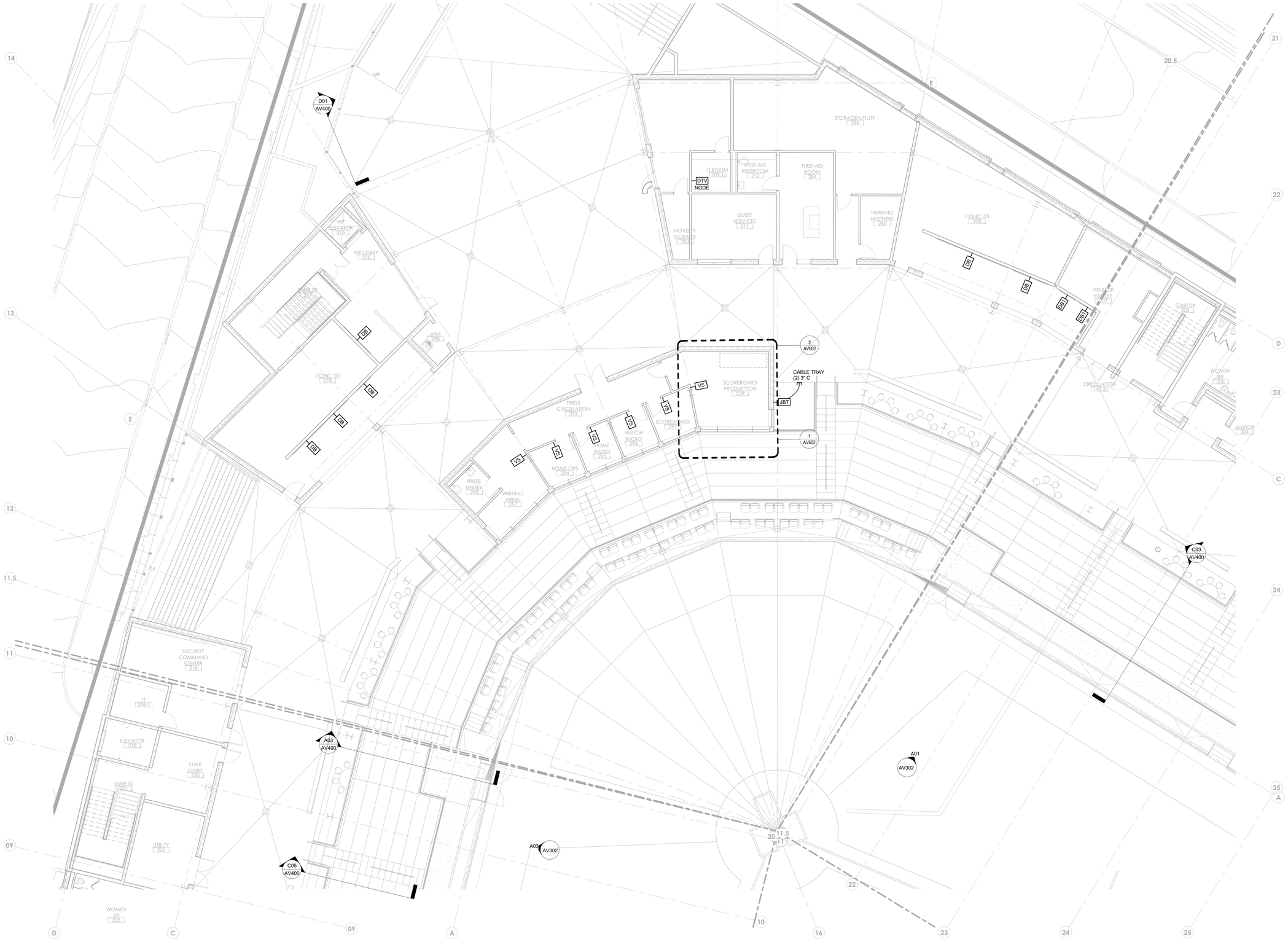
ARCH E1 30" x 42"

KEYNOTES



A01 AV_MAIN CONCOURSE - HOME PLATE

1/8" = 1'-0" re: A01 / AV300

PENDULUM

PROJECT

HAGERSTOWN BALLPARK

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PENDULUM STUDIO LLC
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THORNTON TOMASETTI
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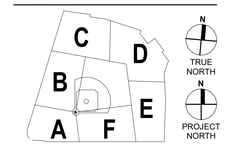
Issued: 08/15/2022

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN



SHEET TITLE

QUADRANT PLAN

SHEET NUMBER

AV104.1

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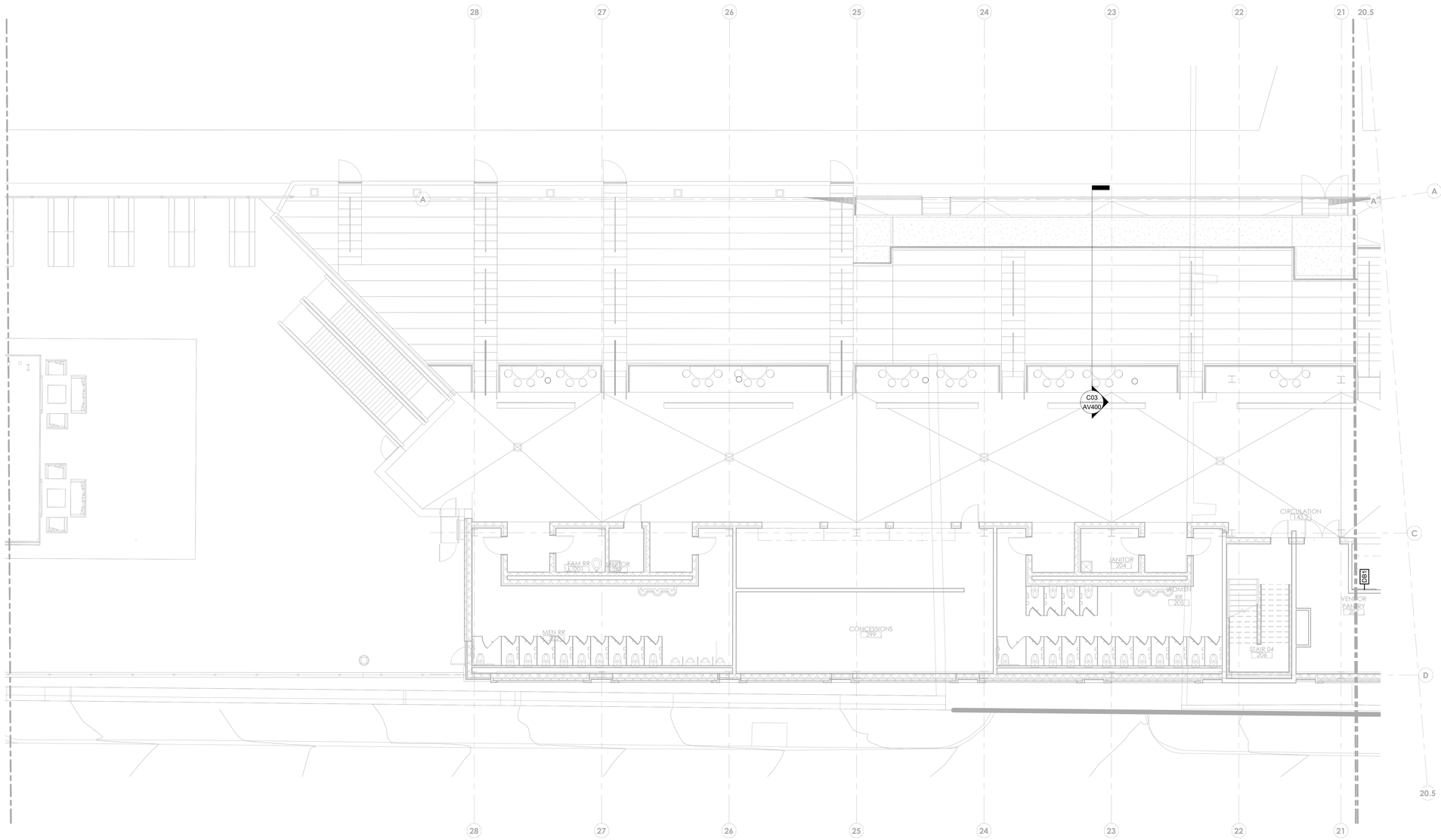
ARCH E1 30" x 42"

KEYNOTES



A01 AV_MAIN CONCOURSE - THIRD BASE LINE

1/8" = 1'-0" re: A01 / AV300

Project Management Initials:
Designer: Designer Checked: Checker Approved: Approver
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PENDULUM

PROJECT

HAGERSTOWN BALLPARK

CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
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tel - 608-514-4373

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WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
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10228 GOVERNOR LANE, STE 3007
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Project **20220903_MSA**
Issued: 08/15/2022

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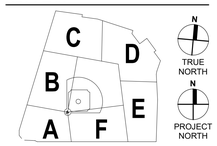

SHEET TITLE

QUADRANT PLAN

SHEET NUMBER

AV104.2

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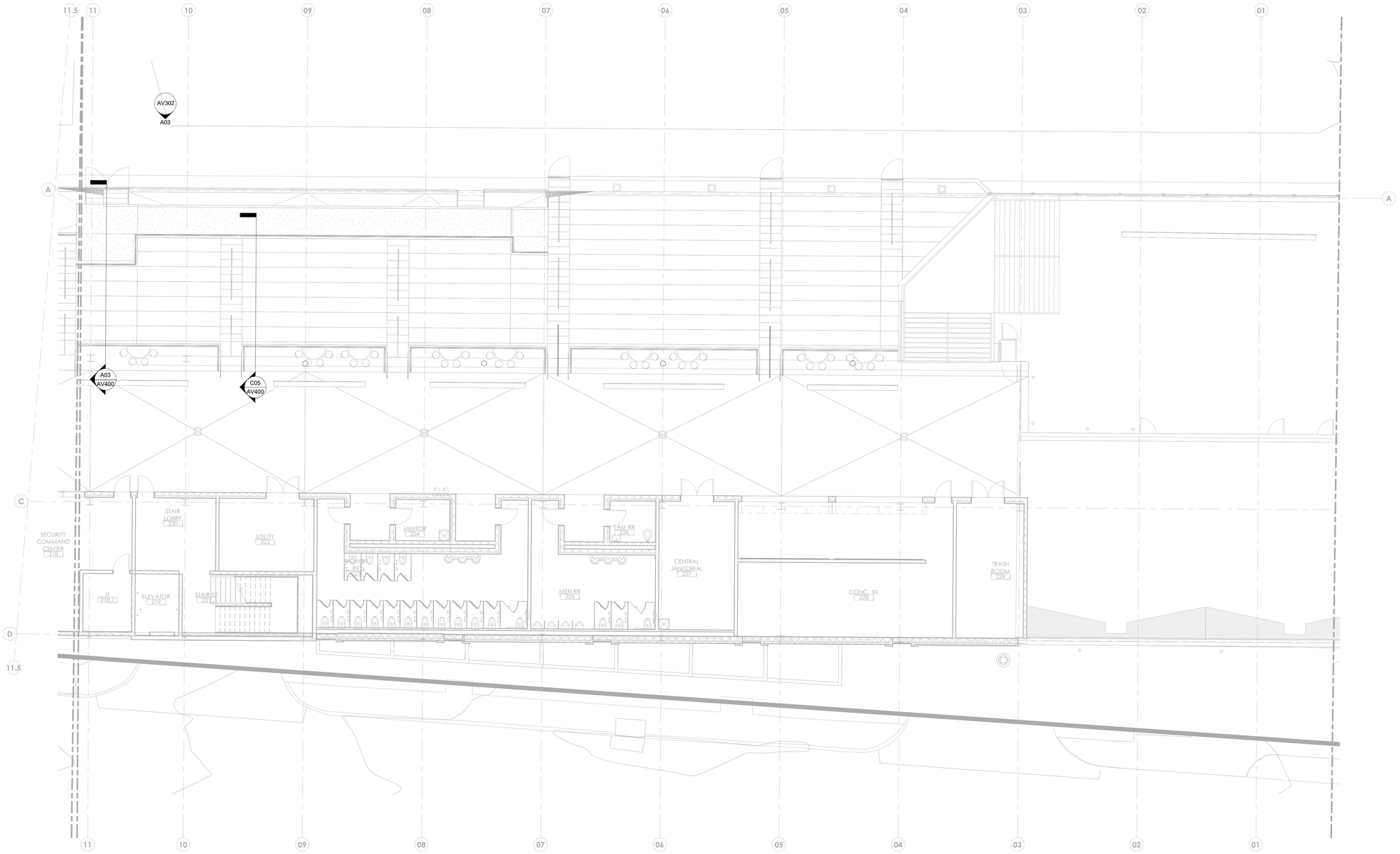
ARCH E1 30" x 42"

KEYNOTES



A01 AV_MAIN CONCOURSE - FIRST BASE LINE

1/8" = 1'-0" re: A01 / AV300

PENDULUM

PROJECT

HAGERSTOWN BALLPARK

CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
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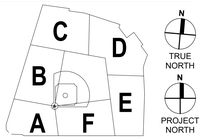

SHEET TITLE

QUADRANT PLAN

SHEET NUMBER

AV104.8

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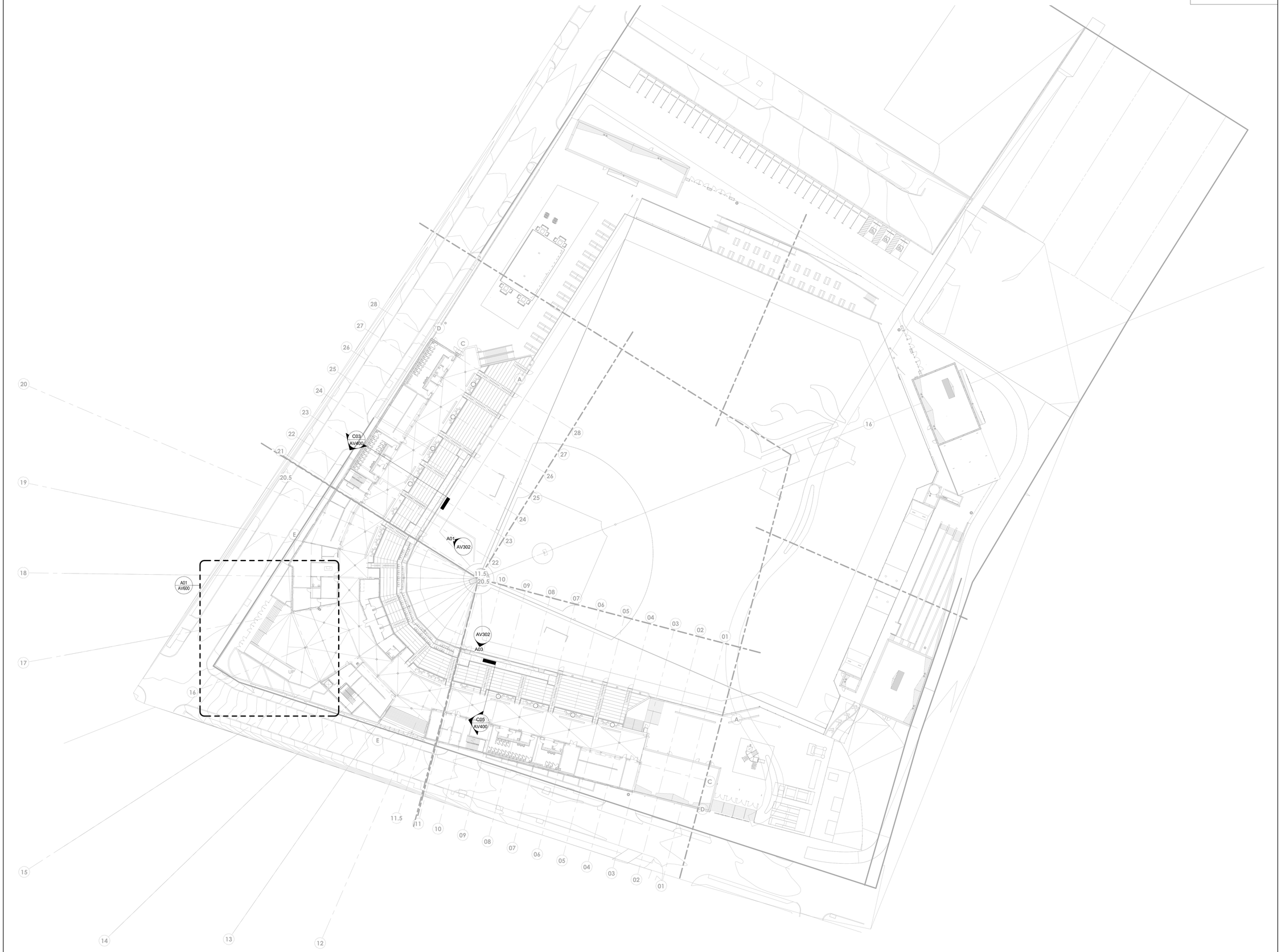
ARCH E1 30" x 42"

KEYNOTES



A01 AV_MAIN CONCOURSE LEVEL

1" = 30'-0" re: A01 / AV300

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HAGERSTOWN BALLPARK

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ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
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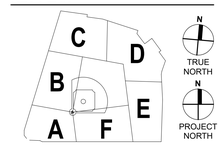

SHEET TITLE

MAIN CONCOURSE REFERENCE PLAN

SHEET NUMBER

AV104

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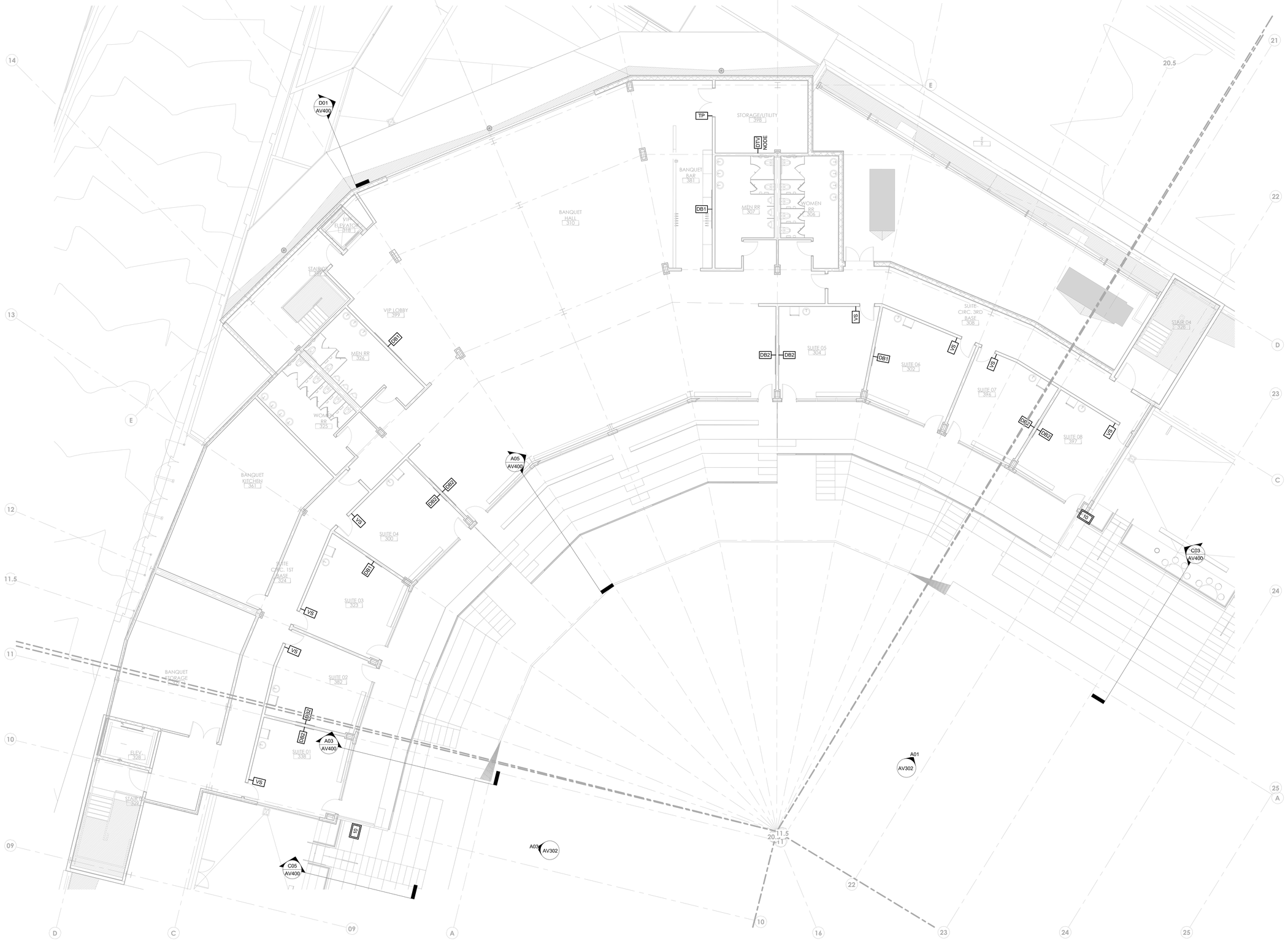
ARCH E1 30" x 42"

KEYNOTES



A01 AV_SUITE LEVEL - HOME PLATE

1/8" = 1'-0" | re: A01 / AV300

PENDULUM

PROJECT

HAGERSTOWN BALLPARK
CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY
CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
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FOOD SERVICE
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MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
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Project **20220903_MSA**
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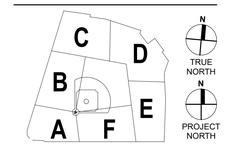

SHEET TITLE

QUADRANT PLAN

SHEET NUMBER

AV105.1

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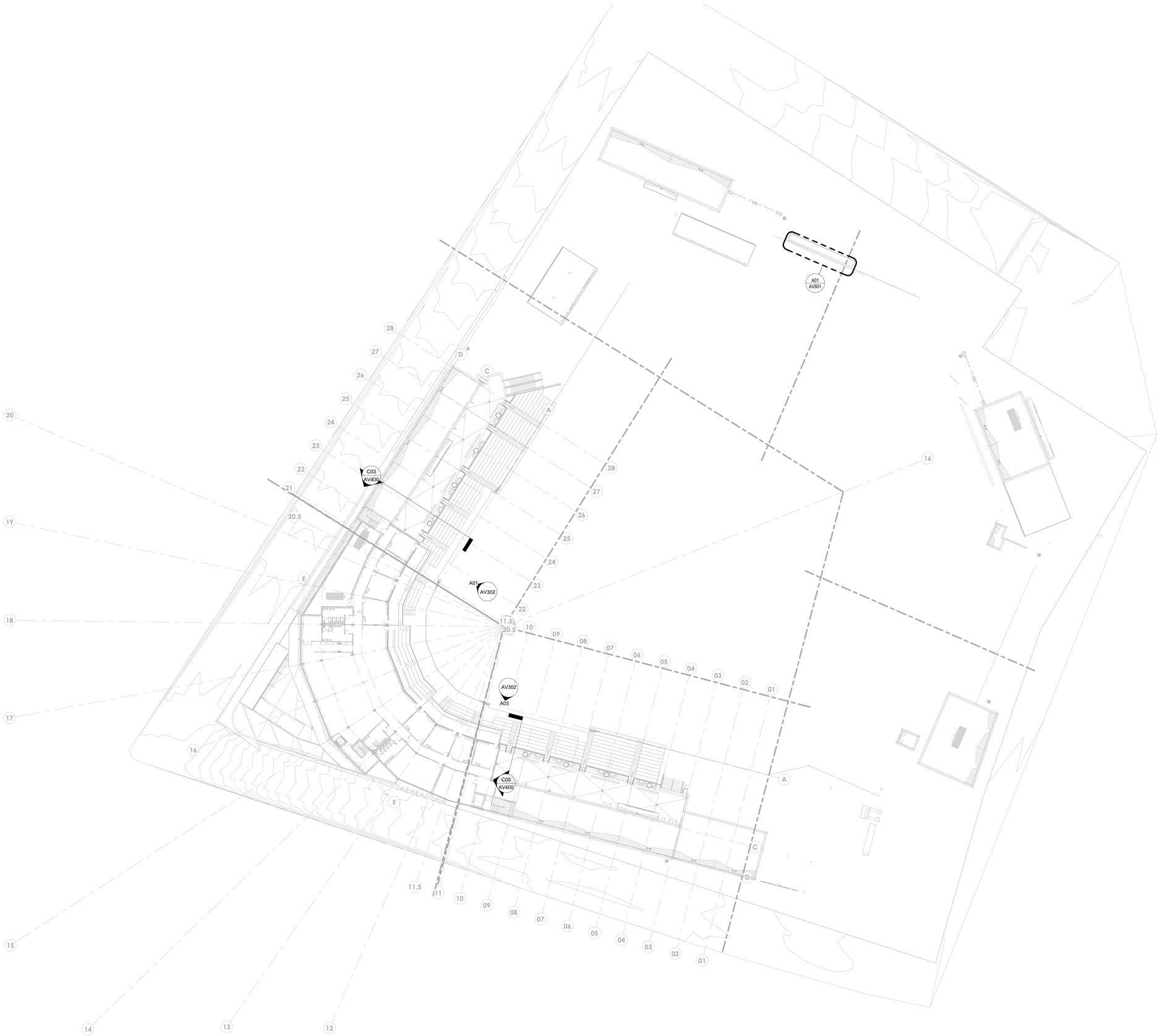
ARCH E1 30" x 42"

KEYNOTES



A01 AV_SUITE LEVEL

1" = 30'-0" | re: A01 / AV300

Project Management Initials:
Designer: Designer Checker: Checker Approver: Approver
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PENDULUM

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HAGERSTOWN BALLPARK

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HAGERSTOWN, MD

ARCHITECT

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PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
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MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
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12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

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HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
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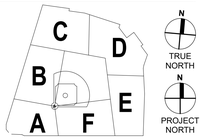

SHEET TITLE

PREMIUM LEVEL REFERENCE PLAN

SHEET NUMBER

AV105

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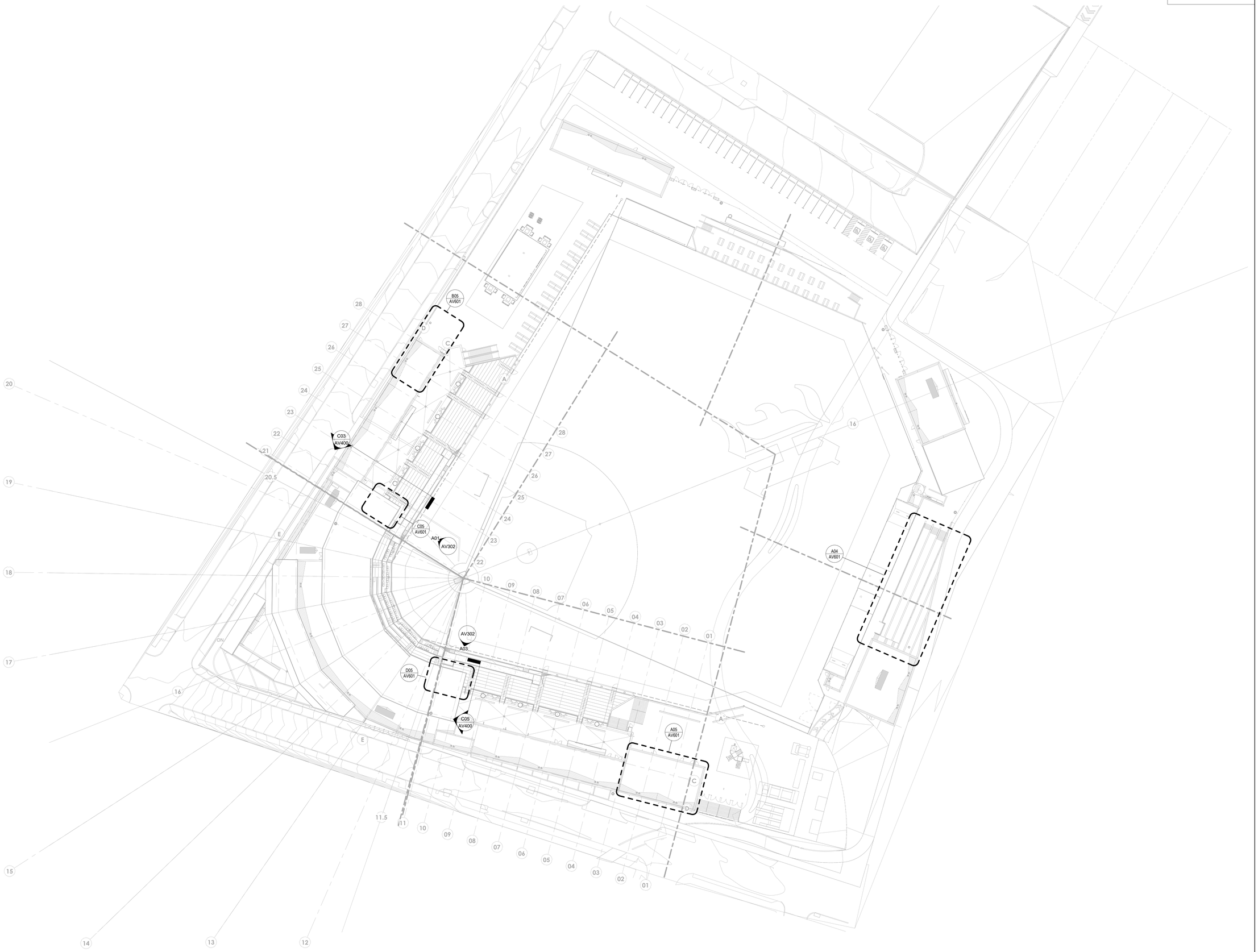
ARCH E1 30" x 42"

KEYNOTES



A01 AV_ROOF PLAN

1" = 30'-0" | re: A01 / AV300

Project Management Initials:
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HAGERSTOWN BALLPARK

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HAGERSTOWN, MD

ARCHITECT

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PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

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WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
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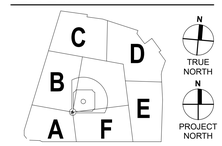

SHEET TITLE

ROOF REFERENCE PLAN

SHEET NUMBER

AV106

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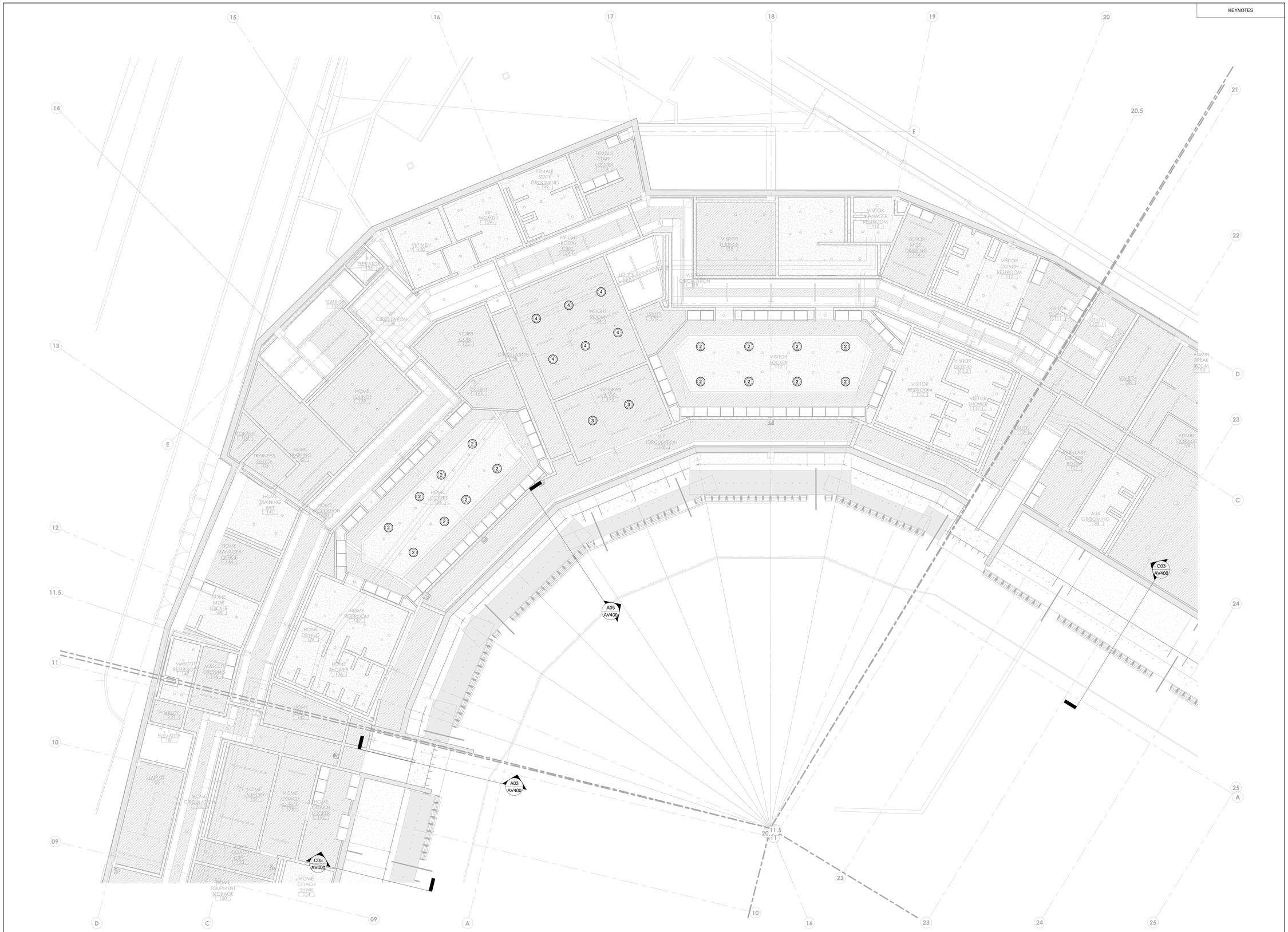
ARCH E1 30" x 42"



A01 AV_FIELD LEVEL - HOME PLATE RCP

1/8" = 1'-0" | re: A01 / AV301

Project Management Initials:
Designer: Designer Checked: Checker Approved: Approver
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PENDULUM

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HAGERSTOWN BALLPARK

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ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
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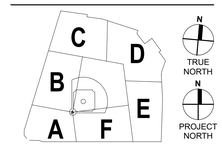

SHEET TITLE

FIELD LEVEL - HOME PLATE RCP

SHEET NUMBER

AV202.1

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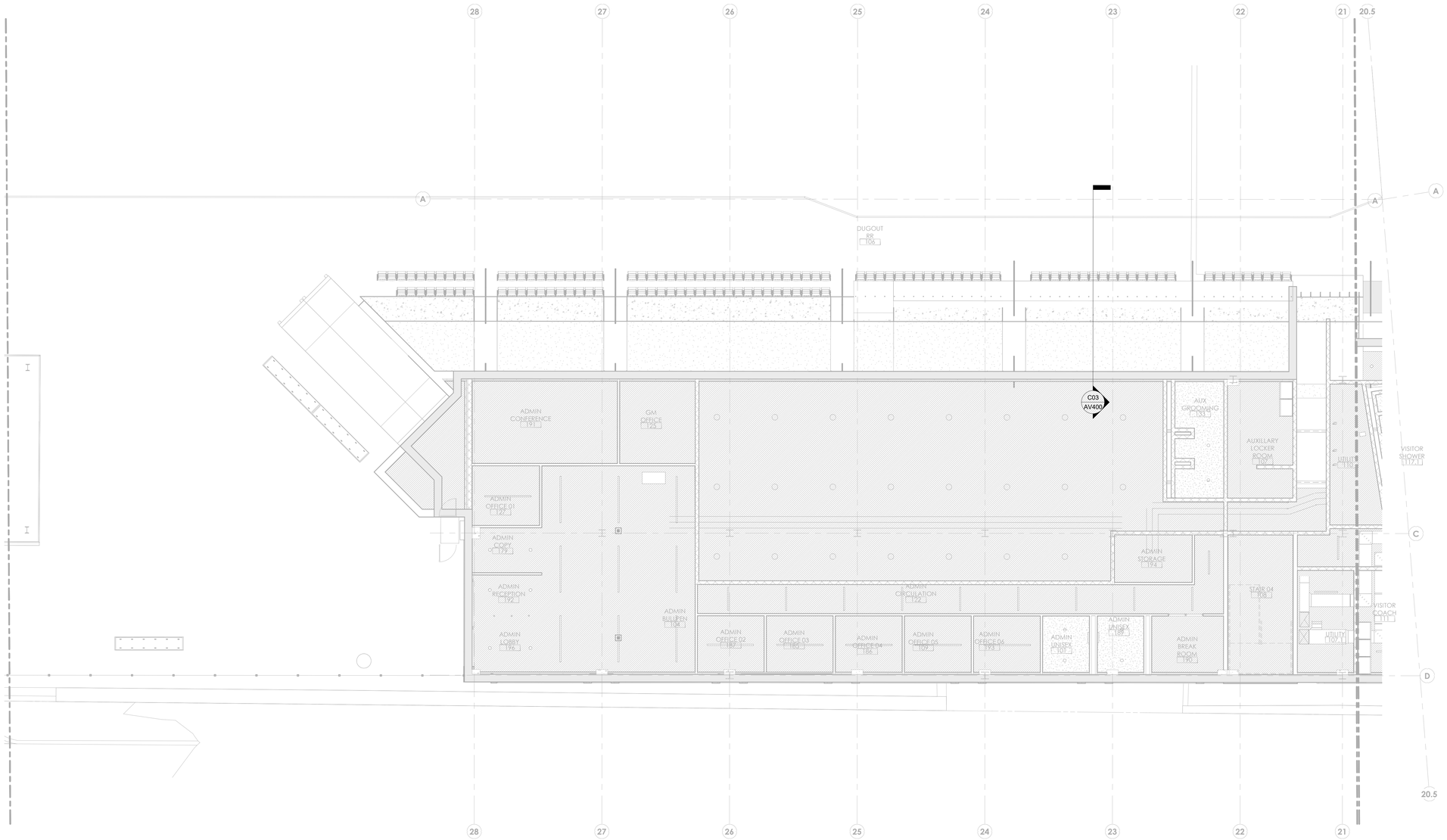
ARCH E1 30" x 42"

KEYNOTES



A01 AV_FIELD LEVEL - THIRD BASE LINE RCP

1/8" = 1'-0" re: A01 / AV301

Project Management Initials:
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PENDULUM

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ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
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CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
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tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
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AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
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PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
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Project **20220903_MSA**
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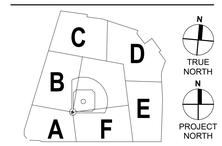
KEY PLAN



SHEET TITLE

FIELD LEVEL - THIRD BASE LINE RCP

SHEET NUMBER

AV202.2

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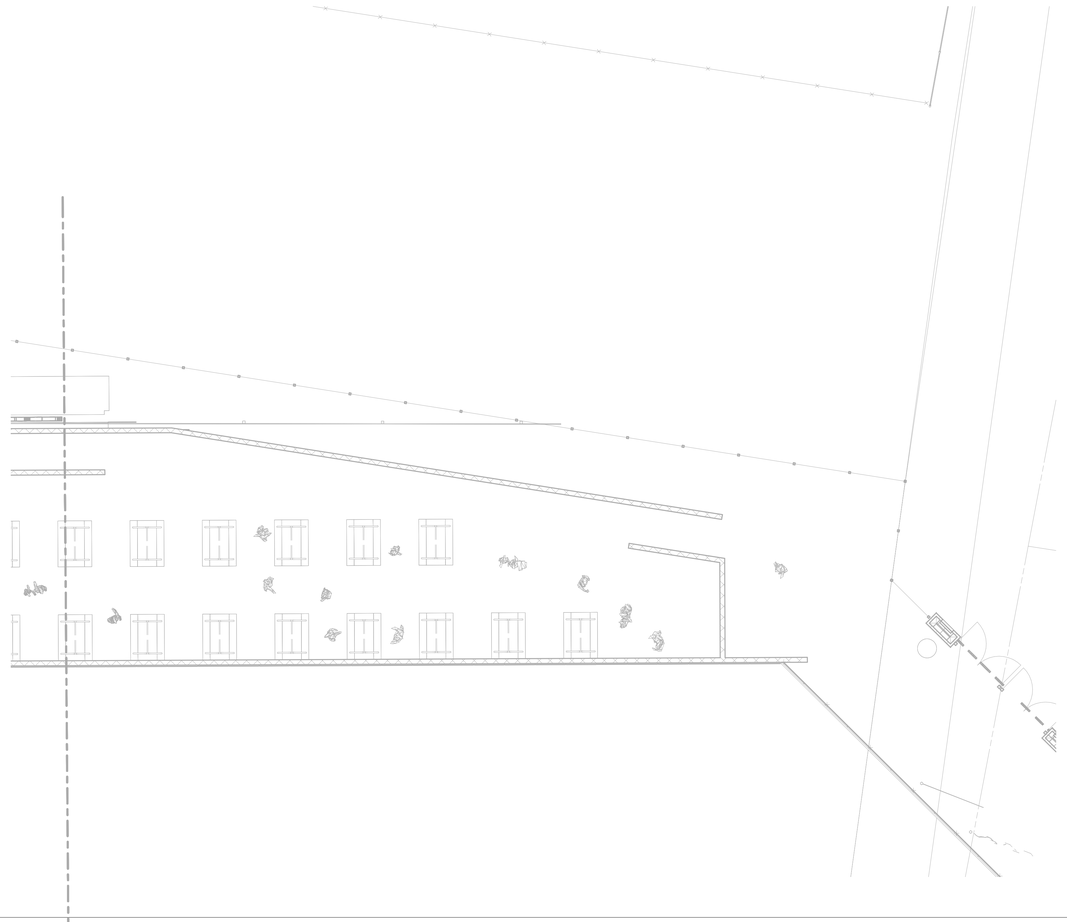
ARCH E1 30" x 42"

KEYNOTES



A01 AV_FIELD LEVEL - LEFT FIELD RCP

1/8" = 1'-0" | re: A01 / AV301

Project Management Initials:
Designer: Designer Checked: Checker Approved: Approver
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PROJECT

HAGERSTOWN BALLPARK

CORNER OF
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HAGERSTOWN, MD

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PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
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MADISON, WI 53704
tel - 608-514-4373

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12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

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HILLIS CARNES
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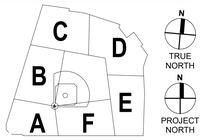

SHEET TITLE

FIELD LEVEL - LEFT FIELD RCP

SHEET NUMBER

AV202.3

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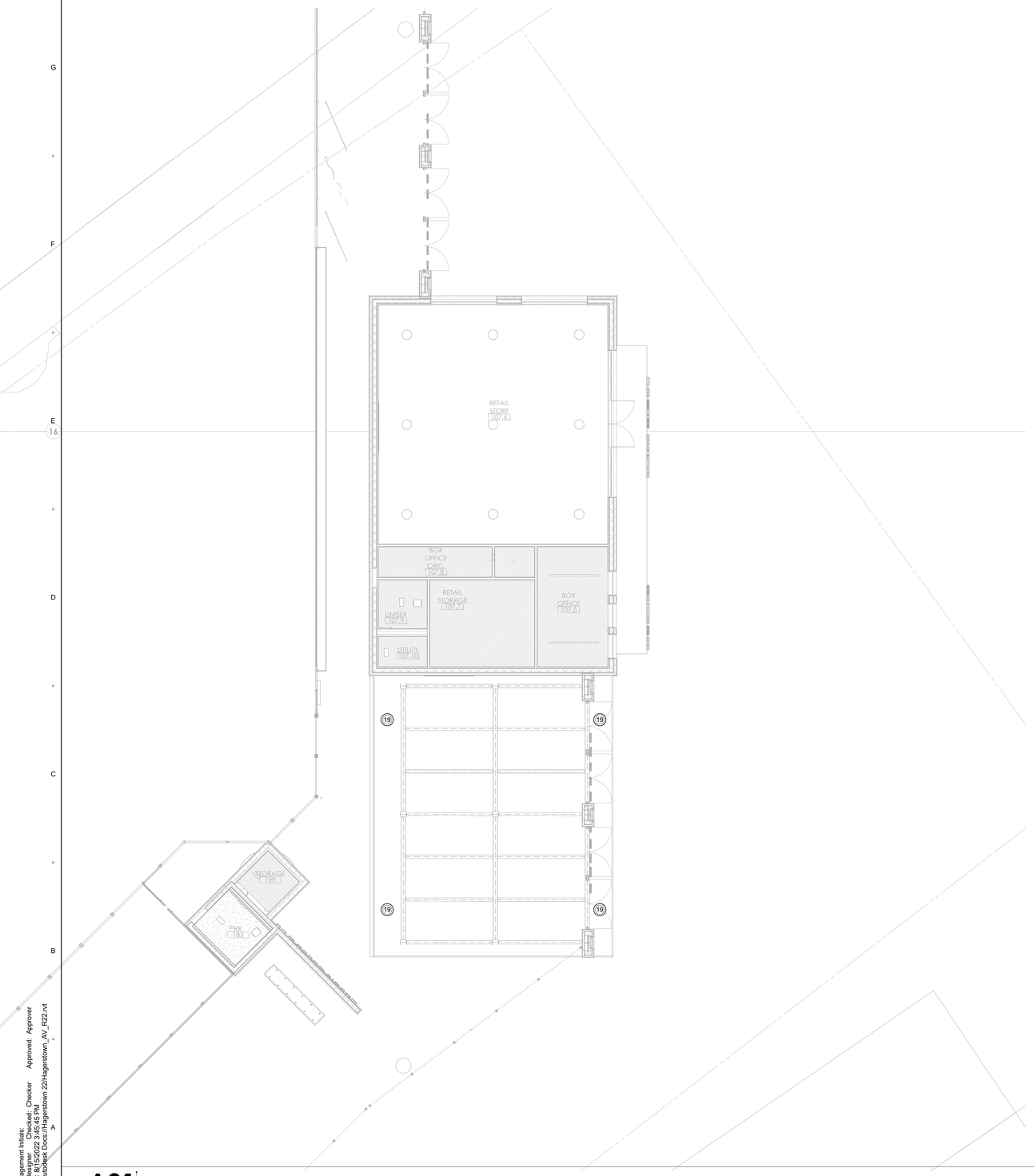
ARCH E1 30" x 42"

KEYNOTES



A01 AV_FIELD LEVEL - CENTER FIELD RCP

1/8" = 1'-0" | re: A01 / AV301

Project Management Initials:
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ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

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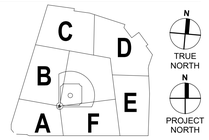

SHEET TITLE

FIELD LEVEL - CENTER FIELD RCP

SHEET NUMBER

AV202.5

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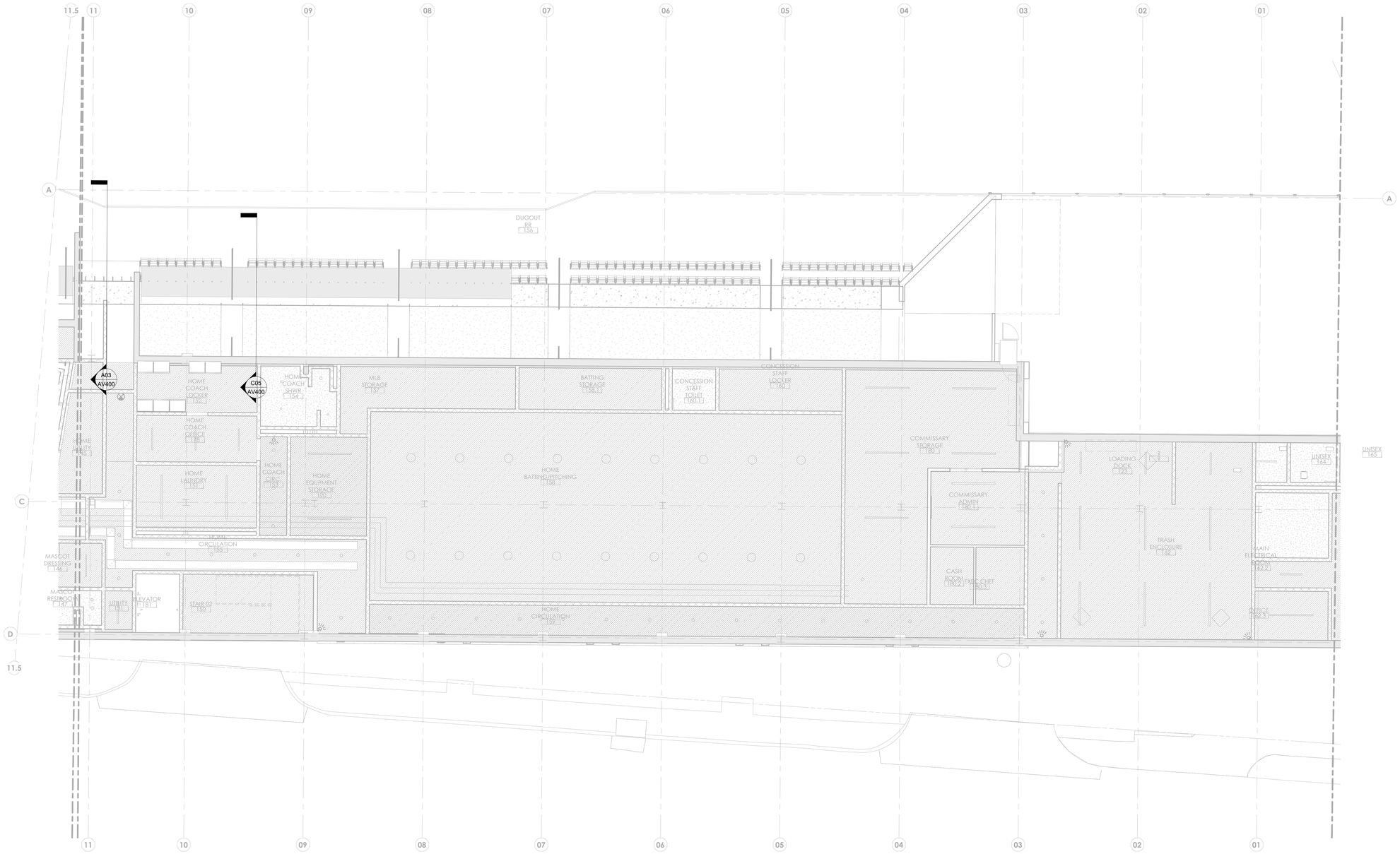
ARCH E1 30" x 42"

KEYNOTES



A01 AV_FIELD LEVEL - FIRST BASE LINE RCP

1/8" = 1'-0" | re: A01 / AV301

PENDULUM

PROJECT

HAGERSTOWN BALLPARK

CORNER OF
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ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
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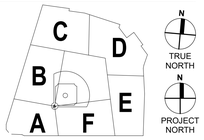

SHEET TITLE

FIELD LEVEL - FIRST BASE SIDE RCP

SHEET NUMBER

AV202.8

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ARCH E1 30" x 42"

KEYNOTES

A01 AV_MAIN CONCOURSE - HOME PLATE RCP

1/8" = 1'-0" re: A01 / AV300

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HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY
CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

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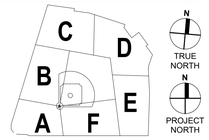

SHEET TITLE

MAIN CONCOURSE - HOME PLATE RCP

SHEET NUMBER

AV204.1

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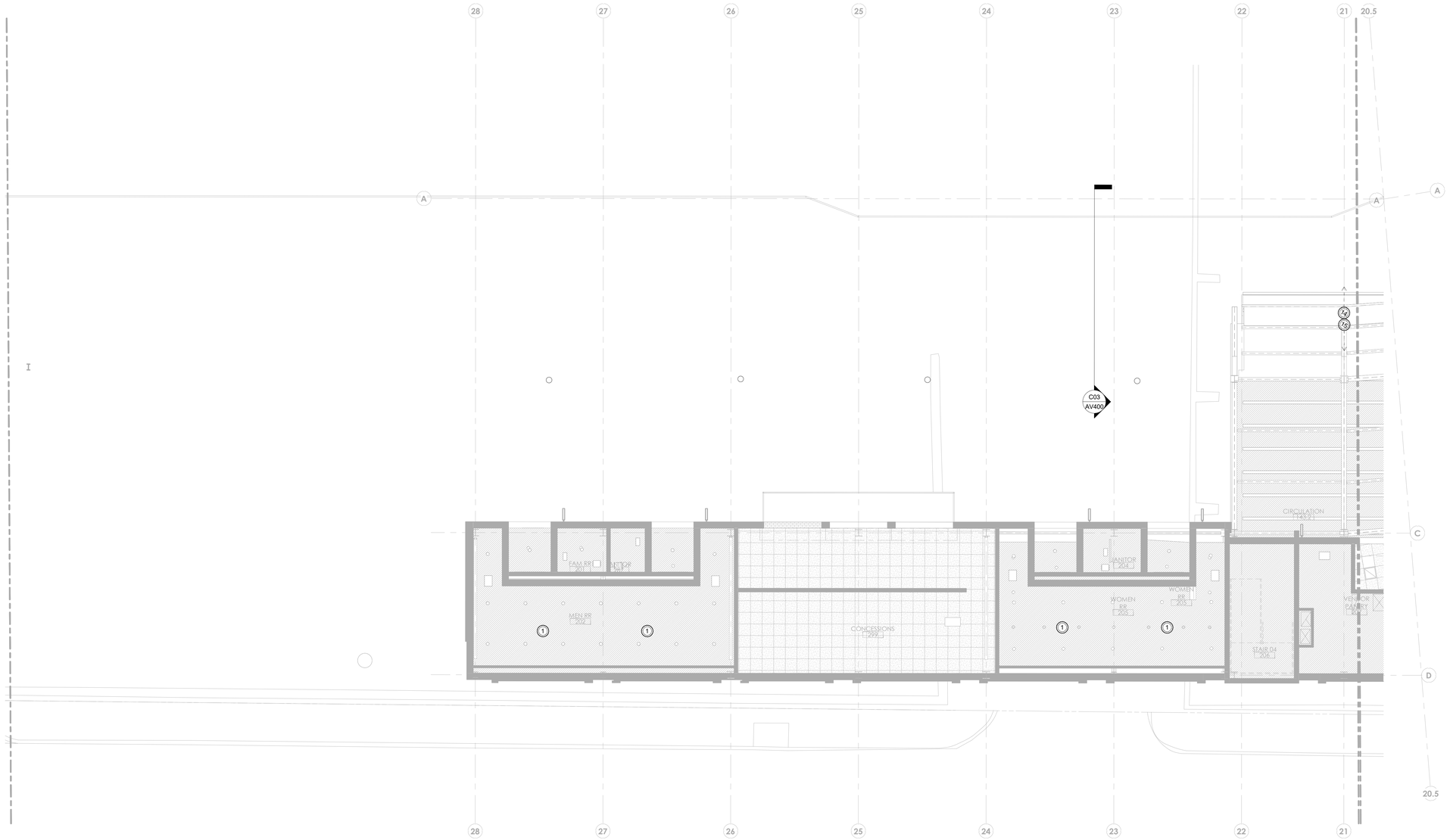
ARCH E1 30" x 42"

KEYNOTES



A01 AV_MAIN CONCOURSE - THIRD BASE LINE RCP

1/8" = 1'-0" | re: A01 / AV300

Project Management Initials:
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HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
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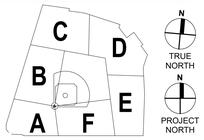

SHEET TITLE

MAIN CONCOURSE - THIRD BASE RCP

SHEET NUMBER

AV204.2

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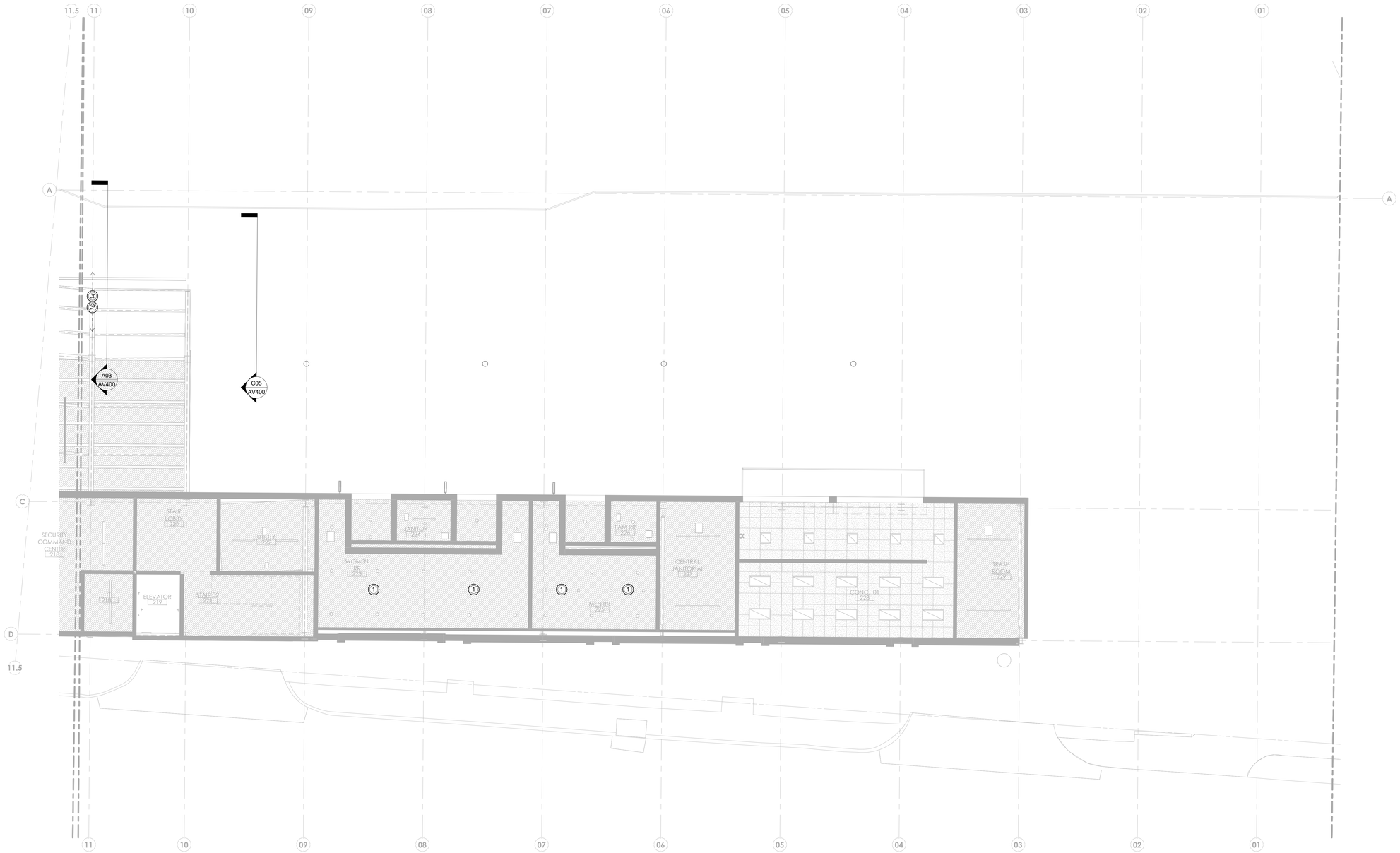
ARCH E1 30" x 42"

KEYNOTES



A01 AV_MAIN CONCOURSE - FIRST BASE LINE RCP

1/8" = 1'-0" | re: A01 / AV300

Project Management Initials:
Designer: Designer Checked: Checker Approved: Approver
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PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY
CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
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HILLIS CARNES
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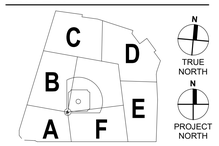

SHEET TITLE

MAIN CONCOURSE - FIRST BASE LINE RCP

SHEET NUMBER

AV204.8

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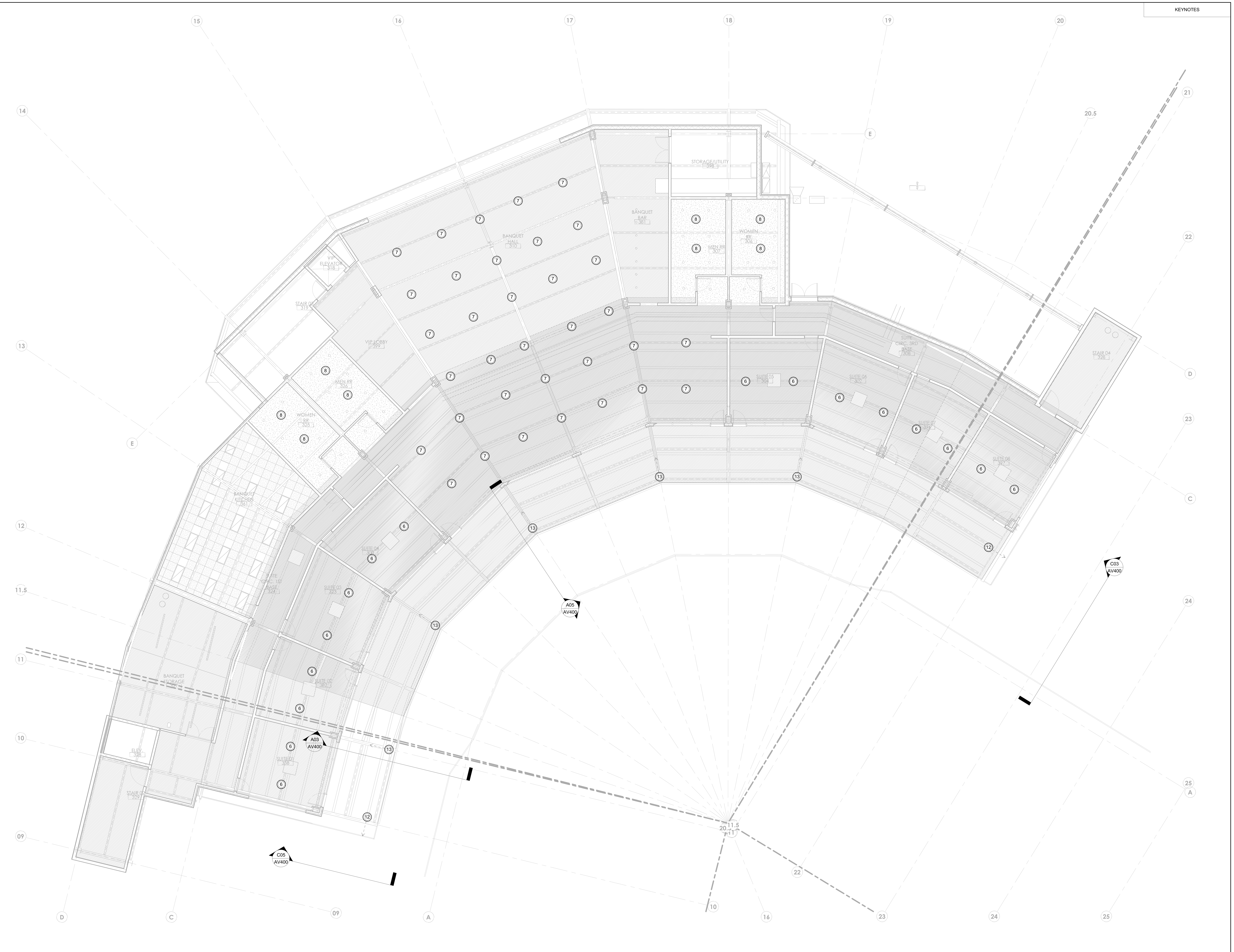
ARCH E1 30" x 42"

KEYNOTES



A01 AV_SUITE LEVEL - HOME PLATE RCP
1/8" = 1'-0" re: A01 / AV300

Project Management Initials:
Designer: Designer Checked: Checker Approved: Approver
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HAGERSTOWN, MD

ARCHITECT
ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT
MD STADIUM AUTHORITY
CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS
CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
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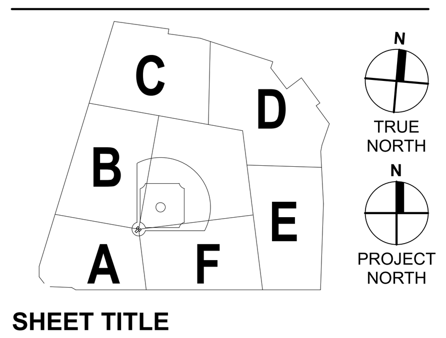

SHEET TITLE
SUITE LEVEL - RCP

SHEET NUMBER
AV205.1

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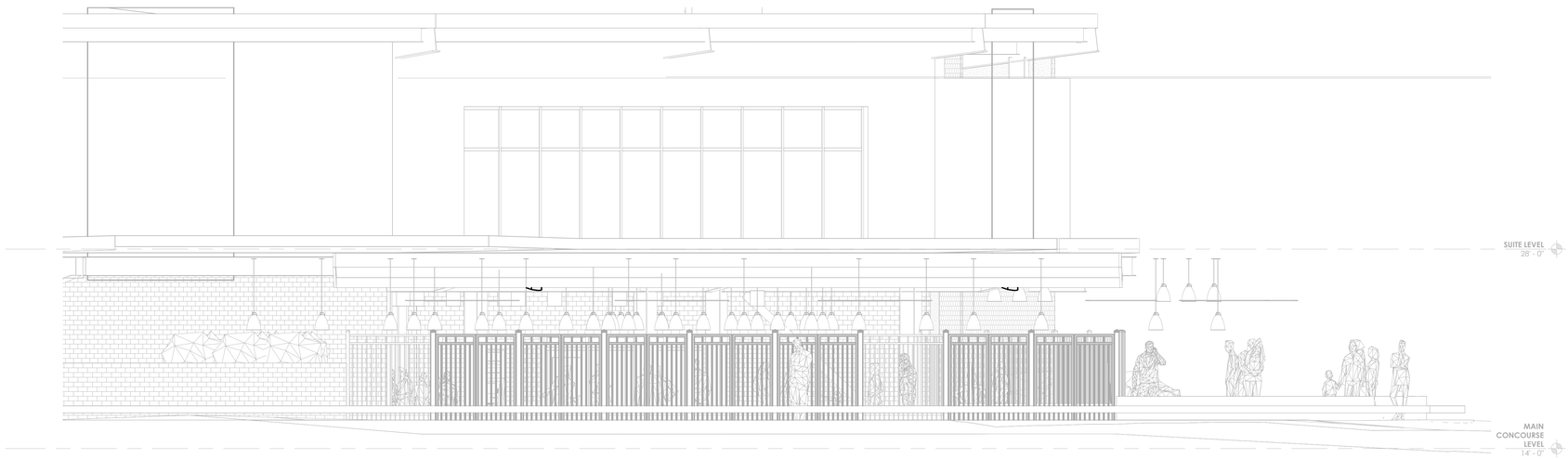
ARCH E1 30" x 42"

KEYNOTES

A02 ENTRY ELEVATION

1/4" = 1'-0" | re: A01 / AV600



A01 ENTRY ELEVATION

1/4" = 1'-0" | re: A01 / AV600

PENDULUM

PROJECT

HAGERSTOWN BALLPARK

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SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
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PLAYING FIELD
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KANSAS CITY, MO, 64105
tel - 913-318-8488

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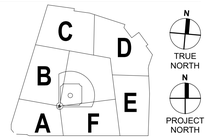
I/R	DATE	DESCRIPTION

KEY PLAN



SHEET TITLE

ELEVATIONS

SHEET NUMBER

AV300

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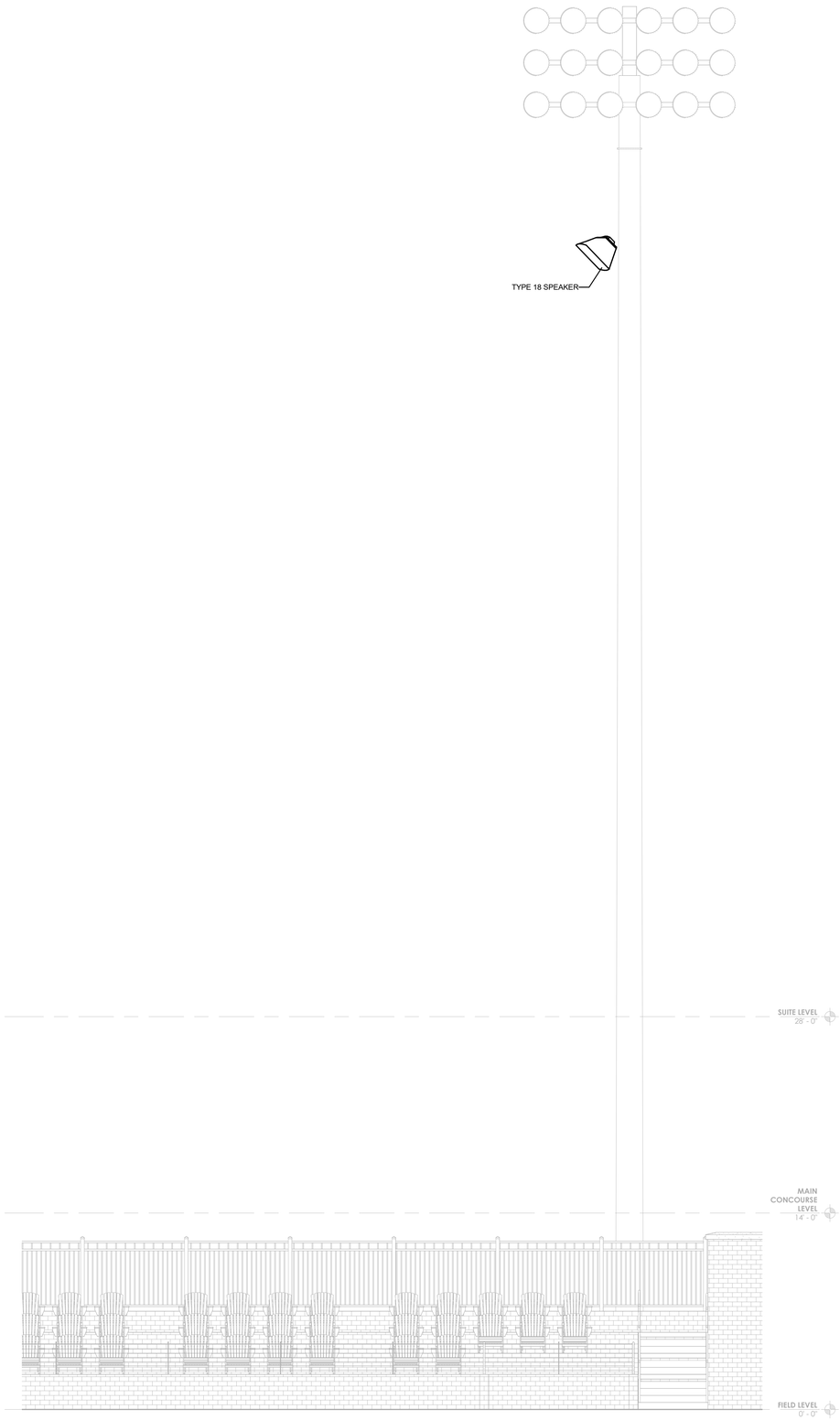
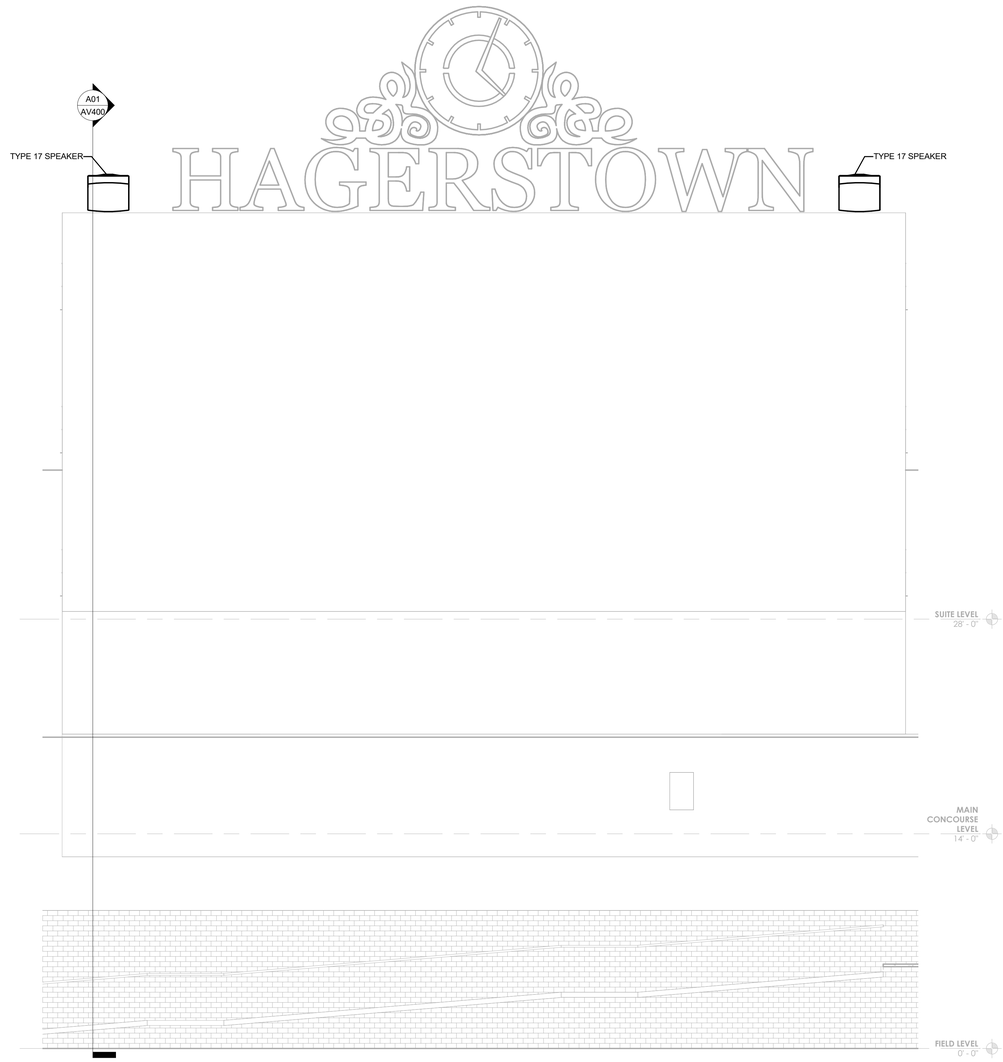
ARCH E1 30" x 42"

KEYNOTES



A04 HISTORIC TRAILS SEATING ELEVATION

1/4" = 1'-0" re: A01 / AV102.6



A01 SCOREBOARD ELEVATION

1/4" = 1'-0" re: A01 / AV601

PENDULUM

PROJECT

HAGERSTOWN BALLPARK
CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY
CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

Project **20220903_MSA**
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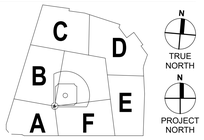
KEY PLAN



SHEET TITLE

ELEVATIONS

SHEET NUMBER

AV301

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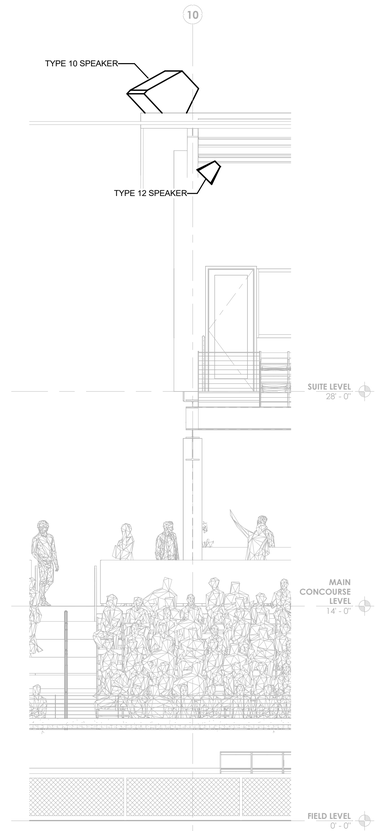
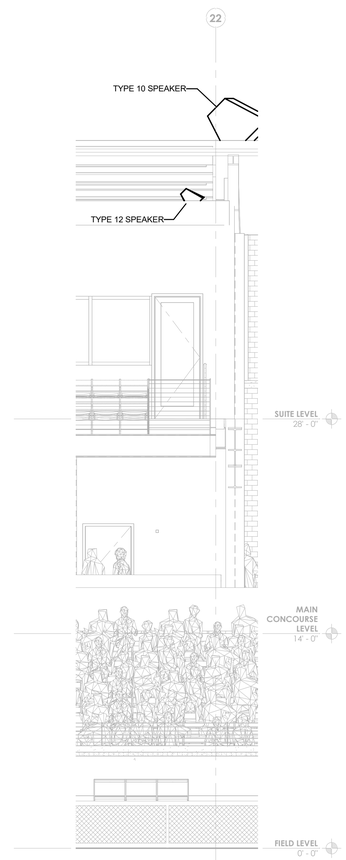
KEYNOTES



A03 TYPE 10 & 12 SPEAKER MOUNTING ELEVATION

1/4" = 1'-0" re: A01 / AV001



A01 TYPE 10 & 12 SPEAKER MOUNTING ELEVATION

1/4" = 1'-0" re: A01 / AV001

PENDULUM

PROJECT

HAGERSTOWN BALLPARK

CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

Project **20220903_MSA**
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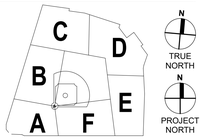
KEY PLAN



SHEET TITLE

ELEVATIONS

SHEET NUMBER

AV302

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ARCH E1 30" x 42"
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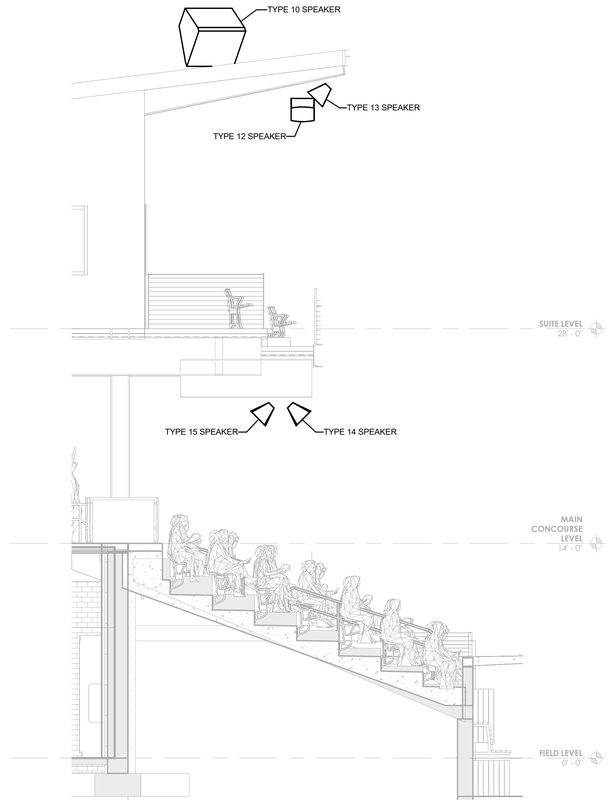
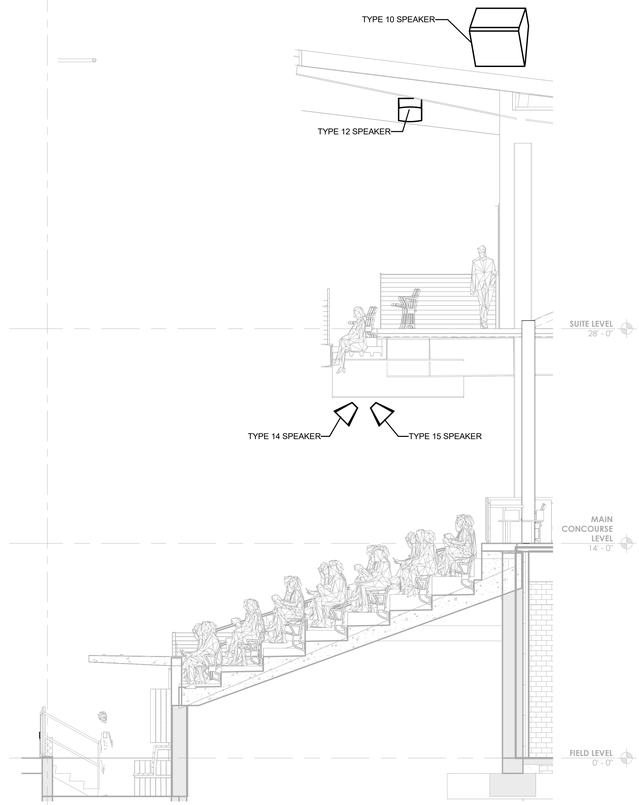
KEYNOTES



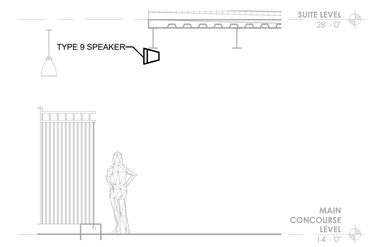
C05 TYPE 10, 12, 13, 14 & 15 SPEAKER MOUNTING SECTION

1/4" = 1'-0" | re: A01 / AV001



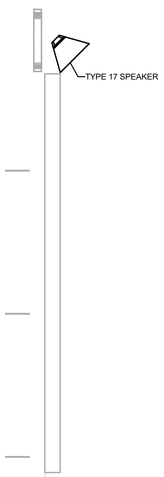
C03 TYPE 10, 12, 14 & 15 SPEAKER MOUNTING SECTION

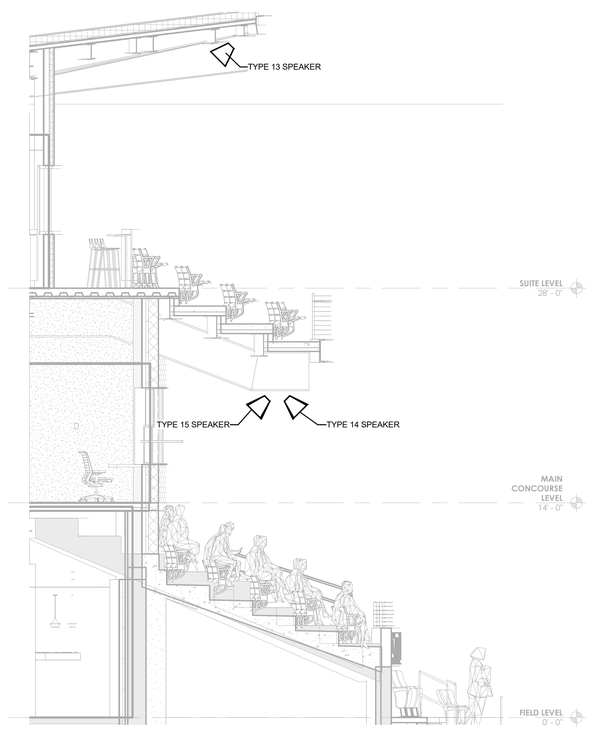
1/4" = 1'-0" | re: A01 / AV001



D01 TYPE 9 SPEAKER MOUNTING SECTION

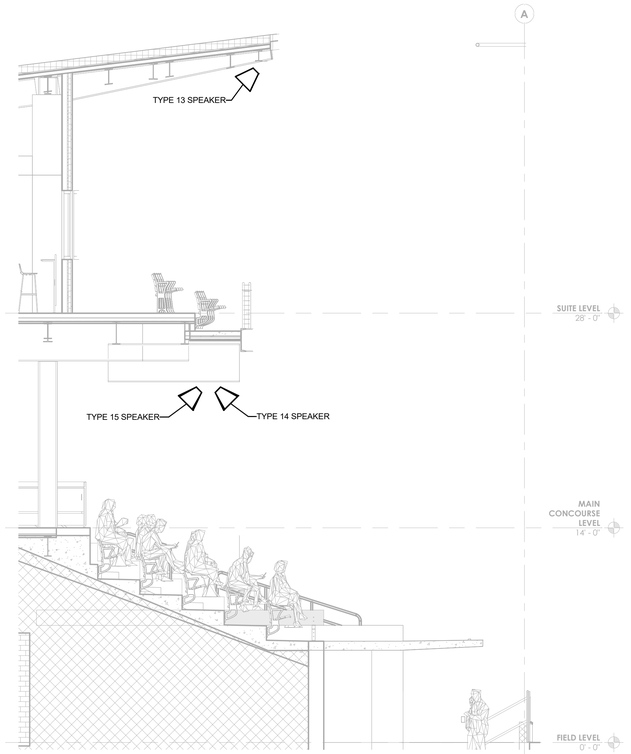
1/4" = 1'-0" | re: A01 / AV104.1





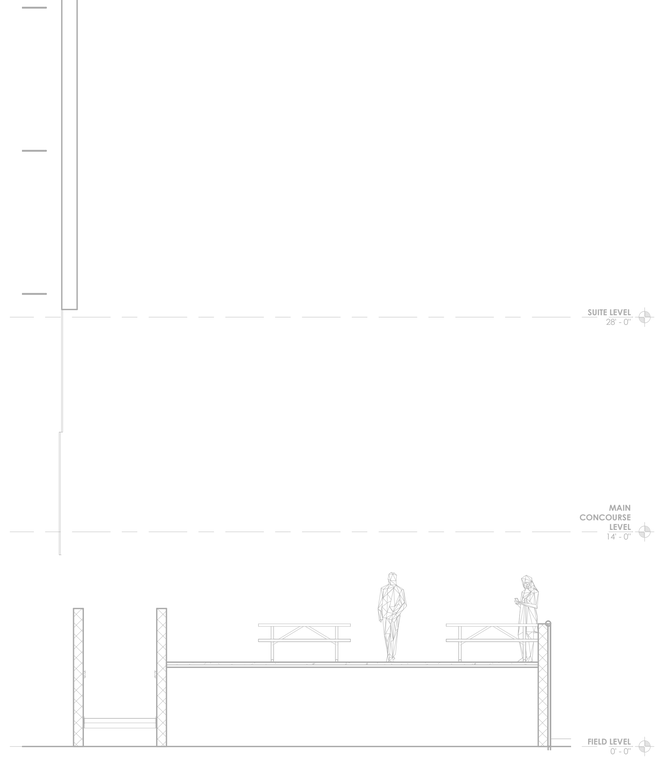
A05 TYPE 13, 14 & 15 MOUNTING SECTION

1/4" = 1'-0" | re: A01 / AV102.1



A03 TYPE 13, 14 & 15 MOUNTING SECTION

1/4" = 1'-0" | re: A01 / AV102.1



A01 SCOREBOARD SECTION

1/4" = 1'-0" | re: A01 / AV301

PENDULUM

PROJECT

HAGERSTOWN BALLPARK
CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY
CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

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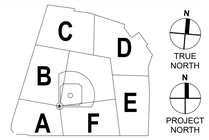
KEY PLAN



SHEET TITLE

SECTIONS

SHEET NUMBER

AV400

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ARCH E1 30" x 42"
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ARCH E1 30" x 42"

KEYNOTES

A01 ENLARGED ENTRY

3/16" = 1'-0" | re: A01 / AV104

PENDULUM

PROJECT

HAGERSTOWN BALLPARK
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SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY
CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

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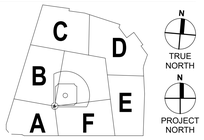
KEY PLAN



SHEET TITLE

ENLARGED PLANS

SHEET NUMBER

AV600

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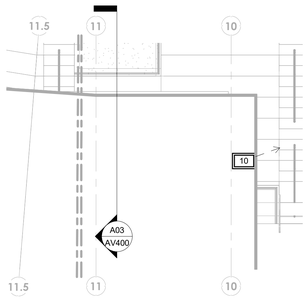
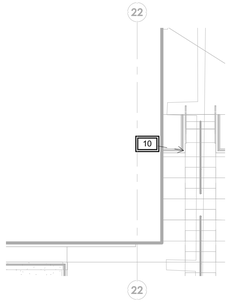
ARCH E1 30" x 42"

KEYNOTES



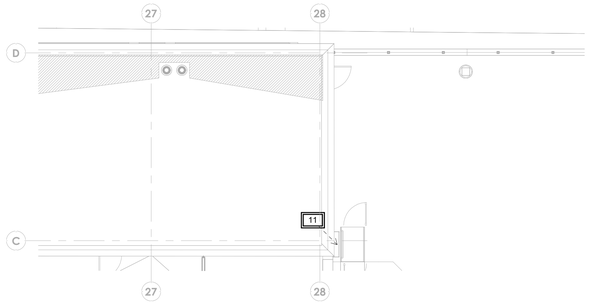
D05 ENLARGED THIRD BASE ROOF PLAN

1/8" = 1'-0" | re: A01 / AV106



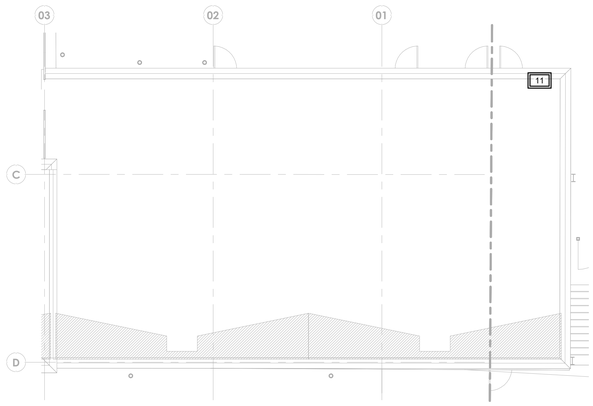
C05 ENLARGED FIRST BASE ROOF PLAN

1/8" = 1'-0" | re: A01 / AV106



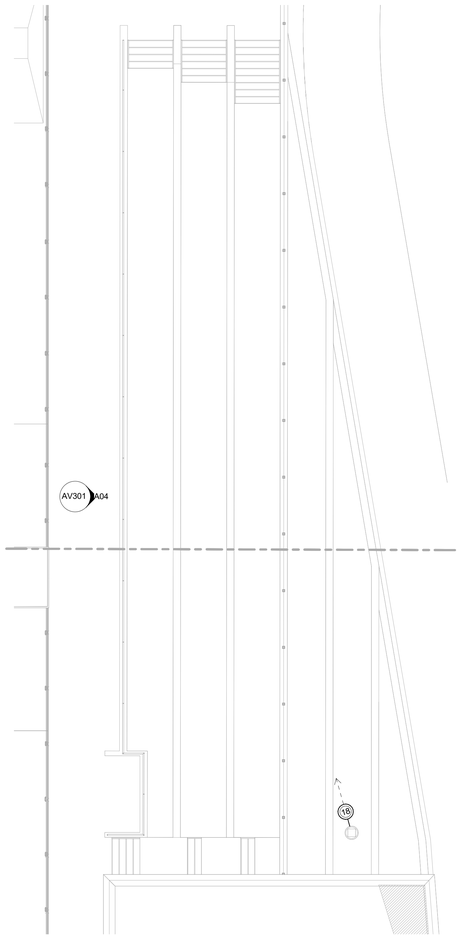
B05 ENLARGED THIRD BASE ROOF PLAN

1/8" = 1'-0" | re: A01 / AV106



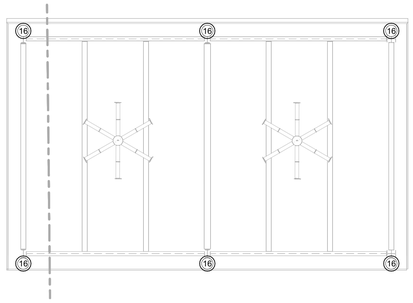
A05 ENLARGED FIRST BASE ROOF PLAN

1/8" = 1'-0" | re: A01 / AV106



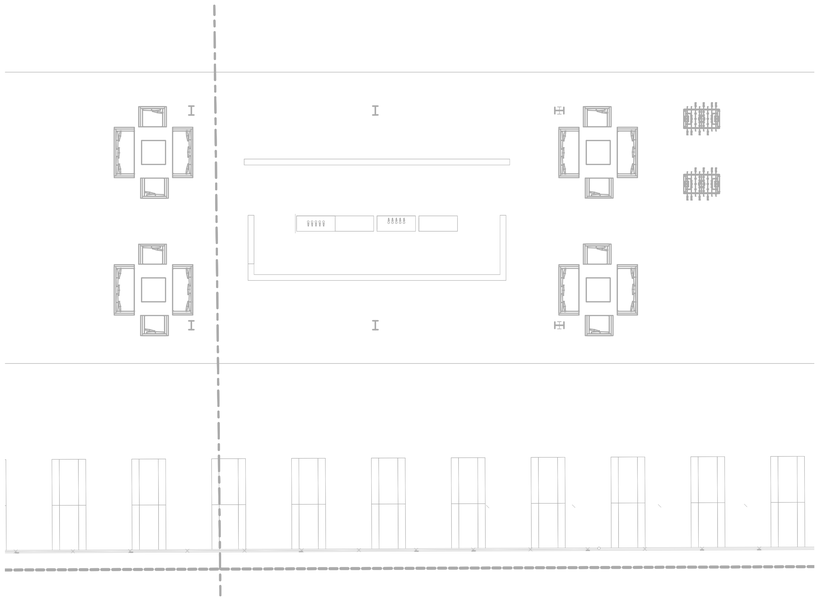
A04 ENLARGED HISTORIC TRAIL SEATING

1/8" = 1'-0" | re: A01 / AV106



D01 ENLARGED BAR REFLECTED CEILING PLAN

1/8" = 1'-0" | re: /



B01 ENLARGED BAR PLAN

1/8" = 1'-0" | re: A01 / AV102

A01 ENLARGED TOP OF SCOREBOARD

1/4" = 1'-0" | re: A01 / AV105

PENDULUM

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ARCHITECT

ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY
CEDRIC LOWE
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BALTIMORE, MD 21201
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CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
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MEP/FP/SUSTAINABILITY
ELEVAR
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CINCINNATI, OH, 45203
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MADISON, WI 53704
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AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
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805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
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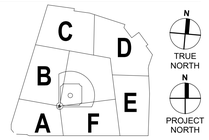
ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN



SHEET TITLE

ENLARGED PLANS

SHEET NUMBER

AV601

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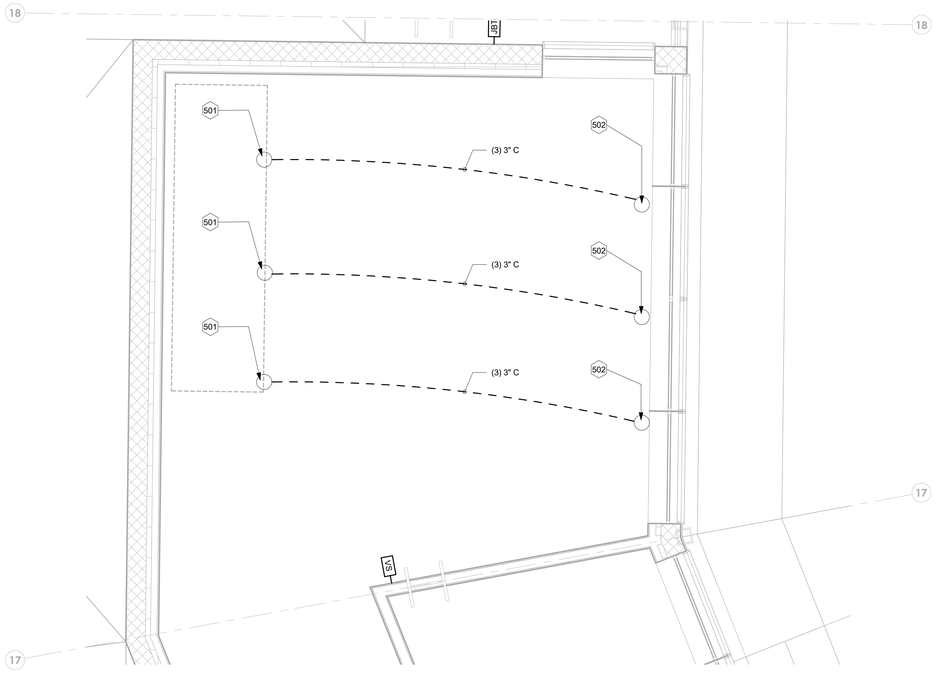
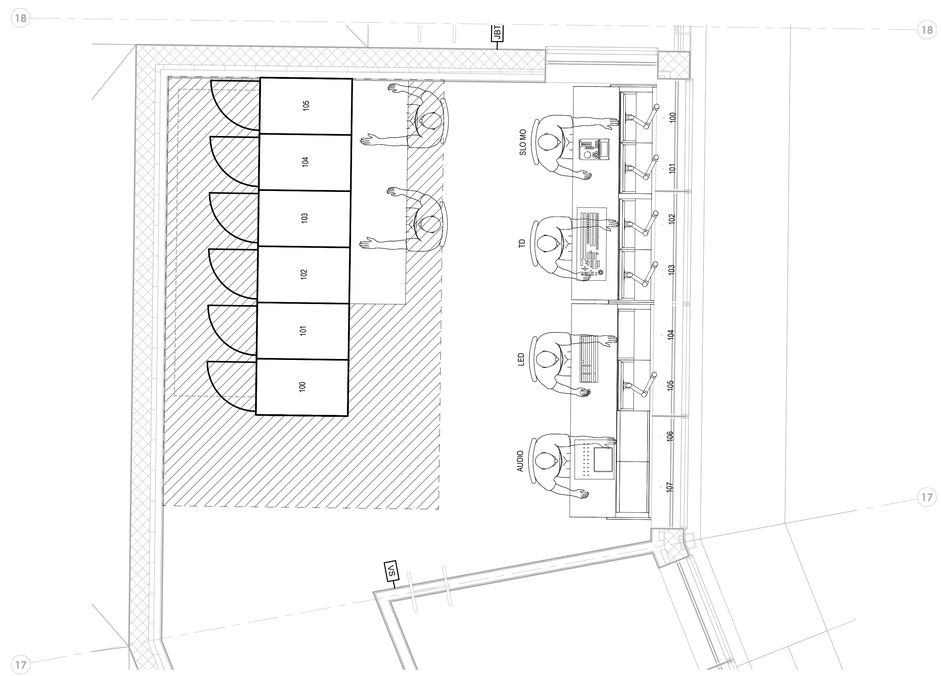
KEYNOTES	
501	STUB CONDUIT INTO BASE OF EQUIPMENT RACK AT 4" AFF AND PROVIDE BUSHING.
502	STUB CONDUIT UNDER TECHNICAL FURNITURE TIGHT TO WALL AT 4" AFF AND PROVIDE BUSHING



1 ENLARGED HIGH PLAN - SCOREBOARD PRODUCTION RM 259

1/2" = 1'-0" re: A01 / AV104.1



2 ENLARGED PLAN - SCOREBOARD PRODUCTION RM 259

1/2" = 1'-0" re: A01 / AV104.1

PENDULUM

PROJECT

HAGERSTOWN BALLPARK
CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY
CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

Project **20220903_MSA**
Issued: 08/15/2022

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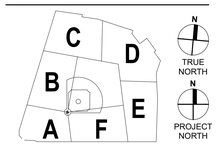
KEY PLAN



SHEET TITLE

ENLARGED PLANS

SHEET NUMBER

AV602

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ARCH E1 30" x 42"
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A05 STADIUM NETWORK FUNCTIONAL DIAGRAM

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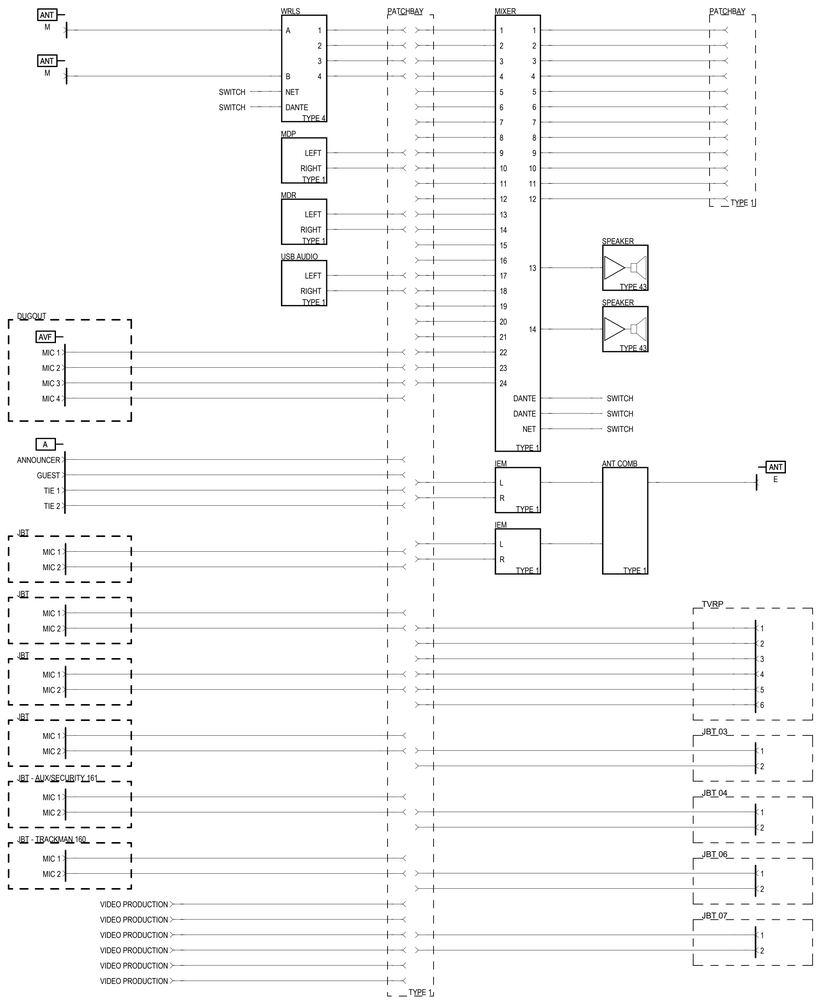

A02 STADIUM CONSOLE FUNCTIONAL DIAGRAM

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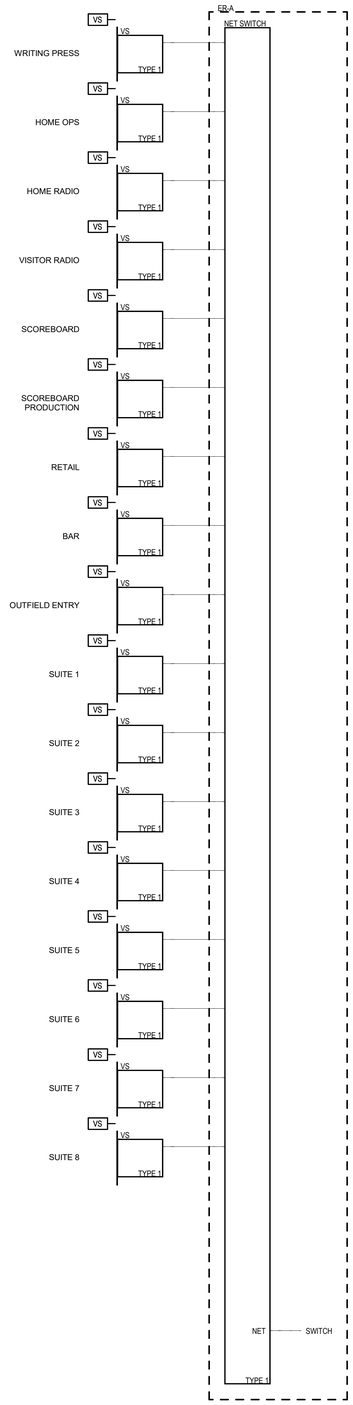

A01 STADIUM CONTROL PANELS

NTS re: /

PENDULUM

PROJECT

HAGERSTOWN BALLPARK
CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY
CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
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CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

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STADIUM AV FUNCTIONAL DIAGRAMS

SHEET NUMBER

AV1110

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ARCH E1 30" x 42"

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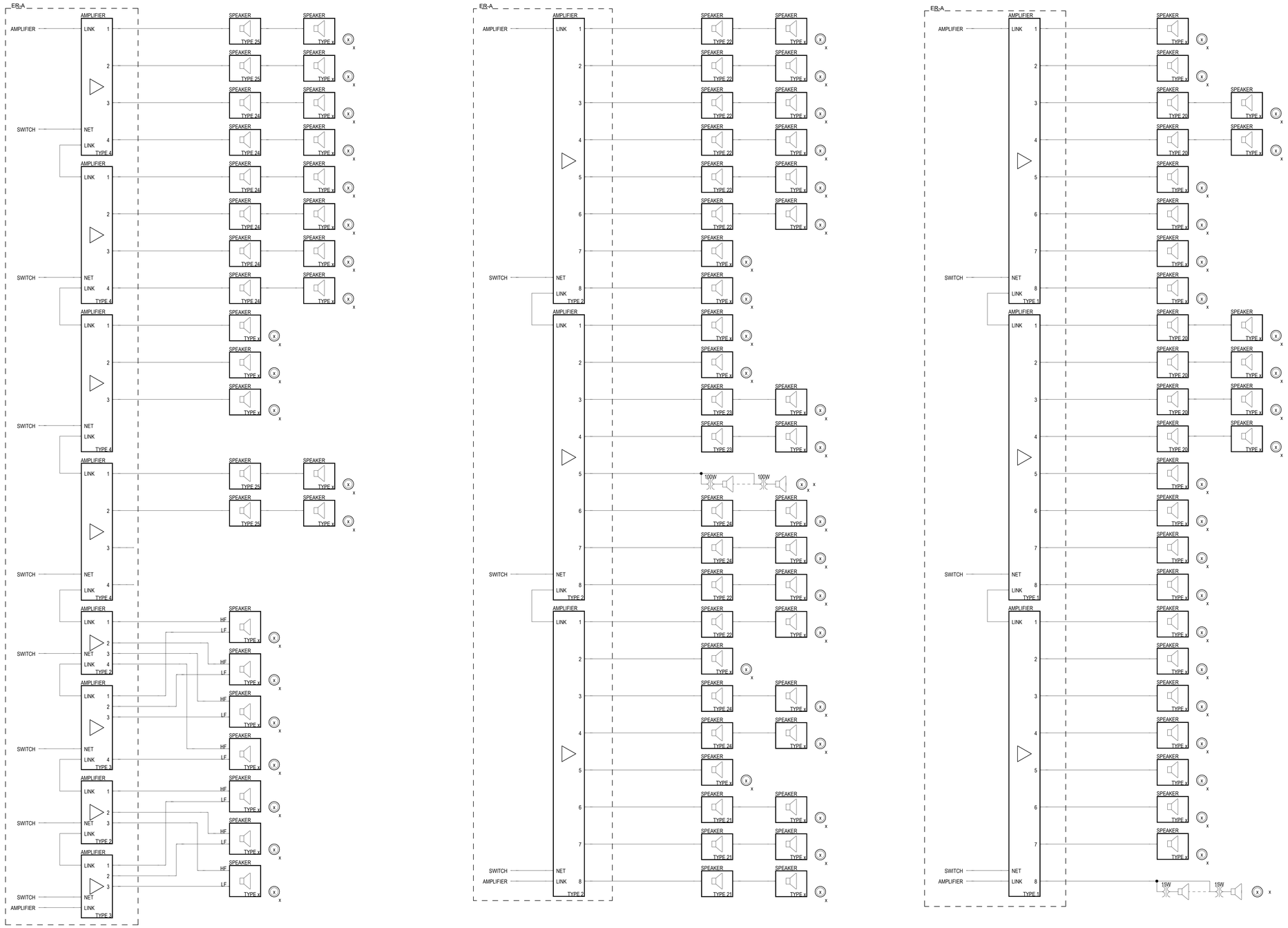

A01 STADIUM AMPLIFIER FUNCTIONAL DIAGRAM

NTS re: /

PENDULUM

PROJECT

HAGERSTOWN BALLPARK
CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY
CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

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SHEET TITLE

STADIUM AV FUNCTIONAL DIAGRAMS

SHEET NUMBER

AV1111

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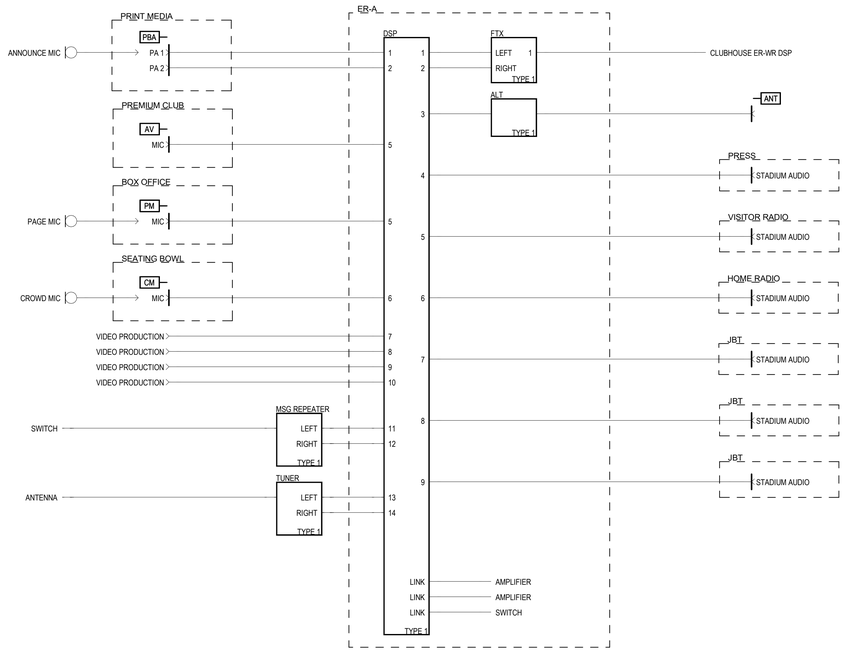
LOOSE EQUIPMENT - REFERENCE SPECIFICATION 27 41 16			
QUANTITY	DESCRIPTION	TYPE	NOTES
2	ANNOUNCER MICROPHONE	1	
4	VOCAL MICROPHONE	1	
10	MICROPHONE CABLE	3	
20	MICROPHONE CABLE	10	
20	MICROPHONE CABLE	20	
10	MICROPHONE CABLE	50	
6	MICROPHONE CABLE	100	
4	INSTRUMENT CABLE	6	
8	INSTRUMENT CABLE	10	
6	MICROPHONE STANDS	1	
2	MICROPHONE STANDS	2	
6	MICROPHONE STANDS	3	
2	MICROPHONE STANDS	4	
2	MONO DI BOX	1	
2	STEREO DI BOX	1	
1	BLUETOOTH RECEIVER BOX	1	
3	FOLDBACK SPEAKER	44	
3	SPEAKER CABLE	100	
2	SPEAKER CABLE	10	
12	HEARING ASSISTANCE RECEIVER	1	
2	HEADPHONES	1	



A02 STADIUM AUDIO FUNCTIONAL DIAGRAM

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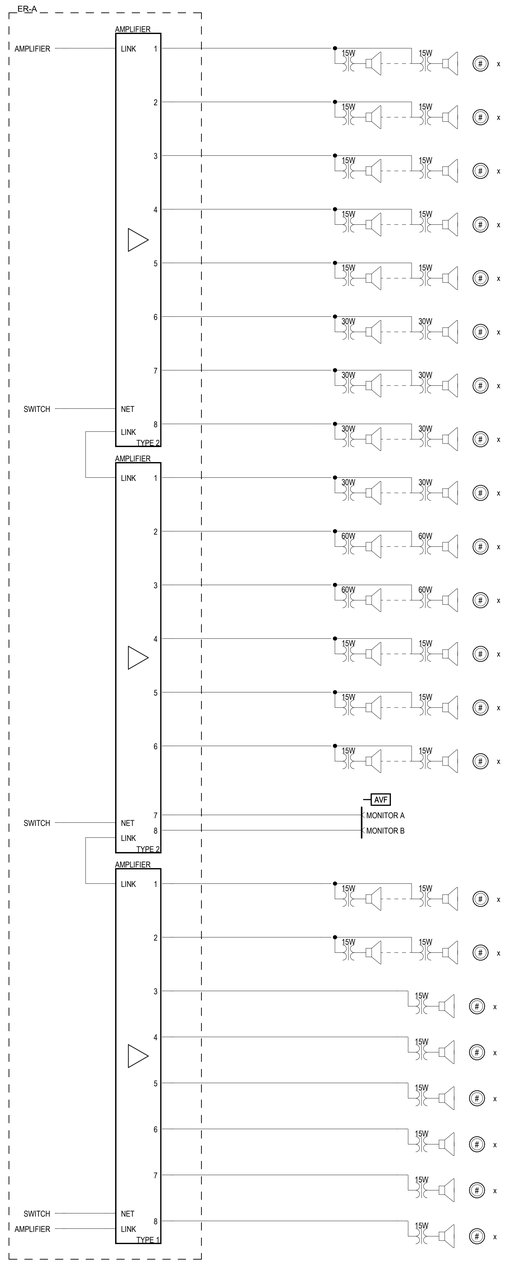

A01 STADIUM AMPLIFIER FUNCTIONAL DIAGRAM 2

NTS re: /

PENDULUM

PROJECT

HAGERSTOWN BALLPARK
CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY
CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

Project **20220903_MSA**
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KEY PLAN

SHEET TITLE

STADIUM AV FUNCTIONAL DIAGRAMS

SHEET NUMBER

AV1112

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D02 PANEL AV
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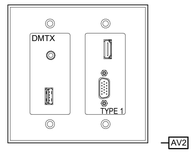

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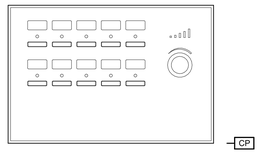

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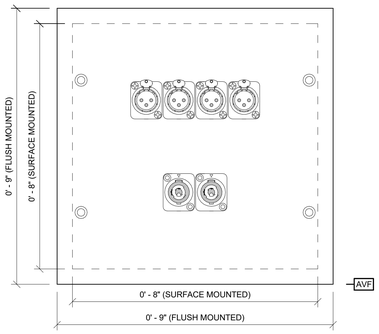

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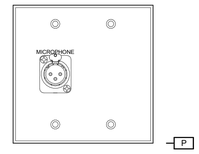

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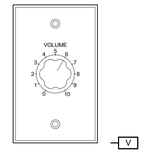

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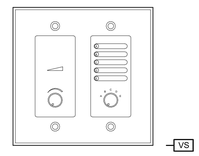

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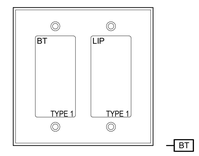

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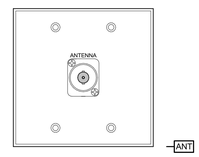

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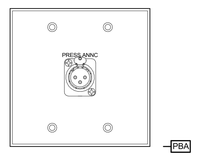

A03 PANEL PBA
6" = 1'-0" re: /

PENDULUM

PROJECT
HAGERSTOWN BALLPARK
CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT
ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT
MD STADIUM AUTHORITY
CEDRIC LOWE
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BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS
CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388
STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348
MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972
FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373
AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700
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KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488
GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

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SHEET TITLE
AV PLATES & PANELS ELEVATIONS

SHEET NUMBER
AV1170

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ARCH E1 30" x 42"

NET SWITCH
DSP
WRLS
IEM IEM
PATCHBAY
PATCHBAY
KVM
MDP
MDR
USB AUDIO
DRAWER
DRAWER
DRAWER
DRAWER
DRAWER
UPS

ER-AB

B01 STADIUM ER-AB

NTS re: /

	TUNER
	ALT
	NET SWITCH
	DSP
AMPLIFIER	AMPLIFIER
AMPLIFIER	AMPLIFIER
AMPLIFIER	AMPLIFIER
AMPLIFIER	AMPLIFIER
AMPLIFIER	AMPLIFIER
AMPLIFIER	AMPLIFIER
AMPLIFIER	AMPLIFIER
AMPLIFIER	AMPLIFIER
AMPLIFIER	AMPLIFIER
AMPLIFIER	AMPLIFIER
UPS	UPS

ER-A 100 ER-A 101

A01 STADIUM ER-A

1" = 1'-0" re: /

PENDULUM

PROJECT

HAGERSTOWN BALLPARK

CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
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BALTIMORE, MD 21201
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CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
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WASHINGTON, DC, 20006
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MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

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CAPITAL FOODSERVICE DESIGN
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KANSAS CITY, MO, 64105
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KEY PLAN

SHEET TITLE

AV EQUIPMENT RACK ELEVATIONS

SHEET NUMBER

AV1180

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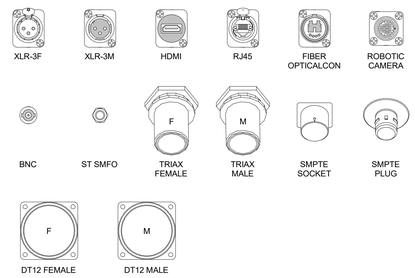
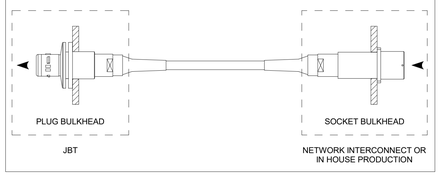
ARCH E1 30" x 42"

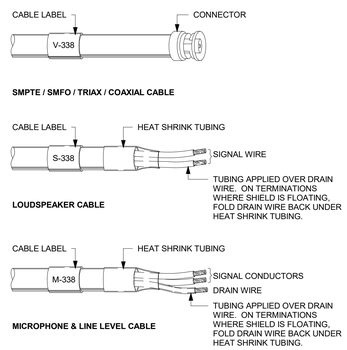
PANEL SYMBOL LEGEND



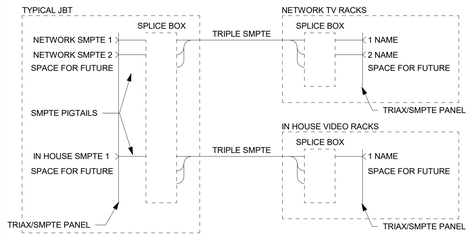
SMPTE CABLE WORK FLOW



AV CABLE PREPARATION DETAILS



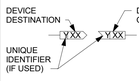
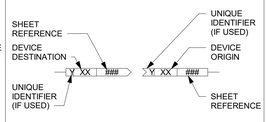
TYPICAL TRIPLE SMPTE CABLE TERMINATION



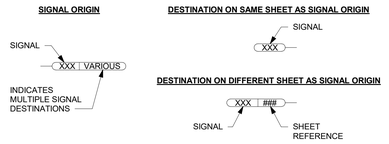
NOTES:
1. TRIPLE SMPTE CABLE TO HAVE ALL 3 CHANNELS TERMINATED AT THE SPLICE BOXES.
2. QUANTITY OF PIGTAILS REQUIRED ARE IN THE NETWORK AND HOUSE BROADCAST CABLE SCHEDULES.
3. NETWORK AND IN-HOUSE CABLE MAY SHARE A SINGLE SPLICE BOX.

TYPICAL TRIPLE SMPTE CABLE TERMINATION

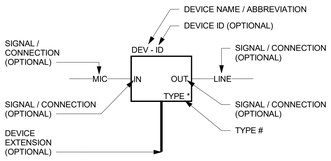
SIGNAL CONTINUATION

SIGNAL TO/FROM ON SHEET DEVICE	SIGNAL TO/FROM OFF SHEET DEVICE
	

SIGNAL TO/FROM VIRTUAL DEVICE



DEVICE DETAIL



GENERAL NOTES

1. LINE TYPES AND NOTES SHOWN ON SHEET AV1200 APPLY TO ALL 1200 SERIES SHEETS, UNLESS NOTED OTHERWISE.

KEYNOTES

503	COORDINATE CABLE TERMINATION IN AUDIO RECORDING PATCH BAY WITH 27 41 17

CABLE TYPE LEGEND

10G	10 G ETHERNET (DUPLEX SINGLE MODE FIBER)
	JACK CONNECTION
	NORMAL THROUGH PATCH
	NORMAL THROUGH PATCH WITH UNUSED PORTION RESERVED FOR FUTURE
	NON-NORMAL PATCH JACK
	INDICATES TERMINATION
	INDICATES TERMINATION WITH PASSIVE LOOP THROUGH
40G	40 G ETHERNET (DUPLEX SINGLE MODE FIBER)
CATX	CATEGORY NETWORK CABLE
DP	DISPLAY PORT CONNECTION
HDMI	HDMI CONNECTION
MONO	MONO ANALOG AUDIO CONNECTION
SDI	HD SDI VIA COAXIAL CABLE
STEREO	STEREO AUDIO CONNECTION
USB	USB CONNECTION

PENDULUM

PROJECT
HAGERSTOWN BALLPARK
CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT
ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT
MD STADIUM AUTHORITY
CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS
CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388
STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348
MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972
FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373
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WJHW
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SAN ANTONIO, TX 78249
tel - 972-934-3700
PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488
GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

Project **20220903_MSA**
Issued: 08/15/2022

ISSUE/REVISION

I/R	DATE	DESCRIPTION
1	Date 1	Revision 1

KEY PLAN

SHEET TITLE
VIDEO PRODUCTION LEGEND AND NOTES

SHEET NUMBER
AV1200

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Project Management Initials:
Designer: Designer Checked: Checker Approved: Approver
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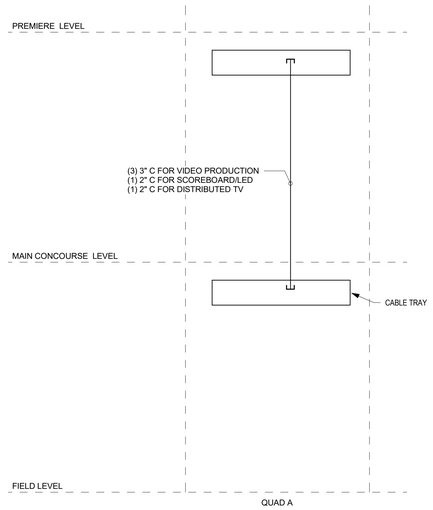
ARCH E1 30" x 42"



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1512 Holmes
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tel - 816.335.3030

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tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

Project **20220903_MSA**
Issued: 08/15/2022

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

SHEET TITLE

VIDEO PRODUCTION CONDUIT RISER

SHEET NUMBER

AV1205

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ARCH E1 30" x 42"

GENERAL NOTES

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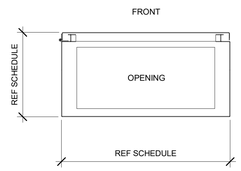
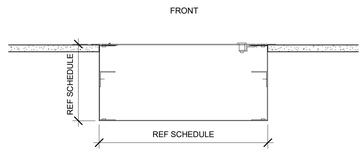
2. ELECTRICAL DEVICES SHOWN FOR REFERENCE ONLY. REFER TO ELECTRICAL DRAWINGS FOR SPECIFIC DETAILS.



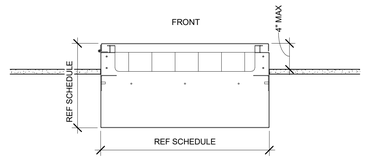
G01 PEDESTAL MOUNT (PM2A) BOTTOM VIEW

1 1/2" = 1'-0" re: /



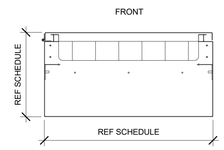
G03 FULLY RECESSED BOTTOM VIEW

1 1/2" = 1'-0" re: /



G06 SEMI-FLUSH BOTTOM VIEW

1 1/2" = 1'-0" re: /



G08 SURFACE MOUNT (S) BOTTOM VIEW

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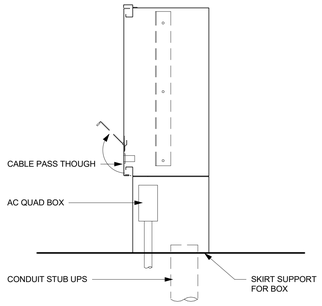

D01 PEDESTAL MOUNT (PM2A) SIDE VIEW

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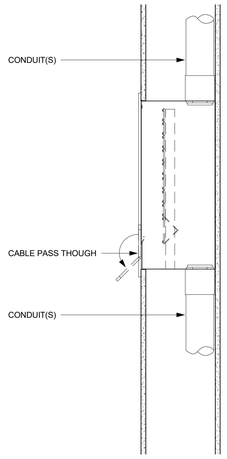
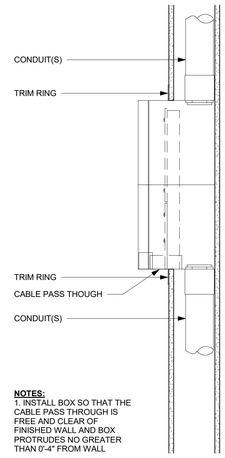


D03 FULLY RECESSED SIDE VIEW

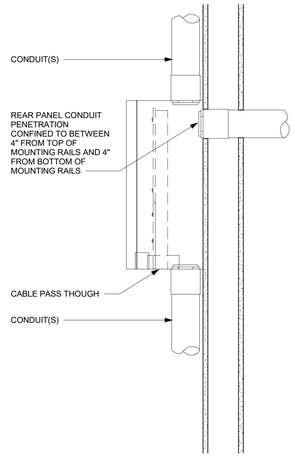
1 1/2" = 1'-0" re: /



NOTES:
1. INSTALL BOX SO THAT THE CABLE PASS THROUGH IS FREE AND CLEAR OF FINISHED WALL AND BOX PROTRUDES NO GREATER THAN 0'-4" FROM WALL

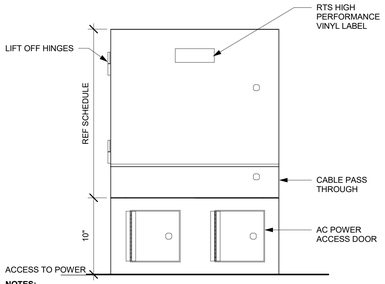
D06 SEMI-FLUSH SIDE VIEW

1 1/2" = 1'-0" re: /



D08 SURFACE MOUNT (S) SIDE VIEW

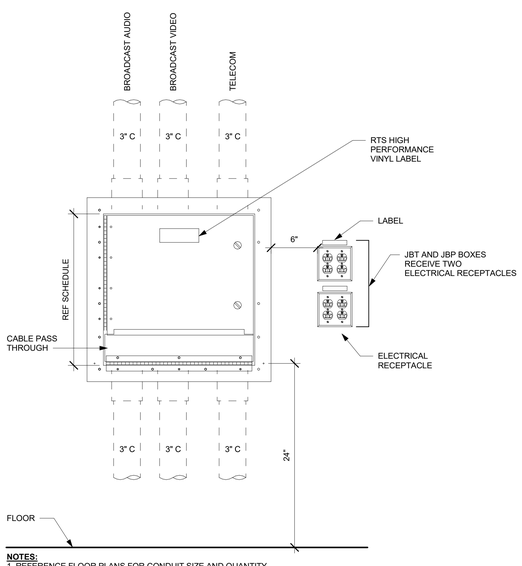
1 1/2" = 1'-0" re: /



NOTES:
1. CABLE PASS THROUGH DOOR IS HINGED AT TOP.

A01 PEDESTAL MOUNT (PM2A) FRONT VIEW

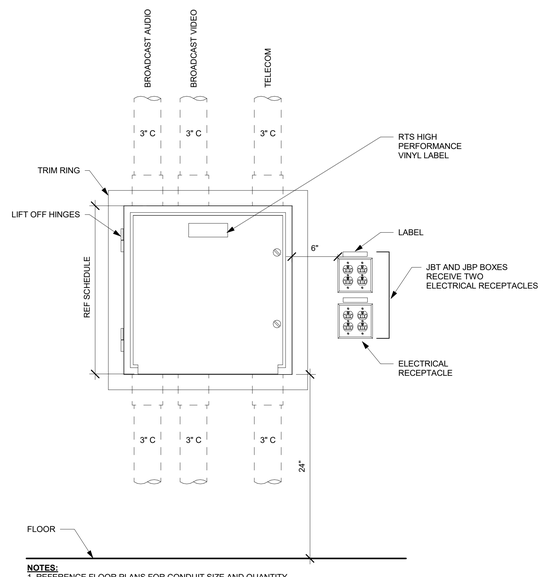
1 1/2" = 1'-0" re: /



NOTES:
1. REFERENCE FLOOR PLANS FOR CONDUIT SIZE AND QUANTITY.
2. CABLE PASS THROUGH DOOR HAS FLIP DOWN DOOR.
3. FULLY RECESSED BOX IS TYPICALLY 14" DEEP TO MATCH THE DEPTH BEHIND THE RACK RAILS OF THE SURFACE MOUNT BOXES.

A03 FULLY RECESSED FRONT VIEW

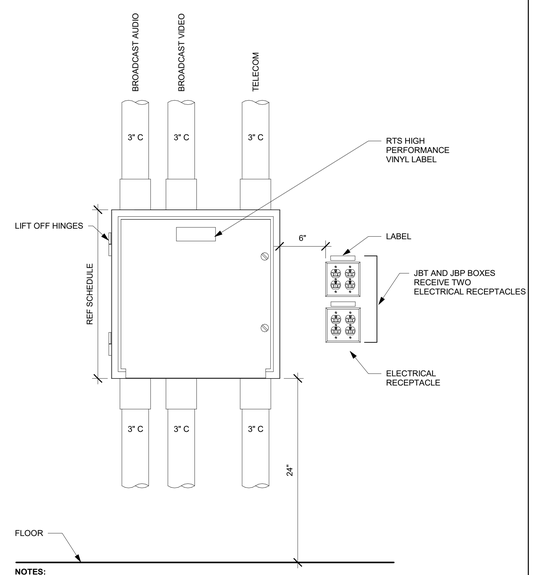
1 1/2" = 1'-0" re: /



NOTES:
1. REFERENCE FLOOR PLANS FOR CONDUIT SIZE AND QUANTITY.
2. SEMI-FLUSH AND SURFACE MOUNT UTILIZE THE SAME BOX.

A06 SEMI-FLUSH FRONT VIEW

1 1/2" = 1'-0" re: /



NOTES:
1. REFERENCE FLOOR PLANS FOR CONDUIT SIZE AND QUANTITY.

A08 SURFACE MOUNT (S) FRONT VIEW

1 1/2" = 1'-0" re: /

PENDULUM

PROJECT
HAGERSTOWN BALLPARK
CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT
ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT
MD STADIUM AUTHORITY
CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS
CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388
STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348
MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972
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MADISON, WI 53704
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HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

Project **20220903_MSA**
Issued: 08/15/2022

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

SHEET TITLE
BROADCAST BOX MOUNTING DETAILS

SHEET NUMBER
AV1207

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Project Management Initials:
Designer: Designer Checked: Checker Approved: Approver
Last Plotted: 8/15/2022 4:00:24 PM
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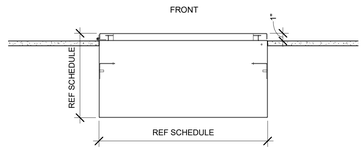
ARCH E1 30" x 42"

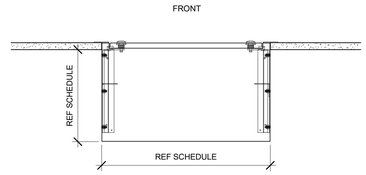
GENERAL NOTES
1. REFER TO JUNCTION BOX SCHEDULE FOR BOX SIZE AND FEATURES. 2. ELECTRICAL DEVICES SHOWN FOR REFERENCE ONLY. REFER TO ELECTRICAL DRAWINGS FOR SPECIFIC DETAILS.

NOTES:
1. LOCATE LABEL AT THE TOP OF EACH FIELD JBT DOOR.
2. LABEL TO BE OF RTS HIGH PERFORMANCE VINYL.
3. LABEL COLOR TO CONTRAST AGAINST BACKGROUND COLOR
4. BOX DESCRIPTION TO MATCH BOX LOCATION IN BOX SCHEDULE.

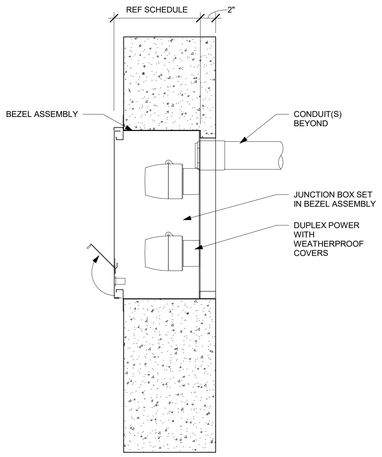
9 JBT, JBE/T, JBE, JBA/R LABEL
NTS re: /



6 OUTDOOR FLUSH (F) BOTTOM VIEW
1 1/2" = 1'-0" re: /

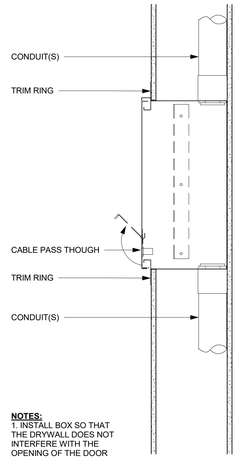


3 FLUSH MOUNT/RECESS DOOR (FM/RD) BOTTOM VIEW
1 1/2" = 1'-0" re: /



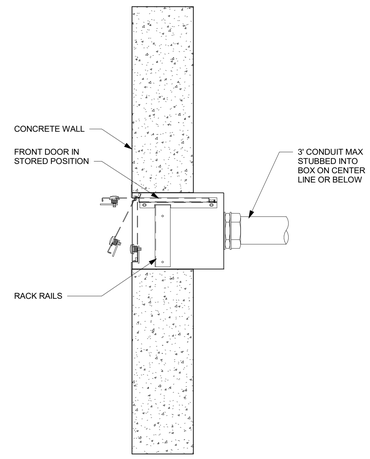
NOTES:
1. THE TUB SHOULD ALLOW THE BOX DOOR TO PROTRUDE 1" TO ALLOW REMOVAL OF THE BROADCAST BOX DOOR.

8 FILED WALL JUNCTION BOX SIDE VIEW
1 1/2" = 1'-0" re: /



NOTES:
1. INSTALL BOX SO THAT THE DRYWALL DOES NOT INTERFERE WITH THE OPENING OF THE DOOR

5 OUTDOOR FLUSH (F) SIDE VIEW
1 1/2" = 1'-0" re: /



2 FLUSH MOUNT/RECESS DOOR (FM/RD) SIDE VIEW
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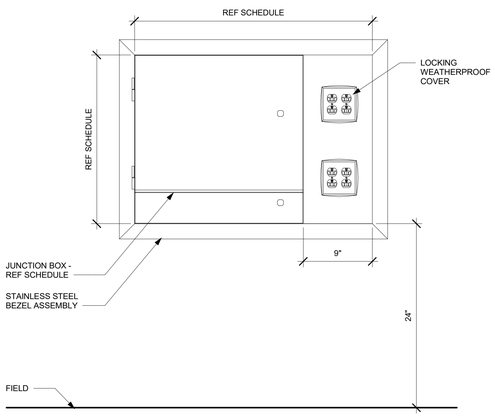
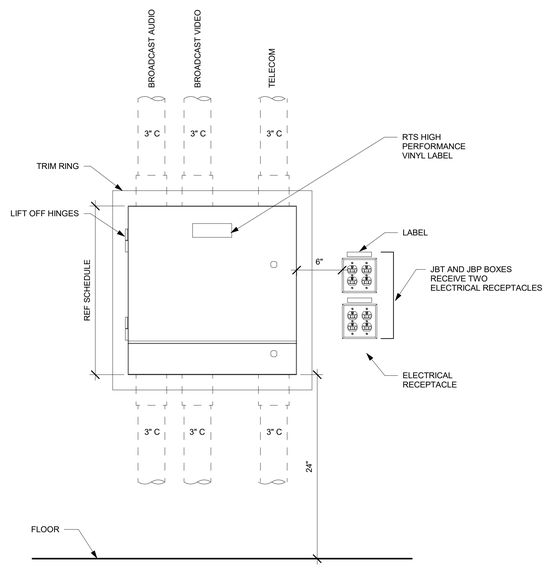
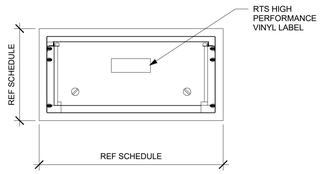


7 FIELD WALL JUNCTION BOX ELEVATION
1 1/2" = 1'-0" re: /



4 OUTDOOR FLUSH (F) FRONT VIEW
1 1/2" = 1'-0" re: /



NOTE:
1. BOX TYPICALLY USED IN FACE OF SEATING RISER

1 FLUSH MOUNT/RECESS DOOR (FM/RD)
1 1/2" = 1'-0" re: /

PENDULUM

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CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT
ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

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Project **20220903_MSA**
Issued: 08/15/2022

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

SHEET TITLE
BROADCAST BOX DETAILS

SHEET NUMBER
AV1208

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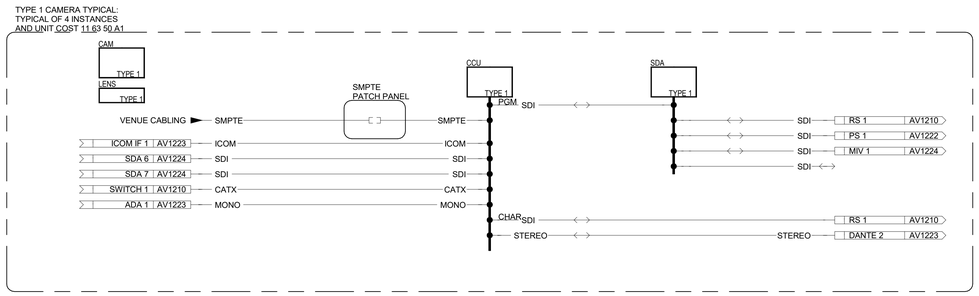

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1512 Holmes
Kansas City, MO 64108
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CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

Project **20220903_MSA**
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I/R	DATE	DESCRIPTION

KEY PLAN

SHEET TITLE

VIDEO PRODUCTION FUNCTIONALS - CAMERAS

SHEET NUMBER

AV1220

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ARCH E1 30" x 42"
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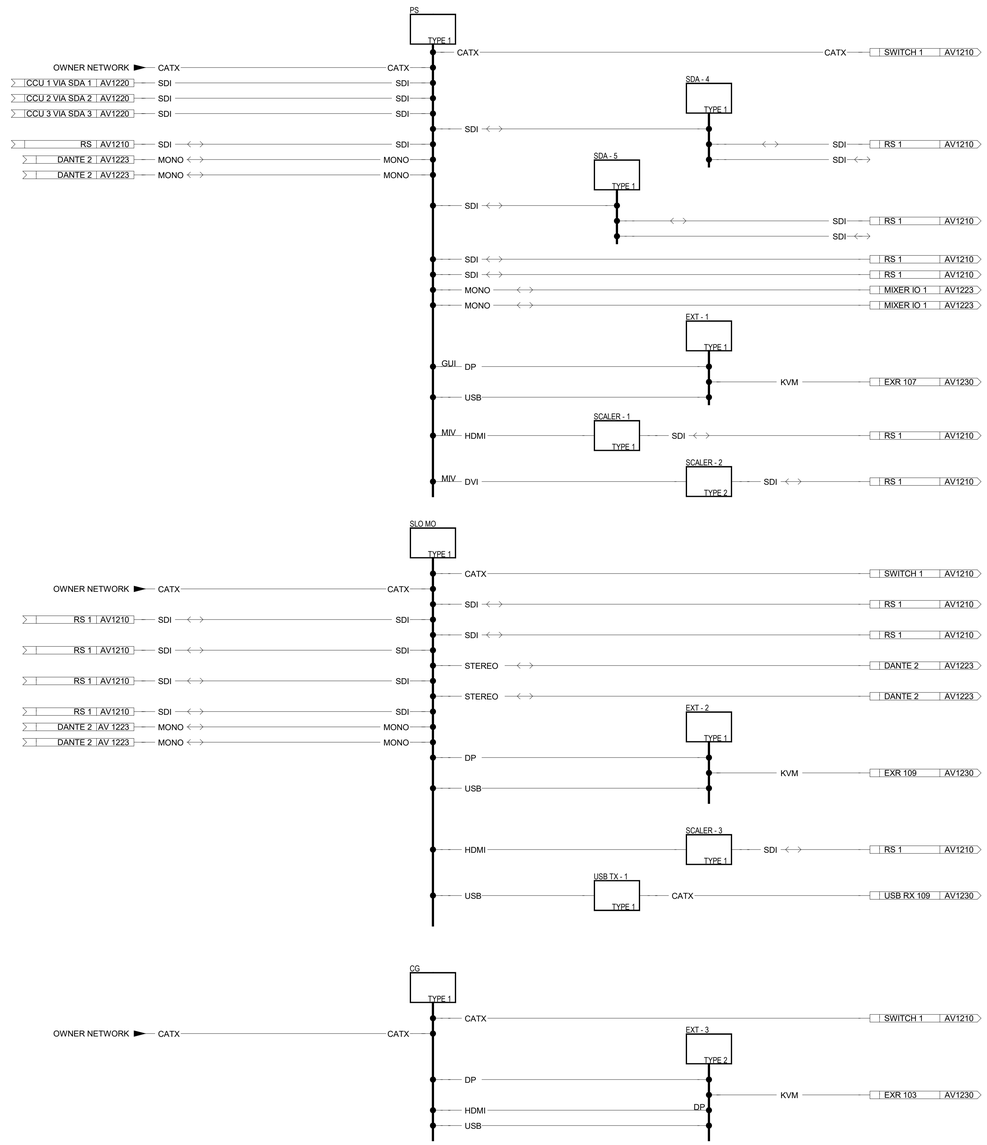

PENDULUM

PROJECT

HAGERSTOWN BALLPARK

CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

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KEY PLAN

SHEET TITLE

VIDEO PRODUCTION FUNCTIONALS - SWITCHER, CLIPS & CG

SHEET NUMBER

AV1222

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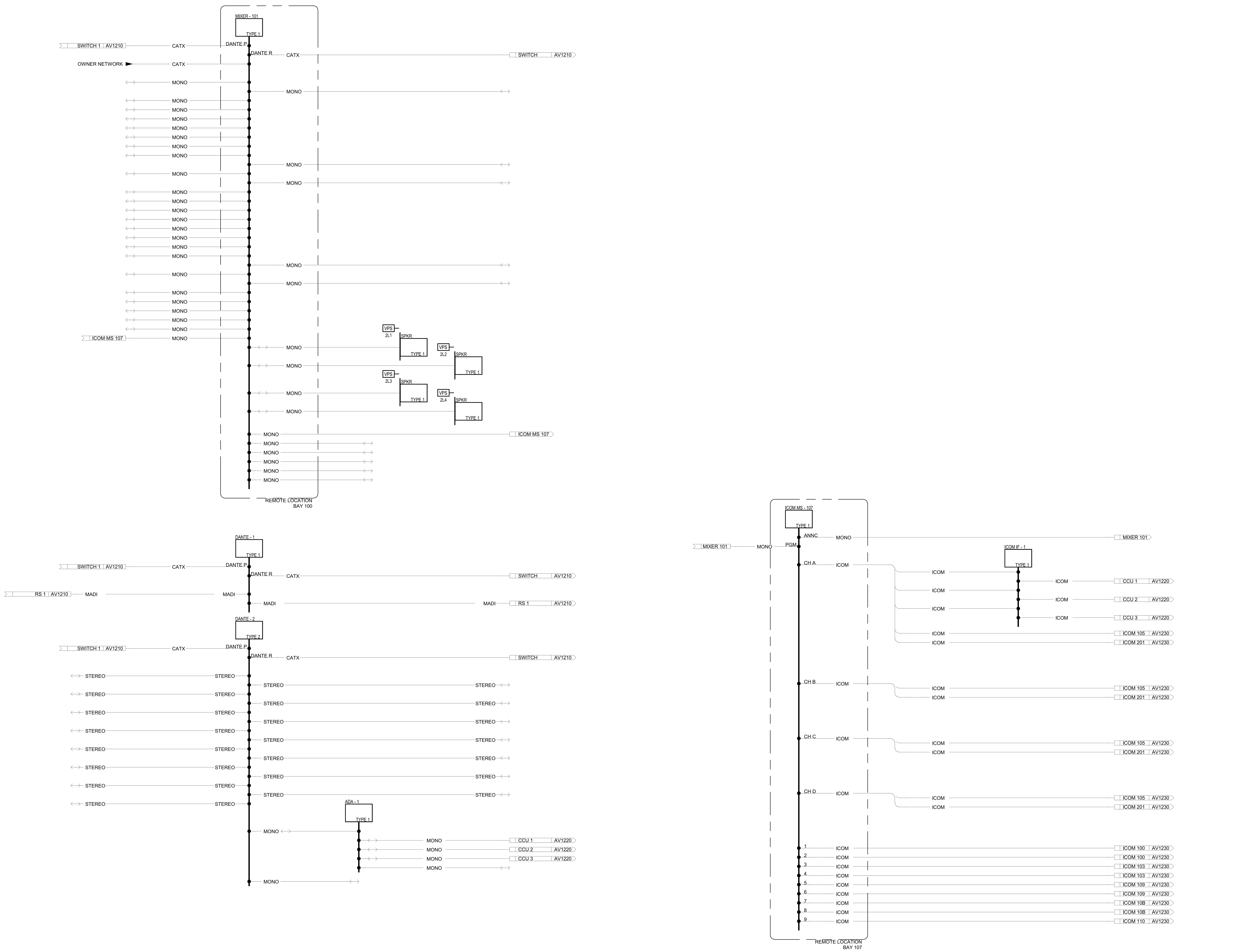

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CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY
CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
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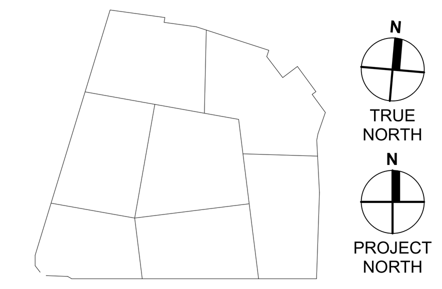

SHEET TITLE

VIDEO PRODUCTION FUNCTIONALS - AUDIO & ICOM

SHEET NUMBER

AV1223

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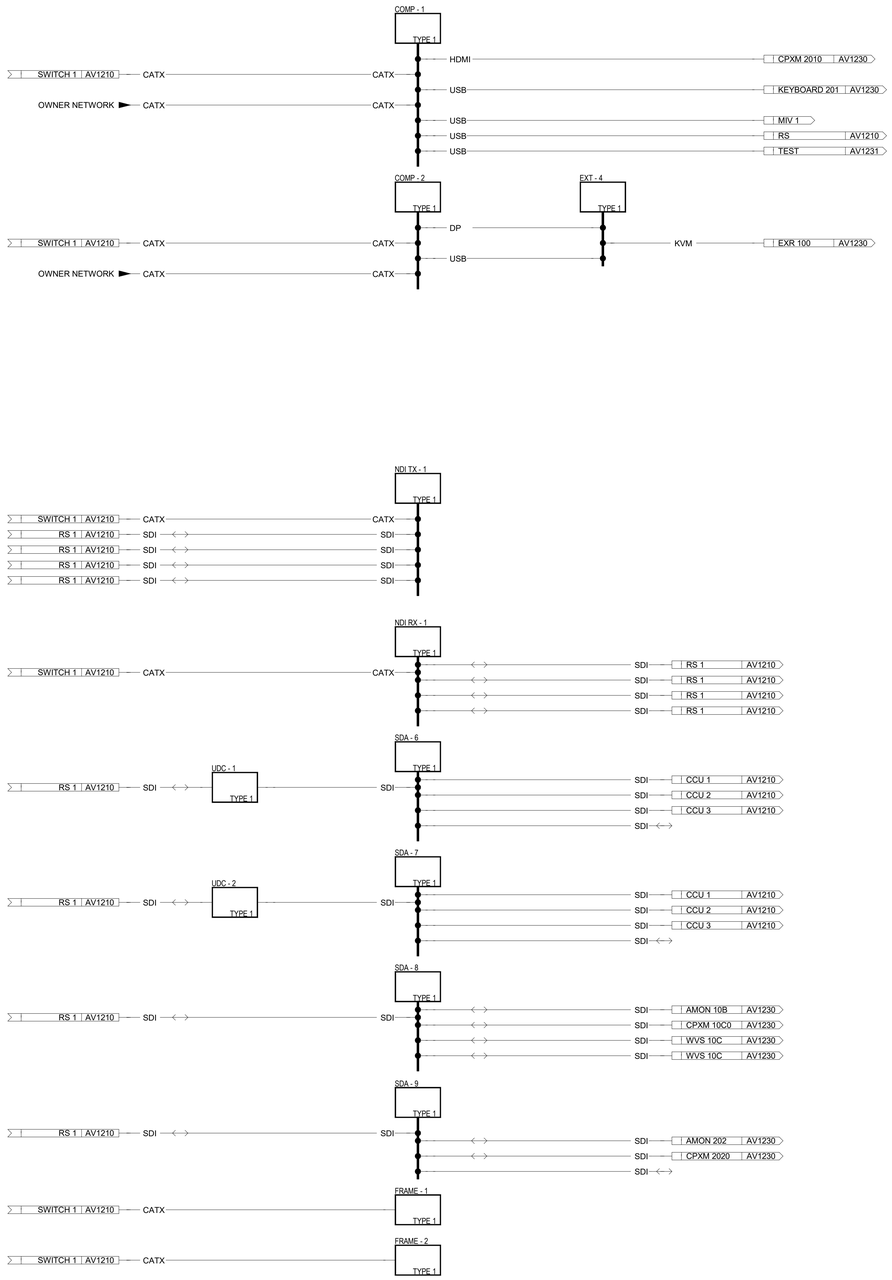

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PROJECT

HAGERSTOWN BALLPARK
CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY
CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

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HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

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SHEET TITLE

VIDEO PRODUCTION FUNCTIONALS - SUPPORT EQUIPMENT

SHEET NUMBER

AV1224

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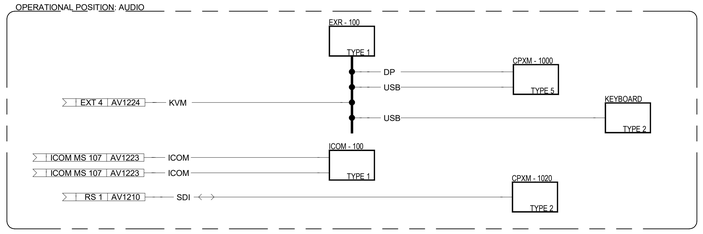
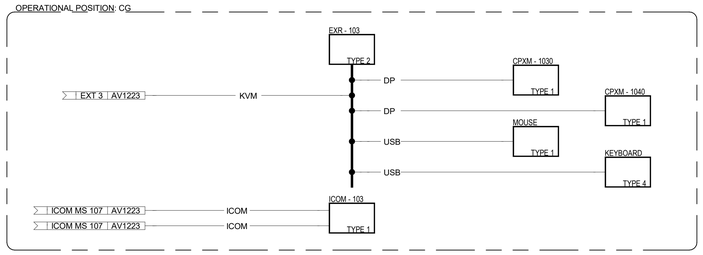
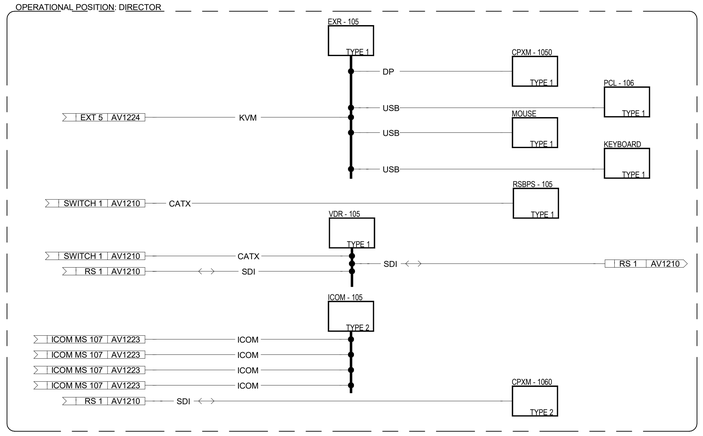


OPERATIONAL POSITION: CG



OPERATIONAL POSITION: DIRECTOR



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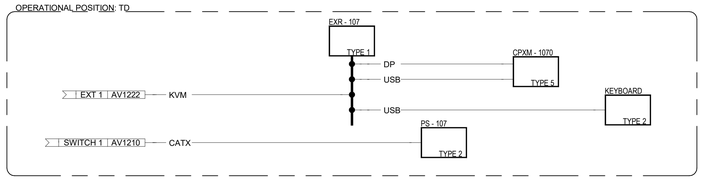
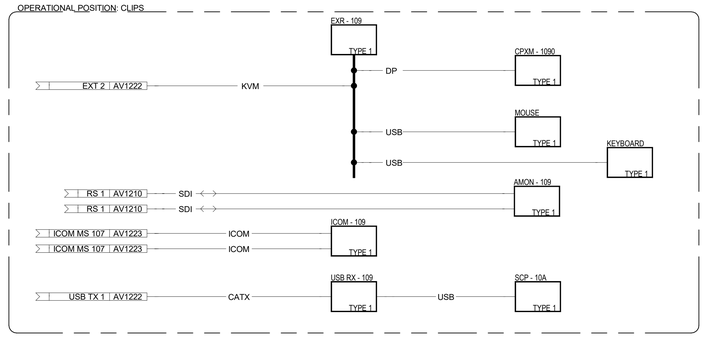
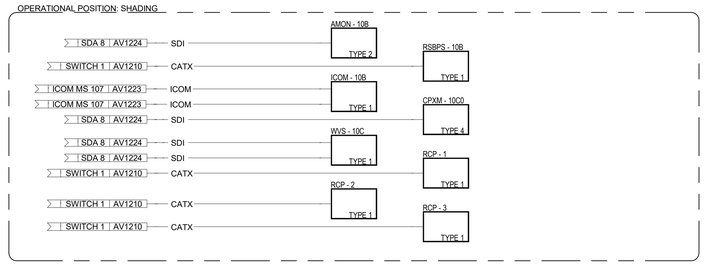


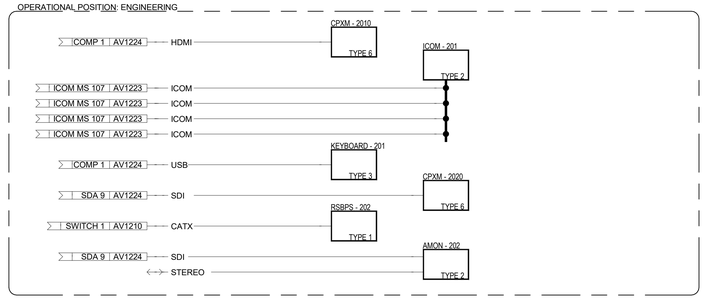
OPERATIONAL POSITION: CLIPS

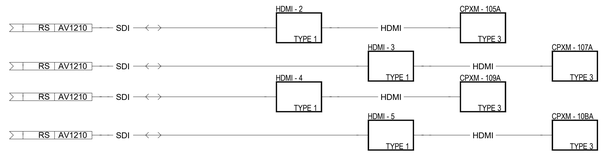


OPERATIONAL POSITION: SHADING



OPERATIONAL POSITION: ENGINEERING





PENDULUM

PROJECT

HAGERSTOWN BALLPARK
CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY
CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

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KEY PLAN

SHEET TITLE

VIDEO PRODUCTION FUNCTIONALS - OPERATIONAL POSITIONS

SHEET NUMBER

AV1230

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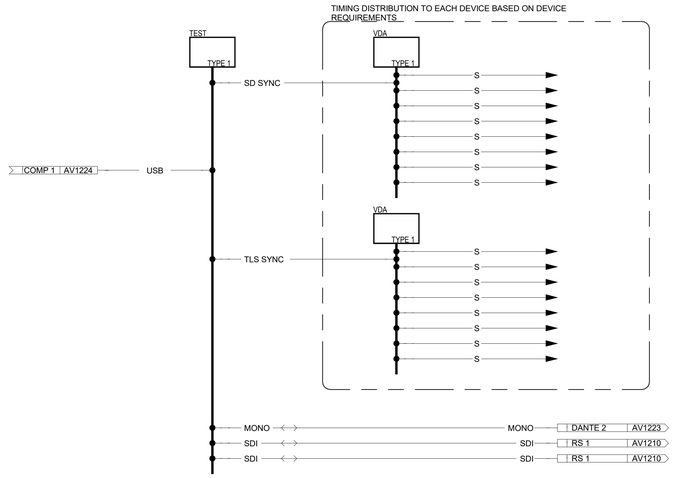

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PROJECT

HAGERSTOWN BALLPARK

CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

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KEY PLAN

SHEET TITLE

VIDEO PRODUCTION FUNCTIONALS - TIMING & SYCHRONIZATION

SHEET NUMBER

AV1231

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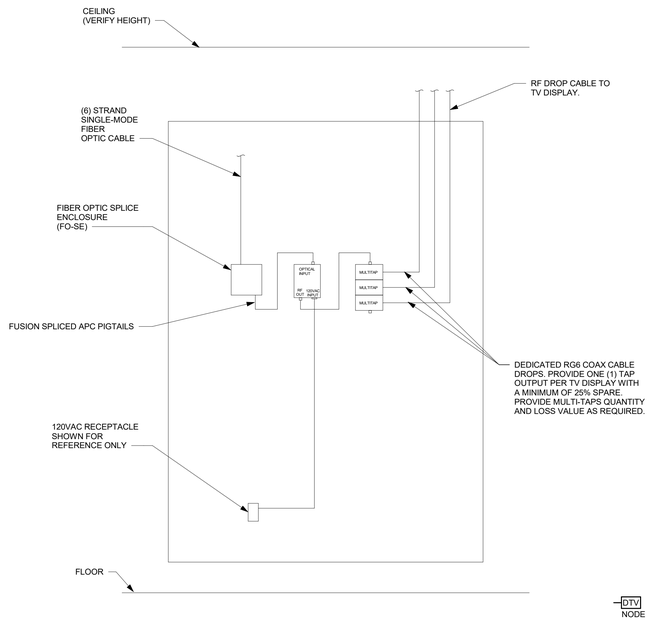

A02 DTV NODE CONCEPT

NTS re: /

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PROJECT

HAGERSTOWN BALLPARK
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HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD
PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY
CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

CONSULTANTS

CIVIL ENGINEERING
SITE RESOURCES
14315 JARRETTSVILLE PIKE, P.O. Box 249
PHOENIX, MD 21131-0249
tel - 410-683-3388

STRUCTURAL ENGINEER
THORNTON TOMASETTI
2001 K STREET, NW, STE 600 N
WASHINGTON, DC, 20006
tel - 202-580-6348

MEP/FP/SUSTAINABILITY
ELEVAR
555 CARR STREET
CINCINNATI, OH, 45203
tel - 513-744-2972

FOOD SERVICE
CAPITAL FOODSERVICE DESIGN
1522 LAKE VIEW AVENUE
MADISON, WI 53704
tel - 608-514-4373

AV / BROADCAST / SCOREBOARD
WJHW
12175 NETWORK BLVD, STE 150
SAN ANTONIO, TX 78249
tel - 972-934-3700

PLAYING FIELD
KIMLEY HORN
805 PENNSYLVANIA AVE, STE 150
KANSAS CITY, MO, 64105
tel - 913-318-8488

GEOTECHNICAL ENGINEER
HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

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DTV FUNCTIONAL DIAGRAM

SHEET NUMBER

AV1410

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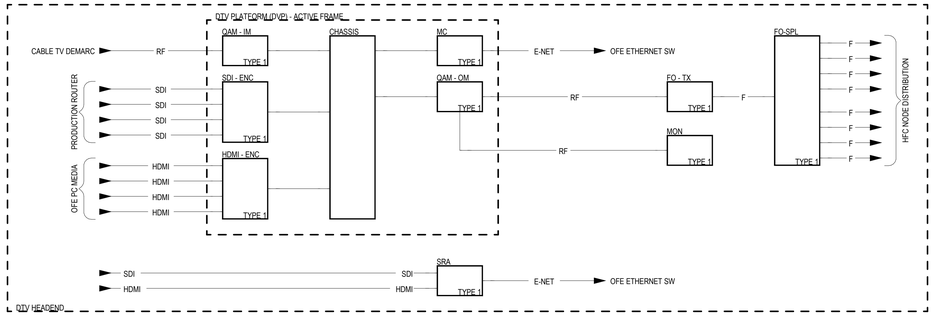

A03 DTV FUNCTIONAL DIAGRAM

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HAGERSTOWN BALLPARK

CORNER OF
SUMMIT AVE AND BALTIMORE ST
HAGERSTOWN, MD

ARCHITECT

ARCHITECT OF RECORD

PENDULUM STUDIO LLC
1512 Holmes
Kansas City, MO 64108
tel - 816.335.3030

CLIENT

MD STADIUM AUTHORITY

CEDRIC LOWE
351 WEST CAMDEN ST., STE 300
BALTIMORE, MD 21201
tel - 410-458-4410 email - clowe@mdstad.com
www.mdstad.com

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SITE RESOURCES
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PHOENIX, MD 21131-0249
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THORNTON TOMASETTI
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MEP/FP/SUSTAINABILITY
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MADISON, WI 53704
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KANSAS CITY, MO, 64105
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HILLIS CARNES
10228 GOVERNOR LANE, STE 3007
WILLIAMSPORT, MD, 21795
tel - 301-582-4662

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KEY PLAN

SHEET TITLE

DTV RISER DIAGRAM

SHEET NUMBER

AV1411

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August 15, 2022

Design Document Set
Specifications for
Hagerstown New Ballpark

Prepared By
Pendulum Studio
1512 Holmes Street
Kansas City, MO 64108

SEAL

Design Development Specifications for Hagerstown New Ballpark

*Highlighted sections included in this submission

*Green Highlighted sections indicate potential sections not included in this set

*Red Box indicates sections to be included, but not in this set

Section	Title
Division 01 – General Requirements	
011000	Summary
012300	Alternates
012500	Substitution Procedures
012600	Contract Modification Procedures
012900	Payment Procedures
013100	Project Management and Coordination
013200	Construction Progress Documentation
013300	Submittal Procedures
014000	Quality Requirements
014200	References
014500	Structural Testing and Inspections - Stadium
015000	Temporary Facilities and Controls
016000	Product Requirements
017300	Execution
017419	Construction Waste Management and Disposal
017700	Closeout Procedures
017823	Operation and Maintenance Data
017839	Project Record Documents
017900	Demonstration and Training
Division 02 - Existing Conditions	
021000	Geotechnical Report Reference Geotechnical Reports Attachment
Division 03 - Concrete	
031000	Concrete Formwork
032000	Concrete Reinforcing
033000	Cast-In-Place Concrete (Structural)
033300	Architectural Concrete
Division 04 - Masonry	
042000	Unit Masonry Assemblies
042113	Brick Masonry
Division 05 - Metals	
051200	Structural Steel Framing
051213	Architecturally Exposed Structural Steel Framing
052100	Steel Joist Framing
053000	Steel Decking (Structural)
053113	Steel Floor Decking
053123	Steel Roof Decking

054000	Cold Formed Metal Framing
054400	Cold-Formed Metal Trusses (Structural)
055025	Metal Fabrications
055050	Metal Gate Fabrications
055100	Metal Stairs
055213	Pipe and Tube Railings
057300	Decorative Metal Railings

Division 06 - Wood, Plastics, and Composites

061000	Rough Carpentry
061600	Sheathing
064023	Interior Architectural Woodwork

Division 07 - Thermal and Moisture Protection

071416	Cold Fluid Applied Waterproofing
071800	Traffic Coatings
072726	Fluid Applied Membrane Air Barrier
074113	Standing Seam Metal Roof
074616	Fiber Cement Siding
075113	Hot Applied Built-Up Asphalt Roofing
076200	Sheet Metal Flashing and Trim
077253	Snow Guards
078413	Penetration Firestopping
079200	Joint Sealants
079500	Expansion Control

Division 08 - Openings

081113	Hollow Metal Doors and Frames
081416	Flush Wood Doors
083113	Access Doors and Frames
083323	Overhead Coiling Doors
083600	Sectional Overhead Doors
084113	Aluminum Framed Entrances and Storefronts
084126	All Glass Entrances
085113	Aluminum Windows
085653	Security Windows
087100	Door Hardware
088000	Glazing
088300	Mirrors
089119	Fixed Louvers

Division 09 - Finishes

092216	Non-Structural Metal Framing
092400	Portland Cement Plastering
092900	Gypsum Board
093013	Ceramic Tiling
095000	Acoustic Ceilings
096510	Resilient Tile (LVT)
096513	Resilient Base and Accessories
095666	Resilient Athletic Flooring

096766 Fluid Applied Flooring - Epoxy
096816 Tile Carpeting
097720 FRP Wall Panels
099000 Painting
099113 Exterior Painting
099600 High Performance Coatings

Division 10 - Specialties

101400 Signs
102113 Plastic Toilet Compartments
102800 Toilet, Bath and Laundry Accessories
104413 Fire Extinguisher Cabinets
104416 Fire Extinguishers
105123 Plastic-Laminate-Clad Lockers
107500 Flagpoles

Division 11 - Equipment

114000 Food Service Equipment
114800 Athletic Equipment
116310 LED /Video Scoreboard Display
116350 Video Production System

Division 12 - Furnishings

123661 Solid Surface Countertops
126300 Fixed Audience Seating

Division 13 – Not Used

Divisions 14 – Conveying Equipment
142400 Machine Roomless Elevators
143100 Escalators
144200 Wheelchair Lifts

Division 15 - 20 - Not Used

Division 21 – Fire Suppression

210500 Common Work Results for Fire Suppression
210517 Sleeves and Sleeve Seals for Fire Suppression Piping
210518 Escutcheons for Fire Suppression Piping
210523 General Duty Valves for Fire Suppression Piping
210533 Heat Tracing for Fire Suppression Piping
210548 Seismic Controls for Fire Suppression Piping
210553 Identification for Fire Suppression Piping and Equipment
210700 Insulation for Fire Suppression Piping
211100 Facility Fire Suppression Water Service Piping
211200 Standpipe Systems
211313 Wet Pipe Sprinkler Systems
211316 Dry Pipe Sprinkler Systems
211430 Fire Suppressions Specialties

Division 22 – Plumbing
220500 Common Work Results for Plumbing
220517 Sleeves and Sleeve Seals

220518 Escutcheons for Plumbing Piping
220519 Meters and Gages for Plumbing Piping
220523 General Duty Valves for Plumbing Piping
220529 Hangers and Supports for Plumbing Piping and Equipment
220533 Heat Tracing for Plumbing Piping
220548 Seismic Controls for Plumbing Piping
220553 Identification for Plumbing Piping and Equipment
220700 Insulation for Plumbing Piping
221113 Facility Water Distribution Piping
221116 Domestic Water Piping
221123 Domestic Water Booster Pump
221313 Facility Sanitary Sewers
221316 Sanitary Water and Vent Piping
221423 Storm Drain Piping
221429 Sump Pumps
221430 Plumbing Specialties
221523 Natural Gas Piping
223300 Electric Domestic Water Heaters
223400 Fuel Fired Domestic Water Heaters
224000 Plumbing Fixtures

Division 23 – Heating, Ventilating, and Air Conditioning

230000 General HVAC
230500 Common Work Results for HVAC
230513 Common Motor Requirements for HVAC Systems
230515 General Piping Requirements
230519 Meters Gages for HVAC Piping
230529 Hangers and Supports for HVAC Piping and Equipment
230548 Vibration Controls for HVAC Piping and Equipment
230553 Identification for HVAC Piping and Equipment
230593 Testing, Adjusting, and Balancing for HVAC
230700 Pipe Insulation
230702 Duct Insulation
230800 HVAC Commissioning
230900 Instrumentation and Controls for HVAC
230993 Sequence of Operations for HVAC Controls
232300 Refrigerant Piping
233113 Metal Ducts
233300 Air Duct Accessories
233423 HVAC Fans
233713 Diffusers, Registers, and Grilles
236200 Air Cooled Condensing Units
233813 Commercial Kitchen Hoods
237413 Packaged Rooftop Units
237433 Dedicated Outside Air Units
238166 Variable Refrigerant Flow Systems
238238 Cabinet Unit Heaters
238240 Electric Heaters

Divisions 24 – 25 – Not Used

Division 26 – Electrical

260500	General Electrical Provisions
260510	Apparatus Coordination, Inspection and Testing
260512	Electrical Powered Equipment
260519	Electrical Power Conductors and Cables
260526	Grounding and Bounding for Electrical Systems
260529	Hangers and Supports for Electrical Systems
260533	Raceway and Boxes for Electrical Systems
260534	Junction and Pull Boxes
260535	Raceway Fittings
260553	Identification for Electrical Systems
260923	Lighting Control Devices
260943	Exterior Wireless Network Lighting Controls
262200	Low Voltage Transformer
262416	Switchboards and Panelboards
262653	Electric Vehicle Charging Equipment
252713	Electricity Metering
262726	Wiring Devices
262730	Taps, Splices and Terminations
262813	Fuses
262816	Enclosed Switches and Circuit Breakers
262913.03	Manual and Magnetic Motor Controllers
262923	Adjustable Frequency Driver
263213	Engine Generator-Natural Gas
263600	Automatic Transfer Switches
264113	Lightning Protection System
264310	SPD-Waveform Corrector
264400	Electrical Service for Elevators
265119	LED Interior Lighting
265619	LED Exterior Lighting
265668	Exterior Athletic Lighting

Division 27 – Communications

271000	Structured Cabling System
270525	Firestopping
270526	Grounding and Bonding for Communications Systems
270528	Pathways for Communications Systems
270529	Hangers and Supports for Communications Systems
270536	Cable Trays for Communications Systems
270544	Sleeves and Seals for Communications Pathways and Cabling
274116	Integrated Audio-Video Systems and Equipment
27343	Distribution Television System
274140	IPTV Distribution System
274143	Installation of Television Displays & Mounts

Division 28 – Electronic Safety and Security

280500	Common Work Results for Electronic Safety
280513	Conductors and Cables for Electronic Security
280526	Grounding and Bonding for Electronic Safety and Security Systems
280528	Electronic Safety and Security Systems Pathways and Support Equipment
281000	Access Control
282000	Video Surveillance
283100	Fire Detection and Alarm

Division 31 – Earthwork

311000	Site Clearing
312000	Earth Moving
316100	Footings
316329	Caissons

Division 32 - Exterior Improvements

321216	Asphalt Paving
321313	Concrete Paving
323113	Chain Link Fences and Gates
323119	Ornamental Metal Fence System
321823.29	Synthetic Turf System

Division 33 – Site Utilities

330500	Common Work Results for Utilities
334100	Storm Utility Drainage Piping

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SECTION 011000 – SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Access to site.
4. Work restrictions.
5. Specification and drawing conventions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

A. Project Identification: Hagerstown New Ballpark

1. Project Location: Corner of Summit Avenue and Baltimore Street, Hagerstown, MD

B. Owner: Maryland Stadium Authority

C. Architect: Pendulum Studio, 1512 Holmes Street Kansas City, MO 64108, (816) 335-3030.

Principal In Charge, Jonathan O'Neil Cole, AIA, NCARB, NOMA

D. Architect's Stadium Consultants: The Architect and/or Owner has retained the following design professionals who have prepared designated portions of the Contract Documents:

1. Civil Engineering –
   - Site Resources
   - 14315 Jarrettsville Pike, P.O. Box 249
   - Phoenix, MD 21131
   - 410-683-3388
2. Structural Engineer –
   - Thornton Tomasetti
   - 2001 K Street, NW, STE 600 N
   - Washington, DC, 2006
   - 202-580-6348
3. Mechanical, Electrical, Plumbing, Fire Protection & Sustainability Engineer –
   - Elevar
   - 555 Carr Street
   - Cincinnati, OH 45203
   - 513-744-2972
4. Food Service –
   - Capital Foodservice Design

- 1522 Lake View Avenue
- Madison, WI 53704
- 608-514-4373

5. AV, Broadcast, Scoreboard Engineer –
   - WJHW
   - 12175 Network Boulevard, STE 150
   - San Antonio, TX 78249
   - 972-934-3700
6. Playing Field Engineer –
   - Kimley-Horn
   - 805 Pennsylvania Ave, STE 150
   - Kansas City, MO 64105
   - 913-318-8488
7. Geotechnical Engineer –
   - Hillis Carnes
   - 10228 Governor Lane, STE 3007
   - Williamsport, MD 21795
   - 301-582-4662

E. Other Owner Consultants: The Owner has retained the following design professionals who have prepared designated portions of the Contract Documents:

a. Verify with Owner.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. The Hagerstown Multi-Purpose Facility located at the corner of Summit and Baltimore in downtown Hagerstown, MD will be a state-of-the-art multipurpose facility meeting or exceeding. Current Minor League Facility Standards for Double A prepared by Major League Baseball (Facility Standards). Amenities will include not only high-level professional baseball, but also other sports including football, soccer, lacrosse, cheerleading and band competitions, etc., as well as concerts, group outings, and Esports events. The design shall also meet Atlantic League of Professional Baseball (ALPB) Standards.

   Generally speaking, the scope of work for this project shall accommodate a capacity of 5,000 patrons, which includes fixed seating, group areas, areas designated for standing room only (SRO), eight (8) enclosed premium skyboxes, and an enclosed premium banquet/club space that accommodates a minimum of 300 patrons.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.5 ACCESS TO SITE

A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

B. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1.6 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet (8 m) of entrances, operable windows, or outdoor-air intakes.

C. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.

D. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

E. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.

1. Maintain list of approved screened personnel with Owner's representative.

1.7 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Execute accepted alternates under the same conditions as other work of the Contract.

C. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Refer to Drawings.

END OF SECTION 012300

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:

1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.

1.4 ACTION SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use form acceptable to Architect or CSI Form 13.1A.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.

e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Substitution request is fully documented and properly submitted.
c. Requested substitution will not adversely affect Contractor's construction schedule.
d. Requested substitution has received necessary approvals of authorities having jurisdiction.
e. Requested substitution is compatible with other portions of the Work.
f. Requested substitution has been coordinated with other portions of the Work.
g. Requested substitution provides specified warranty.
h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Not allowed unless otherwise indicated.

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

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SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

B. Related Requirements:

1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
c. Include costs of labor and supervision directly attributable to the change.
d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
e. Quotation Form: Use CSI Form 13.6D, "Proposal Worksheet Summary," and Form 13.6C, "Proposal Worksheet Detail."

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Requirements:

1. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
2. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule. Cost-loaded Critical Path Method Schedule may serve to satisfy requirements for the schedule of values.

1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:

   a. Application for Payment forms with continuation sheets.
   b. Submittal schedule.
   c. Items required to be indicated as separate activities in Contractor's construction schedule.

2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
3. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:

a. Project name and location.
b. Name of Architect.
c. Architect's project number.
d. Contractor's name and address.
e. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703.
3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:

   a. Related Specification Section or Division.
   b. Description of the Work.
   c. Name of subcontractor.
   d. Name of manufacturer or fabricator.
   e. Name of supplier.
   f. Change Orders (numbers) that affect value.
   g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

      1) Labor.
      2) Materials.
      3) Equipment.

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

   a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.

7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate owner payments or deposits, if any, and balance to be paid by Contractor.
9. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

   a. Temporary facilities and other major cost items that are not direct cost of actual work-in- place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

10. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
4. Indicate separate amounts for work being carried out under Owner-requested projectacceleration.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:

a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit executed waivers of lien on forms, acceptable to Owner.

H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule (preliminary if not final).
4. Submittal schedule (preliminary if not final).
5. List of Contractor's staff assignments.
6. List of Contractor's principal consultants.
7. Copies of building permits.
8. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
9. Initial progress report.
10. Report of preconstruction conference.
11. Certificates of insurance and insurance policies.
12. Performance and payment bonds.
13. Data needed to acquire Owner's insurance.

I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

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SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. Requests for Information (RFIs).
4. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

C. Related Requirements:

1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

A. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home,

office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1.6 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.

d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
f. Indicate required installation sequences.
g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
2. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
3. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
4. Mechanical and Plumbing Work: Show the following:

   a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.

5. Electrical Work: Show the following:

   a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
   b. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.

6. Fire-Protection System: Show the following:

   a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.

7. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
2. File Submittal Format: Submit or post coordination drawing files using Portable Data File (PDF) format.
3. BIM File Incorporation: Develop and incorporate coordination drawing files into Building Information Model established for Project.
4. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.

   a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.

b. Digital Data Software Program: Drawings are available in digital data software program to be confirmed.
c. Contractor shall execute a data licensing agreement in the form of AIA Document C106.

1.7 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Project number.
3. Date.
4. Name of Contractor.
5. Name of Architect.
6. RFI number, numbered sequentially.
7. RFI subject.
8. Specification Section number and title and related paragraphs, as appropriate.
9. Drawing number and detail references, as appropriate.
10. Field dimensions and conditions, as appropriate.
11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
12. Contractor's signature.
13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: AIA Document G716.

1. Attachments shall be electronic files in Adobe Acrobat PDF format.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

a. Requests for approval of submittals.
b. Requests for approval of substitutions.
c. Requests for approval of Contractor's means and methods.
d. Requests for coordination information already indicated in the Contract Documents.
e. Requests for adjustments in the Contract Time or the Contract Sum.
f. Requests for interpretation of Architect's actions on submittals.
g. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."

    a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log at project meetings. Software log with not less than the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

1.8 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Conduct the conference to review responsibilities and personnel assignments.
2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect progress, including the following:

    a. Tentative construction schedule.
    b. Critical work sequencing and long-lead items.
    c. Designation of key personnel and their duties.
    d. Lines of communications.
    e. Procedures for processing field decisions and Change Orders.

f. Procedures for RFIs.
g. Procedures for testing and inspecting.
h. Procedures for processing Applications for Payment.
i. Distribution of the Contract Documents.
j. Submittal procedures.
k. Preparation of record documents.
l. Use of the premises.
m. Work restrictions.
n. Working hours.
o. Owner's occupancy requirements.
p. Responsibility for temporary facilities and controls.
q. Procedures for moisture and mold control.
r. Procedures for disruptions and shutdowns.
s. Construction waste management and recycling.
t. Parking availability.
u. Office, work, and storage areas.
v. Equipment deliveries and priorities.
w. First aid.
x. Security.
y. Progress cleaning.

4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect and Owner's Commissioning Authority of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

a. Contract Documents.
b. Related RFIs.
c. Related Change Orders.
d. Purchases.
e. Deliveries.
f. Submittals.
g. Review of mockups.
h. Possible conflicts.
i. Compatibility requirements.
j. Time schedules.
k. Weather limitations.
l. Manufacturer's written instructions.
m. Warranty requirements.
n. Compatibility of materials.
o. Acceptability of substrates.
p. Temporary facilities and controls.
q. Space and access limitations.
r. Regulations of authorities having jurisdiction.
s. Testing and inspecting requirements.
t. Installation procedures.
u. Coordination with other work.

v. Required performance results. Protection of adjacent work.
w. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

a. Preparation of record documents.
b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
c. Submittal of written warranties.
d. Requirements for preparing operations and maintenance data.
e. Requirements for delivery of material samples, attic stock, and spare parts.
f. Requirements for demonstration and training.
g. Preparation of Contractor's punch list.
h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
i. Submittal procedures.
j. Installation of Owner's furniture, fixtures, and equipment.
k. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

E. Progress Meetings: Conduct progress meetings at weekly intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule

revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

1) Review schedule for next period.

b. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Resolution of BIM component conflicts.
4) Status of submittals.
5) Deliveries.
6) Off-site fabrication.
7) Access.
8) Site utilization.
9) Temporary facilities and controls.
10) Progress cleaning.
11) Quality and work standards.
12) Status of correction of deficient items.
13) Field observations.
14) Status of RFIs.
15) Status of proposal requests.
16) Pending changes.
17) Status of Change Orders.
18) Pending claims and disputes.
19) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Startup construction schedule.
2. Contractor's construction schedule.
3. Construction schedule updating reports.
4. Daily construction reports.
5. Material location reports.
6. Site condition reports.
7. Special reports.

B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submitting schedules and reports.
2. Section 014000 "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Event: The starting or ending point of an activity.

1.4 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file, where indicated.
2. PDF electronic file.

B. Startup construction schedule.

1. Approval of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.

E. Construction Schedule Updating Reports: Submit with Applications for Payment.

F. Daily Construction Reports: Submit at monthly intervals.

G. Material Location Reports: Submit at monthly intervals.

H. Site Condition Reports: Submit at time of discovery of differing conditions.

I. Special Reports: Submit at time of unusual event.

1.5 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's construction schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.

3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
2. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
3. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

    a. Submittals.
    b. Purchases.
    c. Mockups.
    d. Fabrication.
    e. Deliveries.
    f. Installation.
    g. Tests and inspections.
    h. Adjusting.
    i. Startup and placement into final use and operation.

4. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

    a. Structural completion.
    b. Permanent space enclosure.
    c. Completion of mechanical installation.
    d. Completion of electrical installation.
    e. Substantial Completion.

D. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.

1. See Section 012900 "Payment Procedures" for cost reporting and payment procedures.

E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittal

Pending modifications affecting the Work and Contract Time.

F. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

G. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

2.2 STARTUP CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Submit startup, horizontal, bar-chart-type construction schedule within seven days of date established for the Notice to Proceed.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 30 days of date established for the Notice to Proceed. Base schedule on the startup construction schedule and additional information received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

2.4 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. Approximate count of personnel at Project site.
3. Equipment at Project site.
4. Material deliveries.
5. Accidents.
6. Meetings and significant decisions.
7. Unusual events (see special reports).
8. Orders and requests of authorities having jurisdiction.
9. Services connected and disconnected.
10. Equipment or system tests and startups.
11. Substantial Completions authorized.

B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials

or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

1. Material stored prior to previous report and remaining in storage.
2. Material stored prior to previous report and since removed from storage and installed.
3. Material stored following previous report and remaining in storage.

C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.5 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate final completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

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SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
3. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
4. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
5. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

C. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.

    a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

    a. Scheduled date for first submittal.
    b. Specification Section number and title.
    c. Submittal category: Action; informational.
    d. Name of subcontractor.
    e. Description of the Work covered.
    f. Scheduled date for Architect's final release or approval.
    g. Scheduled dates for purchasing.
    h. Scheduled dates for installation.
    i. Activity or event number.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.

1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.

    a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
    b. Digital Drawing Software Program: The Contract Drawings are available in Revit or AutoCAD exported from Revit.
    c. Contractor shall execute a data licensing agreement in the form of AIA Document C106, Digital Data Licensing Agreement.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Do not combine submittals from different specification sections. Submittal packages that contain items from multiple specification sections will be returned without review.
5. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 21 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 21 days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.

D. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.

   a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., ABSCB-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., ABSCB-061000.01.A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner, containing the following information:

   a. Project name.
   b. Date.
   c. Name and address of Architect.
   d. Name of Contractor.
   e. Names of subcontractor, manufacturer, and supplier.
   f. Category and type of submittal.
   g. Submittal purpose and description.
   h. Specification Section number and title.
   i. Drawing number and detail references, as appropriate.
   j. Location(s) where product is to be installed, as appropriate.
   k. Related physical samples submitted directly.
   l. Transmittal number, numbered consecutively.
   m. Other necessary identification.

5. Metadata: Include the following information as keywords in the electronic submittal file metadata:

   a. Project name.
   b. Number and title of appropriate Specification Section.
   c. Manufacturer name.

d. Product name.

E. Options: Identify options requiring selection by Architect.

F. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

I. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Submit electronic submittals via email as PDF electronic files.

a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

2. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

a. Manufacturer's catalog cuts.
b. Manufacturer's product specifications.
c. Standard color charts.
d. Testing by recognized testing agency.

e. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

a. Wiring diagrams showing factory-installed wiring.
b. Operational range diagrams.
c. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:

a. PDF electronic file.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

a. Identification of products.
b. Compliance with specified standards.
c. Notation of coordination requirements.
d. Notation of dimensions established by field measurement.
e. Relationship and attachment to adjoining construction clearly indicated.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm), but no larger than 24 by 36 inches (610 by 915 mm).
3. Submit Shop Drawings in the following format:

a. PDF electronic file.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:

a. Generic description of Sample.
b. Product name and name of manufacturer.
c. Sample source.
d. Number and title of applicable Specification Section.
e. Specification paragraph number and generic name of each item.

3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

a. Number of Samples: Submit three sets of Samples. Architect will retain one Sample set; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.

1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

E. Coordination Drawing Submittals: Comply with requirements specified in Section 013100 "Project Management and Coordination."

F. Contractor's Construction Schedule: Comply with requirements specified in Section 013200 "Construction Progress Documentation."

G. Application for Payment and Schedule of Values: Comply with requirements specified in Section 012900 "Payment Procedures."

H. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."

I. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."

J. Maintenance Data: Comply with requirements specified in Section 017823 "Operation and Maintenance Data."

K. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

L. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

2.2 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

C. BIM File Incorporation: Incorporate delegated-design drawing and data files into Building Information Model established for Project.

1. Prepare delegated-design drawings in the following format: Same digital data software program, version, and operating system as the original Drawings.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

A. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

B. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

C. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

D. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, Commissioning Authority, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Requirements:

1. Divisions 02 through 32 Sections for testing and inspecting requirements.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 ACTION SUBMITTALS

A. Shop Drawings: For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.

1. Indicate manufacturer and model number of individual components.
2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.6 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:

1. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.

B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. Project quality-control manager may also serve as Project superintendent.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.

4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.9 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed to perform same tasks during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.

a. Allow seven days for initial review and each re-review of each mockup.

6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed unless otherwise indicated.

1.10 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

    a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

F. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect, Commissioning Authority, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.

6. Do not perform any duties of Contractor.

G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.11 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Contractor engage qualified testing agency as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect, Commissioning Authority, and Owner promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect and Commissioning Authority with copy to Owner and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's, Commissioning Authority's, reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
7. ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org.
8. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
9. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
10. AF&PA - American Forest & Paper Association; www.afandpa.org.
11. AGA - American Gas Association; www.aga.org.
12. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
13. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
14. AI - Asphalt Institute; www.asphaltinstitute.org.
15. AIA - American Institute of Architects (The); www.aia.org.
16. AISC - American Institute of Steel Construction; www.aisc.org.
17. AISI - American Iron and Steel Institute; www.steel.org.
18. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
19. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
20. ANSI - American National Standards Institute; www.ansi.org.
21. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
22. APA - APA - The Engineered Wood Association; www.apawood.org.
23. APA - Architectural Precast Association; www.archprecast.org.
24. API - American Petroleum Institute; www.api.org.
25. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
26. ARI - American Refrigeration Institute; (See AHRI).
27. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
28. ASCE - American Society of Civil Engineers; www.asce.org.
29. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
30. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
31. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
32. ASSE - American Society of Safety Engineers (The); www.asse.org.
33. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
34. ASTM - ASTM International; (American Society for Testing and Materials International); www.astm.org.
35. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
36. AWEA - American Wind Energy Association; www.awea.org.
37. AWI - Architectural Woodwork Institute; www.awinet.org.
38. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
39. AWPA - American Wood Protection Association; (Formerly: American Wood-Preservers' Association); www.awpa.com.
40. AWS - American Welding Society; www.aws.org.
41. AWWA - American Water Works Association; www.awwa.org.
42. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
43. BIA - Brick Industry Association (The); www.gobrick.com.
44. BICSI - BICSI, Inc.; www.bicsi.org.

45. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.com.
46. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
47. BOCA - BOCA; (Building Officials and Code Administrators International Inc.); (See ICC).
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bwfbadminton.org.
49. CDA - Copper Development Association; www.copper.org.
50. CEA - Canadian Electricity Association; www.electricity.ca.
51. CEA - Consumer Electronics Association; www.ce.org.
52. CFFA - Chemical Fabrics & Film Association, Inc.; www.chemicalfabricsandfilm.com.
53. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
54. CGA - Compressed Gas Association; www.cganet.com.
55. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
56. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
57. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
58. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
59. CPA - Composite Panel Association; www.pbmdf.com.
60. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
61. CRRC - Cool Roof Rating Council; www.coolroofs.org.
62. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
63. CSA - Canadian Standards Association; www.csa.ca.
64. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
65. CSI - Construction Specifications Institute (The); www.csinet.org.
66. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
67. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
68. CWC - Composite Wood Council; (See CPA).
69. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
70. DHI - Door and Hardware Institute; www.dhi.org.
71. ECA - Electronic Components Association; www.ec-central.org.
72. ECAMA - Electronic Components Assemblies & Materials Association; (See ECA).
73. EIA - Electronic Industries Alliance; (See TIA).
74. EIMA - EIFS Industry Members Association; www.eima.com.
75. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
76. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org.
77. ESTA - Entertainment Services and Technology Association; (See PLASA).
78. EVO - Efficiency Valuation Organization; www.evo-world.org.
79. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
80. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
81. FM Approvals - FM Approvals LLC; www.fmglobal.com.
82. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
83. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; www.floridaroof.com.
84. FSA - Fluid Sealing Association; www.fluidsealing.com.
85. FSC - Forest Stewardship Council U.S.; www.fscus.org.
86. GA - Gypsum Association; www.gypsum.org.
87. GANA - Glass Association of North America; www.glasswebsite.com.
88. GS - Green Seal; www.greenseal.org.
89. HI - Hydraulic Institute; www.pumps.org.
90. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
91. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).

92. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
93. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
94. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
95. IAS - International Approval Services; (See CSA).
96. ICBO - International Conference of Building Officials; (See ICC).
97. ICC - International Code Council; www.iccsafe.org.
98. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
99. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
100. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
101. IEC - International Electrotechnical Commission; www.iec.ch.
102. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
103. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
104. IESNA - Illuminating Engineering Society of North America; (See IES).
105. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
106. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
107. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
108. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
109. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
110. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
111. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
112. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
113. ISO - International Organization for Standardization; www.iso.org.
114. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
115. ITU - International Telecommunication Union; www.itu.int/home.
116. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
117. LMA - Laminating Materials Association; (See CPA).
118. LPI - Lightning Protection Institute; www.lightning.org.
119. MBMA - Metal Building Manufacturers Association; www.mbma.com.
120. MCA - Metal Construction Association; www.metalconstruction.org.
121. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
122. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
123. MHIA - Material Handling Industry of America; www.mhia.org.
124. MIA - Marble Institute of America; www.marble-institute.com.
125. MMPA - Moulding & Millwork Producers Association; (Formerly: Wood Moulding & Millwork Producers Association); www.wmmpa.com.
126. MPI - Master Painters Institute; www.paintinfo.com.
127. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
128. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
129. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
130. NADCA - National Air Duct Cleaners Association; www.nadca.com.
131. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
132. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
133. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
134. NCMA - National Concrete Masonry Association; www.ncma.org.
135. NEBB - National Environmental Balancing Bureau; www.nebb.org.
136. NECA - National Electrical Contractors Association; www.necanet.org.
137. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
138. NEMA - National Electrical Manufacturers Association; www.nema.org.

139. NETA - InterNational Electrical Testing Association; www.netaworld.org.
140. NFHS - National Federation of State High School Associations; www.nfhs.org.
141. NFPA - NFPA; (National Fire Protection Association); www.nfpa.org.
142. NFPA - NFPA International; (See NFPA).
143. NFRC - National Fenestration Rating Council; www.nfrc.org.
144. NHLA - National Hardwood Lumber Association; www.nhla.com.
145. NLGA - National Lumber Grades Authority; www.nlga.org.
146. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
147. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
148. NRCA - National Roofing Contractors Association; www.nrca.net.
149. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
150. NSF - NSF International; (National Sanitation Foundation International); www.nsf.org.
151. NSPE - National Society of Professional Engineers; www.nspe.org.
152. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
153. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
154. NWFA - National Wood Flooring Association; www.nwfa.org.
155. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
156. PDI - Plumbing & Drainage Institute; www.pdionline.org.
157. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); www.plasa.org.
158. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
159. RFCI - Resilient Floor Covering Institute; www.rfci.com.
160. RIS - Redwood Inspection Service; www.redwoodinspection.com.
161. SAE - SAE International; (Society of Automotive Engineers); www.sae.org.
162. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
163. SDI - Steel Deck Institute; www.sdi.org.
164. SDI - Steel Door Institute; www.steeldoor.org.
165. SEFA - Scientific Equipment and Furniture Association; www.sefalabs.com.
166. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
167. SIA - Security Industry Association; www.siaonline.org.
168. SJI - Steel Joist Institute; www.steeljoist.org.
169. SMA - Screen Manufacturers Association; www.smainfo.org.
170. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
171. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
172. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
173. SPIB - Southern Pine Inspection Bureau; www.spib.org.
174. SPRI - Single Ply Roofing Industry; www.spri.org.
175. SRCC - Solar Rating and Certification Corporation; www.solar-rating.org.
176. SSINA - Specialty Steel Industry of North America; www.ssina.com.
177. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
178. STI - Steel Tank Institute; www.steeltank.com.
179. SWI - Steel Window Institute; www.steelwindows.com.
180. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
181. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
182. TCNA - Tile Council of North America, Inc.; (Formerly: Tile Council of America); www.tileusa.com.
183. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
184. TIA - Telecommunications Industry Association; (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
185. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
186. TMS - The Masonry Society; www.masonrysociety.org.
187. TPI - Truss Plate Institute; www.tpinst.org.
188. TPI - Turfgrass Producers International; www.turfgrasssod.org.

189. TRI - Tile Roofing Institute; www.tileroofing.org.
190. UBC - Uniform Building Code; (See ICC).
191. UL - Underwriters Laboratories Inc.; www.ul.com.
192. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
193. USAV - USA Volleyball; www.usavolleyball.org.
194. USGBC - U.S. Green Building Council; www.usgbc.org.
195. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
196. WASTEC - Waste Equipment Technology Association; www.wastec.org.
197. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
198. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
199. WDMA - Window & Door Manufacturers Association; www.wdma.com.
200. WI - Woodwork Institute; (Formerly: WIC - Woodwork Institute of California); www.wicnet.org.
201. WMMPA - Wood Moulding & Millwork Producers Association; (See MMPA).
202. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
203. WWPA - Western Wood Products Association; www.wwpa.org.

B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
2. ICC - International Code Council; www.iccsafe.org.
3. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.
4. ASCE - American Society of Civil Engineers; www.asce.org.
5. FBC - Florida Building Code; www.floridabuilding.org.
6. FFPC - Florida Fire Prevention Code; www.nfpa.org.

C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up-to-date as of the date of the Contract Documents.

1. COE - Army Corps of Engineers; www.usace.army.mil.
2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
4. DOD - Department of Defense; http://dodssp.daps.dla.mil.
5. DOE - Department of Energy; www.energy.gov.
6. EPA - Environmental Protection Agency; www.epa.gov.
7. FAA - Federal Aviation Administration; www.faa.gov.
8. FG - Federal Government Publications; www.gpo.gov.
9. GSA - General Services Administration; www.gsa.gov.
10. HUD - Department of Housing and Urban Development; www.hud.gov.
11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; http://eetd.lbl.gov.
12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
13. SD - Department of State; www.state.gov.
14. TRB - Transportation Research Board; National Cooperative Highway Research Program; www.trb.org.
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
18. USP - U.S. Pharmacopeia; www.usp.org.
19. USPS - United States Postal Service; www.usps.com.

D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
2. DOD - Department of Defense; Military Specifications and Standards; Available from Department of Defense Single Stock Point; http://dodssp.daps.dla.mil.
3. DSCC - Defense Supply Center Columbus; (See FS).
4. FED-STD - Federal Standard; (See FS).
5. FS - Federal Specification; Available from Department of Defense Single Stock Point; http://dodssp.daps.dla.mil.

    a. Available from Defense Standardization Program; www.dsp.dla.mil.
    b. Available from General Services Administration; www.gsa.gov.
    c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org/ccb.

6. MILSPEC - Military Specification and Standards; (See DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

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SECTION 014500

QUALITY ASSURANCE: STRUCTURAL TESTING AND INSPECTION

PART 1 - GENERAL

1.1 GENERAL

A. Quality assurance is testing and inspection to assist the Owner in evaluating the Contractor's performance and quality control in the fabrication shop and field. It is not a substitute for the testing and inspection which is required as part of the Contractor's quality control program.

B. Cost: Except as specifically noted otherwise, the testing agency for quality assurance shall be engaged and paid by the Owner.

1. The Owner has negotiated inspection services based upon the assumption that all fabrication work shall be performed at one single fabrication shop. Costs associated with work being performed in additional shops will require reimbursement to the Owner.

C. Definitions:

1. See Sections 033000 and 051200.
2. The term “Testing Agency” in this Specification section is defined as an independent testing and inspection service engaged by the Owner for quality assurance testing and inspection of structural construction in accordance with applicable building code provisions and any additional activities listed in the Contract Documents.
3. The term “Geotechnical Engineer” in this Specification section is defined as an independent geotechnical engineering service engaged by the Owner for quality assurance testing and inspection of the actual soil conditions to verify compliance with the geotechnical conditions, recommendations and design values described in the Project Geotechnical Report and used as the basis of design for the most current Contract Documents.

1.2 SCOPE

A. Testing Agency shall provide qualified personnel at the site to test and inspect materials installed by and work performed by the Contractor, for the following structural items as indicated in Part 3 of this Specification section:

1. Section 031000 Concrete Formwork
2. Section 032000 Concrete Reinforcement and Embedded Assemblies
3. Section 033000 Cast-In-Place Concrete
4. Section 042200 Concrete Masonry Units
5. Section 051200 Structural Steel

6. Section 053000 Steel Deck
7. Section 316100 Footings
8. Section 316329 Caissons

B. Refer to the drawings for Special Inspections requirements for the Project. The Special Inspections shown on the drawings may contain additional testing and inspection that is not listed in this specification section.

1.3 TESTING AGENCY QUALIFICATIONS

A. Testing Agency shall be an independent agency with the experience and capability to conduct testing, inspection and sampling as indicated in accordance with ASTM E 329.

B. Testing Agency shall be an agency approved by the local building official to perform Special Inspections and other related services as outlined in the governing project Building Code.

C. Testing, inspection, and sampling shall be done in accordance with the applicable ASTM standards.

D. Personnel performing visual inspection and non-destructive testing of welds shall meet the requirements of AWS D1.1 for weld inspectors and shall have current certification as an AWS Certified Welding Inspector.

1.4 TESTING AGENCY RESPONSIBILITIES

A. Provide qualified personnel at the site to test and inspect structural construction as the work progresses using the most current Contract Documents and approved shop drawings.

B. Provide additional testing and inspection as needed due to the following:

1. Work performed contrary to Drawings and Specifications
2. Work performed with improper supervision
3. Work performed without prior notice

C. Report deficiencies to Contractor, Owner, Design Professionals within 24 hours.

D. Rejection: The Testing Agency has the right to reject any material at any time, when it is determined that the material or workmanship does not conform to the Contract Documents and shall immediately notify the Owner, Design Professionals, and Contractor of deficiencies. Failure to detect any defective work or material shall not prevent later rejection when such a defect is discovered nor shall it obligate Design Professionals for final acceptance.

E. Noncompliance Log: Indicate to the Contractor where remedial work must be performed and maintain a current log of work not in compliance with the Contract Documents. This noncompliance log shall be submitted to the Design Professionals and Owner on a weekly basis.

F. Reports: Prepare daily inspection, observation, and/or test reports as required herein and provide an evaluation statement in each report stating whether or not the work conforms to requirements of Specifications and Drawings and shall specifically note deviations from them. The daily reports shall be collected and submitted for record to the Design Professionals and Owner weekly.

G. Certification: Upon completion of work and resolution of remedial items, certify in a letter to the Design Professionals and Owner, that the installation is in accordance with the requirements of the Drawings and Specifications.

1.5 CONTRACTOR RESPONSIBILITIES

A. The Contractor shall have sole responsibility for coordinating their work with the Testing Agency to assure that all test and inspection procedures required by the Contract Documents and Public Agencies are provided. The Contractor shall cooperate fully with the Testing Agency in the performance of their work and shall provide the following:

1. Information as to time and place of starting shop fabrication and field construction/erection, at least one week prior to the beginning of the work.
2. The most up to date construction schedule.
3. At least 24 hours advance notice of work requiring testing and inspection.
4. Access to areas as required for testing and inspection.
5. Site File: At least one copy of the most current Contract Documents and approved shop drawings shall be kept available in the contractor’s field office. Drawings not bearing evidence of approval and release for construction by the Design Professionals shall not be kept on the job. Provide drawings for the work to be performed in the shop or field one week prior to the start of work.
6. Representative material samples requested by the Testing Agency for testing, if necessary.
7. Full and ample means of assistance for testing and inspection of material.
8. Facilities for proper storage of material samples as required.
9. Proper facilities, including scaffolding, temporary work platforms, safety equipment etc., for inspection of the work in shop and field.

B. Immediately notify the Owner’s Testing Agency and Design Professionals in writing of conditions that will adversely affect the work.

C. Materials and installed work may require testing and retesting at any time during progress of work, as directed by Design Professionals. Tests, including retesting of rejected materials for installed work will be done at Contractor's expense.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. Testing Agency shall provide qualified personnel at site to test and inspect structural construction using the latest Contract Documents and approved submittals as indicated in the following sections.

3.2 CONCRETE FORMWORK

A. Quality Assurance:

1. Prior to placement of reinforcement, inspect formwork for grade, quality of material, absence of foreign matter, and other imperfections that might affect concrete placement and tolerances stated herein.
2. Inspect formwork for shape, location and dimensions of the concrete member being formed.
3. Inspect formwork for compliance with specified tolerances, block outs, camber, shoring ties and seal of form joints.
4. Verify condition of bond surfaces, locations and sizes of all accessories, embedment items, and anchorage for prevention of displacement.
5. Verify proper use/application of form release agents.
6. Verify in-situ concrete strength meets requirements for formwork removal in specification section 031000 prior to removal of shores and formwork from beams and structural slabs.
7. Inspect concrete surfaces immediately after removal of formwork and prior to any patching or repair work.

3.3 CONCRETE REINFORCEMENT AND EMBEDDED ITEMS

A. Quality Assurance:

1. Prior to placement, inspect reinforcement and embeds for grade, quality of material, absence of foreign matter, and for suitable storage.
2. Provide continuous inspection of reinforcement and embedded assemblies during placement and immediately prior to concreting operations for: size, quantity, vertical and horizontal spacing and location, correctness of bends and splices, mechanical splices, clearances, compliance with specified tolerances, security of supports and ties, concrete cover, and absence of foreign matter.
3. Inspect epoxy-coated reinforcement for coating damage and required applied coatings.
4. Provide continuous inspection of adhesive anchors installed in horizontal or upwardly inclined orientations and those marked (CERT) on the latest Drawings.
5. Adhesive anchors shall be proof tested in tension as follows:

a) Testing Agency shall submit an adhesive anchorage proof testing plan to the SER for review and approval prior to performing the anchor proof testing. The anchorage testing plan shall meet the requirements as specified in this section and indicate which anchors have been selected for testing.
b) Proof testing shall be performed as a confined tension test in accordance with the guidelines of ASTM E488 and the requirements of ACI 355.4.
c) Testing shall be performed after the minimum curing period specified by the manufacturer.
d) 10 percent of each type and size of an adhesive anchor assembly and 100 percent of anchors marked (CERT) shall be proof tested in tension by the Owner's Testing Agency.
e) All anchors selected for proof testing shall be production anchors. Sacrificial anchors are not acceptable for inclusion in the proof testing plan unless specifically approved by the SER prior to performance of the testing.
f) The adhesive anchors proof tension loads shall be as specified in the general notes of the structural drawings.
g) Anchors shall have no visible indications of displacement or damage during or after proof load application. Concrete cracking in the vicinity of the anchor after loading shall be considered a failure.
h) If more than 10% of the tested adhesive anchors fail to achieve the specified proof load, 100% of the anchors of the same diameter and type as the failed anchor shall be proof tested, unless otherwise direct in writing by the SER. Immediately notify the SER of all failed proof tests.

6. Mechanical post-installed anchors shall be proof tested as follows:

a) Testing Agency shall submit a mechanical anchorage proof testing plan to the SER for review and approval prior to performing the anchor proof testing. The anchorage testing plan shall meet the requirements as specified in this section and indicate which anchors have been selected for testing.
b) 10 percent of each type and size of mechanical anchor shall be proof tested by the Owner's Testing Agency. The required proof test for the anchors is as follows:
c) For torque-controlled mechanical anchors, a proof torque shall be applied to the anchor using a calibrated torque wrench and the proof torque shall be achieved with no more than one-half turn of the anchor nut.
d) For displacement-controlled mechanical anchors, proof of set is to be achieved by inserting the proper setting tool into the anchor and verifying that full set has been achieved.
e) The required proof torque load for torque-controlled mechanical anchors shall be as specified in the general notes of the structural drawings.

f) All anchors selected for proof testing shall be production anchors. Sacrificial anchors are not acceptable for inclusion in the proof testing plan unless specifically approved by the SER prior to performance of the testing.
g) Concrete cracking in the vicinity of the anchor during or after proof torque load application shall be considered a failure.
h) If more than 10% of the tested mechanical anchors fail to achieve the specified proof torque load or set, 100% of the anchors of the same diameter and type as the failed anchor shall be proof tested, unless otherwise direct in writing by the SER. Immediately notify the SER of all failed proof tests.

7. Periodic inspection for post-installed adhesive and mechanical anchors shall be provided in accordance with the building code except that continuous inspection shall be provided for the conditions identified in section A.4. The inspector shall observe all aspects of the anchor installation and shall, at a minimum, verify the following items:

a) Hole drilling method in accordance with the Manufacturer's Published Installation Instructions (MPII) and these installation requirements.
b) Anchor spacing and edge distance.
c) Hole diameter and depth.
d) Hole cleaning in accordance with the MPII.
e) Anchor element type, material, diameter, and length.
f) For adhesive anchors, adhesive identification and expiration date.
g) For adhesive anchors, adhesive installation in accordance with the MPII.
h) For torque-controlled mechanical anchors, the number of turns required to achieve the anchor set torque per the MPII.
i) For displacement-controlled mechanical anchors, the proper setting tool is used to achieve the anchor set per the MPII.

3.4 CAST-IN-PLACE CONCRETE

A. Quality Assurance:

1. Monitor concrete placement as follows:

a) Verify use of required design mix
b) Record location of point of concrete discharge of each batch truck tested, cross referenced to grid lines.
c) Record temperature of concrete at time of placement.
d) Record weather conditions at time of placement, including temperature, wind speed, relative humidity, and precipitation.
e) Record types and amounts of admixtures added to concrete at the project site.
f) Record amount of water added at the site and verify that total water content does not exceed amount specified in the mix

design. Addition of water at the site is subject to prior approval by the Design Professional.

g) Monitor consistency and uniformity of concrete.

h) Monitor preparation for concreting operations, placement of concrete, and subsequent curing period for conformance with Specifications for following procedures:

i. Concrete curing.
ii. Hot weather concreting operations.
iii. Cold weather concreting operations.

2. Conduct tests of concrete as follows and in accordance with ASTM C 1077:

a) Testing frequency: Sample sets for all tests listed below of each concrete design mix placed each day shall be taken not less than once a day, nor less than once for each 100 cubic yards. (75 cubic meters) of concrete, nor less than once for each 5000 square feet (500 square meters) of surface area for slabs or walls. Additional tests shall be performed if deemed necessary by the Owner's Testing Agency and Design Professionals. In addition, sample each truckload used for columns, regardless of other frequencies listed above.

b) Obtain each test sample from different batches selected on a strictly random basis before commencement of concrete placement. Record location in structure of sampled concrete.

c) Determine air content of normalweight concrete in accordance with either ASTM C 231 or ASTM C 138. Determine air content of lightweight concrete in accordance with ASTM C 173. Conduct one test for air content for each strength test required or for every 50 cubic yards (40 cubic meters) of fly ash concrete placed, whichever is less.

d) Determine unit weight of lightweight concrete in accordance with ASTM C 567.

e) Test water content of freshly mixed concrete on a random basis, a minimum of once per 100 cubic yards (75 cubic meters) or every 5000 square feet (500 square meters) of concrete placement, during placement in accordance with AASHTO T 318 for the following concrete types:

i. Hard troweled slabs exposed to view
ii. Slab to receive a bonded finish floor material
iii. Slabs with specified concrete compressive strength exceeding 6000 psi (42MPa)

f) Conduct slump tests in accordance with ASTM C 143.

g) Slump indicated in mix designs shall be achieved at point of placement. Correlation between slump at point of initial discharge from truck and point of placement must be established to determine amount of slump loss which occurs between initial

discharge and point of placement. Adjustment may be necessary to achieve slump indicated in mix designs at point of placement.

h) Conduct slump tests for Self Consolidating Concrete (SCC) as follows

i. In accordance with ACI 237, where SCC is used, perform slump flow and visual stability index tests in accordance with ASTM C1611 on the first batch of SCC, and then consecutive batches until two consecutively produced batches are within specification. SCC with a visual stability index value of 2 or 3 shall be stabilized, where possible, with a viscosity modifying admixture or rejected at the discretion of the Engineer and Ready Mix Quality Control Representative. The Ready Mix Producer shall be responsible for adjusting the mix to provide desired flow and stability. After establishing the consistency of the SCC mix, testing shall continue in accordance with the requirements of the above paragraph.

ii. In accordance with ACI 237, where SCC is used, perform slump flow tests in accordance with ASTM C1621 using a J-ring to determine the passing ability of the SCC mix around reinforcement. If the reinforcing bars retain the coarse aggregates inside the ring, the mixture has a high potential for blocking and should be reproportioned at the direction of the Engineer and Ready Mix Quality Control Representative.

i) Conduct strength tests of concrete as follows:

i. Secure sample sets in accordance with ASTM C 172.

ii. Mold cylinders in accordance with ASTM C 31 and cure under standard moisture and temperature conditions in accordance with ASTM C 31, Section 7 (a). Quantity of cylinders listed below is based on a cylinder size of 4 inch (100mm) diameter x 8 inches (200mm) long. If 6 inch (150mm) diameter by 12 inch (300mm) long cylinders are used, the total quantity of cylinders may be reduced by one with two cylinders instead of three tested at the age designated for determination of f’c.

iii. Test cylinders in accordance with ASTM C 39. For specified concrete strength of 10,000 psi (70MPa) and above, cylinders shall be ground and not capped.

iv. For 28 day mixes mold six cylinders. Test two cylinders at seven days and three cylinders at 28 days. The 28 day strength shall be the average of the three 28 day cylinders. One cylinder shall be retained in reserve for later testing if required.

v. For 56 day mixes mold seven cylinders. Test one cylinder at seven days, two cylinders at 28 days, and three cylinders at 56 days. The 56 day strength shall be the

average of the three 56 day cylinders. One cylinder shall be retained in reserve for later testing if required.

vi. For 90 day mixes mold eight cylinders. Test one cylinder at seven days, one at cylinder at 28 days, two cylinders at 56 days, and three cylinders at 90 days. The 90 day strength shall be the average of the three 90 day cylinders. One cylinder shall be retained in reserve for later testing if required.

vii. When early age concrete strength verification is required by the Contractor for formwork removal or stressing of post-tensioning tendons, strength shall be verified, at the Contractor's expense, by additional compression tests of field-cured cylinders or by the maturity method in accordance with ASTM C1074.

viii. If one cylinder in a test manifests evidence of improper sampling, molding or other damage, discard cylinder and base test results on that of remaining cylinder.

3. Evaluate concrete for conformance with Specifications as follows:

a) Slump:

i. Maintain a slump moving average, comprised of the average of all batches or most recent five (5) batches tested, whichever is fewer.

b) Strength test:

i. Maintain a compressive strength moving average, comprised of three (3) consecutive strength test results, for each mix design used in work.

ii. Strength level of concrete will be considered satisfactory provided averages of all sets of three (3) consecutive strength test results (i.e. moving average) equal or exceed specified 28-day strength, and no individual strength test result falls below specified 28-day strength by more than 500 psi (3.5MPa).

iii. If strength tests fail to meet minimum requirements, concrete represented by such tests shall be considered questionable and shall, if deemed appropriate by the SER, be subject to further evaluation by core testing as specified herein or other testing methods.

iv. Maintain a log that contains the results of all concrete strength tests. The log shall include the results of each test performed, be in electronic spreadsheet format, and updated and submitted along with concrete test data. See example log attached at the end of this Specification Section.

c) Conduct core tests on questionable concrete in accordance with ACI 318 and ASTM C 42.

i. Location of cores shall be coordinated with Design Professionals so as to least impair strength of structure. Before testing cores, discard and replace any that show evidence of having been damaged subsequent to or during removal from structure or which have reinforcement present.

ii. Cores from structure exposed to soil or constant moisture in service (e.g. basement walls, retaining walls, slab-on-grade, piers, footings, etc.) shall be tested in a fully saturated condition. Cores for all other concrete may be tested dry. Prior to commencement of coring, verify with Design Professionals whether cores are to be tested wet or dry.

iii. Fill core holes with low slump concrete or mortar with a strength equal to or greater than that specified for area cored.

d) Concrete in area represented by core test will be considered adequate if average strength of cores is equal to at least 85% of, and if no single core is less than 75% of specified strength.

4. Floor flatness and levelness tolerance compliance testing is to be performed within 72 hours of concrete placement by Testing Agency, and prior to the removal of shores and forms.

A) Testing Agency to test and report flatness (F_F), levelness (F_L) prior to shoring removal. For slabs that include camber, do not test for levelness (F_L). Perform F_F/F_L testing in accordance with ASTM E 1155 requirements.

EXAMPLE CONCRETE STRENGTH SPREADSHEET LOG

PROJECT:
DATE:
ARCHITECT:
STRUCTURAL ENGINEER:

SPECIMEN I.D.	TICKET NUMBER	PLACEMENT LOCATION	MIX I.D.	CURE TYPE*	DATE TESTED	AGE AT TEST (DAYS)	AVERAGE DIAMETER (IN)	AVERAGE CROSS-SECTIONAL AREA (IN^2)	BREAKING LOAD (LB)	BREAK TYPE **	AVERAGE COMPRESSIVE STRENGTH (PSI)
S0002	1234	First Floor Slabs and Beams	H3651	I, CA, CB	3/8/2106	7	4	12.56	165990	Type 1	13210
						14					
						28					
						56					

*FIELD CURING CONDITIONS: NCB=NO CURING BOX, CB=CURING BOX, I=INSULATED, CO=COOLED, HE=HEATED, CA=CAPPED, IC=ICED, O=OTHER

**BREAK TYPES (AS CLASSIFIED BY ASTM C39):

3.5 CONCRETE MASONRY UNITS

A. Quality Assurance:

1. Testing Requirements:

a) Mortar:

i. Testing Frequency: At the beginning of all masonry work take at least one test sample on three successive working days and at least one week intervals thereafter. Additional samples shall be taken whenever any change in materials or job conditions occur.
ii. Test compressive strength and air content test in conformance with ASTM C780.

b) Grout: The following testing requirements are for grout proportions determined by specified compressive strength only:

i. Testing Frequency: Samples of grout shall be taken for each mix design, each day grout is placed, and not less than every 5,000 square feet (465 square meters) of masonry wall surface area or fraction thereof.
ii. Test compressive strength in conformance with ASTM C1019.
iii. For self-consolidating grout also perform slump flow and Visual Stability Index (VSI) in conformance with ASTM C1611.

c) Compressive strength of masonry (f'm), unit strength method:

i. Testing Frequency: Prior to masonry construction and for every 5,000 square feet (465 square meters) of masonry wall surface area or fraction thereof.
ii. Sample and test units to verify conformance with ASTM C90.
iii. Thickness of bed joints does not exceed 5/8" (15.9 mm)
iv. Verify grout conforms to ASTM C476.

2. Inspection Requirements:

a) Inspect and verify the following items periodically unless otherwise noted as continuous. Periodic inspections shall be random and unannounced and shall occur at least once per week. Where items are noted as continuous, inspections shall be performed whenever and wherever the work is being performed.

i. Compliance with approved submittals
ii. At beginning of CMU construction, verify the following:

(1) Proportions of site-prepared mortar.
(2) Construction of mortar joints.
(3) Location of reinforcement and connectors.
(4) Block unit size.

iii. Prior to grouting, verify the following:

(1) Grout space.
(2) Grade, type, and size of reinforcement and anchor bolts.
(3) Placement of reinforcement and connectors.
(4) Proportions of site-prepared grout.
(5) Construction of mortar joints.
(6) Bond pattern.
(7) Tie-in at intersecting walls.
(8) Condition of block units after placement.
(9) Bond beam and/ or tie beam locations, reinforcement, and lap splice lengths.

iv. During CMU construction, verify the following:

(1) Size and location of structural elements.
(2) Type, size, and location of anchors and/or embedments, including other details of connection of masonry to structural members, frames, or other construction.
(3) Welding of reinforcement (continuously inspect).
(4) Preparation, construction, and protection of masonry during cold weather or hot weather. For cold and hot weather requirements see Section 042200.
(5) Placement of grout (continuously inspect).
(6) Lintel size, location, and bearing lengths.

v. Observe preparation of grout specimens, mortar specimens, and/or prisms.

b) Inspections will also include verification that:

i. Materials are properly stored.
ii. Installation is within specified construction tolerances.
iii. Proper mortar ingredients and mixing techniques are being used.
iv. Mortar time on board is within specified limits.
v. Joints are being properly tooled.
vi. Flashing assembly is being properly fabricated and installed.
vii. Weeps and vents are being installed and are functional.
viii. Control joints are being installed as indicated, or, as specified.

3.6 STRUCTURAL STEEL

A. Quality Assurance:

1. Shop inspection shall include alignment and straightness of members, camber, preparation for connections, dimensional checks, testing of shop bolts, witnessing of welding procedures, testing of cuts, weld access holes and copes of Heavy Sections as defined in this Specification, examination and testing of completed welds, headed studs and deformed bar anchors, cutting of Heavy Sections, finishing of column ends, cleaning, painting and storage of material. All shop fabrication shall be inspected in the shop. Camber shall be verified in a minimum of 10% of all members requiring camber. If, in the opinion of the SER and Testing Agency this testing discloses a large ratio (10% or more) of unacceptable cambers, the required percentage of tested cambers may be increased by the SER to 100% at no expense to the Owner. Where testing is required for less than 100% of locations, select test locations at random and throughout the project.
2. Field inspection shall include connections, proper tensioning of bolts, levelness, plumbness and alignment of the frame, conformance to AWS welding methods, examination of surface before welding, examination and testing of completed welds, headed studs and deformed bar anchors and field painting, including touch-up. Where testing is required for less than 100% of locations, select test locations at random and throughout the project.
3. Review the following items in the shop and field:

    a) Welding certificates, procedures, and personnel
    b) Stud welding setup and operators; bolting procedure and crew
    c) Bolting procedure and crew
    d) Visually inspect seam welds of tube and pipe for evidence of cracking or lack of fusion. At each end piece of tube or pipe, inspect interior face of seam weld for evidence of cracking, lack of fusion, or less than full flashing.
    e) Mill certifications for compliance with the Contract Documents.

4. Inspect high strength bolted construction in accordance with RCSC "Specification for Structural Joints using ASTM A 325 or A 490 Bolts," including but not limited to:

    a) Surface preparation and bolt type conforms to plans and Specifications prior to start of bolting operations.
    b) Proper bolt storage and handling procedures per codes and standards referenced by this Specification are being followed.
    c) Visually inspect all bolted connections.
    d) For all bolted connections that are indicated as snug tight, connections are properly compacted and brought to the snug tight condition progressing outward from the most rigid part.
    e) For all bolted connections that are indicated as pretensioned or slip critical, pre-installation verification testing is performed by the

inspector in cooperation with the contractor in accordance with RCSC section 9.2 and section 7.

f) For all bolted connections that are indicated as pretensioned or slip critical, through routine observation, as defined in RCSC 9.2.1, 9.2.3 or 9.2.4, that the pretensioning methods of RCSC 8.2.1, 8.2.3, or 8.2.4, as appropriate, are performed.

i. "Routine observation" is defined as observation of 10 bolts for every 100 bolts with a minimum of 2 bolts per connection.

g) Retest bolted connections that fail initial inspection after correction by the Fabricator or Erector.

5. Test and inspect welding and welded construction including but not limited to:

a) Review of submittals:

i. Review all Welding Procedures prepared by the Contractor’s Engineer or Certified Welding Engineer. Verify the accuracy of all essential variables of the Welding Procedure including but not limited to confirmation that weldability and heat induction for Heavy Sections and high restraint welds comply with AWS requirements.

ii. Review of welding procedures including prequalification, qualifications test and, for Heavy Sections and High Restraint Welds, the welding procedure prepared by the Contractor's Engineer or Welding Consultant

iii. Submit for record a report indicating that the Welding Procedures have been reviewed as indicated above to the Design Professionals.

b) Test all complete joint penetration welds for soundness by means of either radiographic or ultrasonic testing in accordance with AWS D1.1 and ASTM E164 procedures. All flaws in plate or flange material revealed during such tests shall be repaired and retested by the Contractor at the Contractor's expense.

c) Test all partial joint penetration welds for soundness by means of visual and magnetic particle inspection, unless other methods are specified in the Contract Documents. All flaws in plate or flange material revealed during such tests shall be repaired and retested by the Contractor at the Contractor's expense.

d) Testing of welds at Heavy Sections and High Restraint Welds shall be performed not less than 48 hours after the weld has been completed.

e) Visually inspect all fillet welds. In addition test ten percent (10%) of all fillet welds using a non-destructive method, such as dye penetrant or magnetic particle. Select test locations randomly throughout the structure, but test at least one weld in each

location with 6 or more welds per connection. If, in the opinion of the SER and Testing Agency this testing discloses a large ratio (10% or more) of unacceptable welds, the required percentage of tested welds may be increased by the SER to 100%, all at the Contractor's expense.

f) Inspection and Testing by the Testing Agency of High Restraint Welds and where Heavy Sections are to be joined by partial or complete joint penetration welds in tension:

i. Joint Preparation: Monitor fit up and joint preparation (bevel angle, etc.) for conformance to the submitted welding procedures including preheat and interpass temperature. Monitor base metal temperature during welding operations.

ii. Test Complete Joint Penetration Welds in accordance to the requirements of this Specification section, ultrasonically in accordance with AWS D1.1 procedures. On T or corner joints, pay careful attention to the heat affected zone and base metal where the weld shrinkage stresses are in the through thickness direction.

iii. Test Partial Joint Penetration Butt Joints in accordance with this Specification section by the magnetic particle method. At T or corner joints, in addition to the magnetic particle testing, ultrasonically scan the heat affected zone and adjacent base metal from face "C" per AWS D1.1 Table 6.7 and Annex Q7 to detect lamellar tears and shall be done with a compression wave. The Testing Agency shall submit a testing procedure that includes evaluation (acceptance criterion) procedures to the Design Professionals for review.

g) At Heavy Sections and High Restraint Welds: provide pre-production sample testing of heat treatment, observe fabrication, welding and heat treatment of the samples for conformance with submitted welding procedures. Establish locations of testing coupons following AWS procedures. Test coupons following AWS procedures to verify satisfactory results using the welding procedure and heat treatment.

6. Visually inspect all headed studs and deformed bar anchors for complete fusion and full 360-degree weld flash (or fillet).

a) Check all studs with incomplete fusion, and at random five studs at each of six beams per floor, by bending to an angle of 15 degrees from its original axis (away from any missing flash). If more than twenty percent of studs fail on one member, check all studs on member. In addition, for each member with any defective studs, test an additional member.

b) Contractor to replace any studs that crack or break. Contractor to only straighten studs that would foul other work or have less than 1 inch (25mm) cover in bent position.

7. Cleaning & Painting:

a) Examine shop painting to verify conformance with this Specification.
b) Examine loading and unloading of steel to visually observe that damage does not occur during shipping and handling.

3.7 STEEL DECK

A. Quality Assurance:

1. Decking is subject to inspection and testing once connected in place:

a) Expense of removing and replacing any portion of decking for testing purposes will be borne by the Owner if connections are found to be satisfactory.
b) Contractor shall remove work found to be defective and provide acceptable work at no additional cost to the Owner.

2. Field inspect all steel deck after erection for the following:

a) Proper deck profile, type (acoustic, cellular, vented), gage and finish
b) Correct deck orientation, alignment, bearing and laps (if applicable)
c) Supplementary items including secondary supports, closures, pour stops, sumps and their connections to deck and to other members
d) Damage of members during transportation, storage and erection
e) Proper installation and erection
f) Proper deck to supporting member and deck to deck connections (quantity, size, spacing and quality of welds/fasteners) including inspection of deck welding

3. Field inspect headed studs (shear connectors) as follows:

a) At the start of each day's operations for welding headed studs, the Contractor shall first weld a minimum of two studs to demonstrate proper welding set up for that day’s typical deck and support conditions. Testing Agency to observe Contractor hammer-bending the studs to an angle 15 degrees from the vertical without weld failure.
b) Should failure occur in the weld zone of either stud, Contractor shall adjust welding set up and repeat the test until two consecutive studs are, tested and found satisfactory before any production welding of studs may begin.

c) Perform demonstration tests at each significant change in conditions including deck thickness, deck coating (painted to galvanized) or number of deck layers.
d) Do not weld studs through more than one layer of steel deck, except where cellular deck is specified.
e) Failed test studs shall be removed and replaced by production studs.
f) During production installation, bend testing of headed studs is required where incomplete weld flash is observed, and at random locations on each floor. For production testing requirements see Section 051200.

3.8 FOOTINGS

A. Quality Assurance by Geotechnical Engineer (or Testing Agency if the same entity):

1. Review Contractor's proposed footing installation methods, sequences, and procedures.
2. Verify bearing stratum and bearing capacity of each footing; verify levelness of footing end bearing surface.
3. Determine final bearing elevation at each footing location.
4. Observe, record, and report footing as-built plan location, footing size and final elevations of bottom (where possible) and top of completed footings.
5. Coordinate with Testing Agency.

B. Quality Assurance by Testing Agency:

1. Inspection of Batch Plant: As required to ensure that concrete delivered to job complies with Specifications and design mix. Batch plant inspection shall be required once at start of job and thereafter if concrete falls below Specifications.
2. Inspection of Reinforcement: Provide continuous visual inspection of site fabrication. Record the steel reinforcement bar sizes, grade, length, and number of bars.
3. Inspection of Concrete and Reinforcement Placement: Provide continuous visual inspection of installation of reinforcement and concrete placement including verification of laitance removal at top of footings.
4. Check ready mix delivery tickets for correct concrete mix design number. Record batch to placement time. Check slump, temperature, and batch to placement time for each set
5. Slump Tests: ASTM C143. Make one test from each truck.
6. Concrete Compressive Strength Tests: Testing agency will take a minimum of one sample set of concrete cylinders per 20 cubic yards of concrete. See CAST-IN-PLACE CONCRETE section of this specification for requirements. Cure cylinders to simulate same curing conditions as concrete in footings. Reports of cylinder tests shall state footing location(s), laboratory or site curing, compression strength, type of fracture, age at testing, concrete supplier, mix specification strength, any other pertinent information, test results, and conclusions.

7. Additional Tests: Perform additional testing if, in the opinion of the Design Professionals, concrete of poor quality has been placed based on cylinder strengths below Specification requirements or visual defects. Tests may be compression tests on cored cylinders, ASTM C42, and load tests as outlined in ACI 318, or as directed by the Design Professionals. Complete continuous coring of footings will be required, at Contractor's expense, where verification of quality of concrete is not otherwise attainable.

3.9 CAISSONS

A. Quality Assurance by Owner’s Geotechnical Engineer (or Testing Agency if the same entity):

1. Review Contractor's proposed caisson installation methods, sequences, procedures and equipment.
2. Verify bearing stratum and bearing capacity of each caisson; verify levelness of caisson end bearing surface.
3. Determine final bearing elevation at each caisson location; where design elevation does not provide specified minimum bearing capacity, recommend to Contractor that additional shaft excavation will be required to reach stratum with specified bearing capacity.
4. Visually inspect and test samples of water being pumped from caisson to determine solids content.
5. Observe, record, and report Contractor's in plan location and plumb tolerance measurements, shaft diameter, bell size and final elevations of bottom and top of completed caissons.
6. On a full-time basis, visually inspect installation of each caisson including excavation of bell and shaft, verification of bearing stratum, extent of cleanup, placement of concrete, and removal of temporary casings. Evaluate and note any actions that may cause soil inclusion in caisson or may affect integrity of the completed caisson.
7. Observe temporary steel liner installation and check for shaft squeeze in the soft clay layers.
8. Coordinate with Testing Agency.

B. Quality Assurance by Testing Agency:

1. Inspection of batch plant as required to ensure that concrete delivered to job complies with Specifications and design mix. Batch plant inspection shall be required once at start of job and thereafter if concrete falls below Specifications.
2. Visually inspect fabrication of permanent steel plate casings and corrugated steel liners. Verify welder AWS certifications, and perform ultrasonic testing, per AWS D1.1, of 100% of welds only for permanent steel plate casings that are indicated on the drawings as contributing to the design capacity of the caisson.
3. Provide continuous visual inspection of site fabrication. Record the steel reinforcement cage bar sizes, grade, length, and number of bars and tie

spacing, prior to placement into the shaft. Record use of spacers and/or centralizers.

4. Provide continuous visual inspection of installation of reinforcement and concrete placement including verification of laitance removal at top of caissons and at construction joints.
5. Check ready mix delivery tickets for correct concrete mix design number. Record batch to placement time. Check slump, temperature, and batch to placement time for each set
6. Perform slump Tests per ASTM C143. Make 1 test from each truck.
7. Perform concrete compressive strength tests in accordance with the requirements in the CAST-IN-PLACE CONCRETE section of this specification. Take a minimum of one sample set of concrete cylinders per caisson but no more than one set per truckload.
8. Perform additional testing if, in the opinion of the Design Professionals, concrete of poor quality has been placed based on cylinder strengths below Specification requirements or visual defects. Tests may be compression tests on cored cylinders per ASTM C42 and/or load tests as outlined in ACI 318, or as directed by the Design Professionals. Complete continuous coring of caissons will be required, at Contractor's expense, where verification of quality of concrete is not otherwise attainable.

END OF SECTION

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:

1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.
2. Drawings "Dewatering" for disposal of ground water at Project site.
3. Drawings "Asphalt Paving" for construction and maintenance of asphalt pavement for temporary roads and paved areas.
4. Drawings "Concrete Paving" for construction and maintenance of cement concrete pavement for temporary roads and paved areas.

1.3 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, testing agencies, and authorities having jurisdiction.

B. Water Service: Pay water-service use charges for water used by all entities for construction operations.

C. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

1.4 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

D. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.

1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

E. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:

1. Locations of dust-control partitions at each phase of work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air-filtration system discharge.
4. Waste handling procedures.
5. Other dust-control measures.

1.5 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch (3.8-mm) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts; minimum 2-3/8-inch (60- mm) OD line posts and 2-7/8-inch (73-mm) OD corner and pull posts, with 1-5/8-inch (42-mm) OD top rails.

B. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches (914 by 1524 mm).

2.2 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:

1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot (1.2-m) square tack and marker boards.
3. Drinking water and private toilet.
4. Coffee machine and supplies.
5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F (20 to 22 deg C).
6. Lighting fixtures capable of maintaining average illumination of 20 fc (215 lx) at desk height.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 017700 "Closeout Procedures"

C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

D. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

E. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

F. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
2. Install lighting for Project identification sign.

G. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line for each field office.

1. Provide additional telephone lines for the following:

a. Provide a dedicated telephone line for each facsimile machine in each field office.
b. Provide one telephone line(s) for Owner's use.

2. At each telephone, post a list of important telephone numbers.

a. Police and fire departments.
b. Ambulance service.
c. Contractor's home office.
d. Contractor's emergency after-hours telephone number.
e. Architect's office.
f. Engineers' offices.
g. Owner's office.
h. Principal subcontractors' field and home offices.

3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

H. Electronic Communication Service: Provide a desktop computer in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications. Equip computer with not less than the following:

1. Processor: Intel Core i7, or newer, 64-bit operating system 2.70 GHz processing speed.
2. Memory: 12 gigabyte.
3. Disk Storage: 300 gigabyte hard-disk drive and combination DVD-RW/CD-RW drive.
4. Display: 22-inch (560-mm) LCD monitor with 256-Mb dedicated video RAM.
5. Full-size keyboard and mouse.
6. Network Connectivity: 02/110 BaseT Ethernet, verify.
7. Operating System: Microsoft Windows 10.
8. Productivity Software:

    a. Microsoft Office Professional, current edition, including Word, Excel, and Outlook.
    b. Adobe Reader 11.0 or higher.
    c. WinZip 7.0 or higher.

9. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions.
10. Internet Service: Router and ISP, equipped with hardware firewall, providing minimum 38 Mbps upload and 50 Mbps download speeds at each computer.
11. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

C. Parking: Provide temporary parking areas for construction personnel.

D. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.

E. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touch up signs so they are legible at all times.

F. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

G. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

H. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

B. Temporary Erosion and Sedimentation Control: Comply with requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and requirements specified in Division 31 or Drawings "Site Clearing."

C. Storm water Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of storm water from heavy rains.

D. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

E. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.

F. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.

G. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

H. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire- prevention program.

1. Prohibit smoking in construction areas.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 MOISTURE AND MOLD CONTROL

A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

3.6 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials

contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.

3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:

1. Section 012500 "Substitution Procedures" for requests for substitutions.
2. Section 014200 "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.

2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

    a. Form of Approval: As specified in Section 013300 "Submittal Procedures."
    b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.
7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:

a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

4. Manufacturers:

a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Coordination of Owner-installed products.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.

B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Certificates: Submit certificate signed by professional engineer certifying that location and elevation of improvements comply with requirements.

C. Certified Surveys: Submit two copies signed by professional engineer.

D. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

A. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, and other construction affecting the Work.

1. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

B. General: Engage a professional engineer to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

C. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

D. Final Property Survey: Engage a professional engineer to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction personnel.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.7 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

a. Use containers intended for holding waste materials of type to be stored.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.

2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Recycling nonhazardous construction waste.

1.3 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

C. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of waste management coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.

1.5 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."

B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

1. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 RECYCLING CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall be shared equally by Owner and Contractor.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Repair of the Work.

B. Related Requirements:

1. Section 017300 "Execution" for progress cleaning of Project site.
2. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.
3. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
4. Section 017900 "Demonstration and Training" for requirements for instructing Owner's personnel.

1.3 ACTION SUBMITTALS

A. Product Data: For cleaning agents.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificate of Insurance: For continuing coverage.

B. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
2. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
3. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.

   a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.

4. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
2. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
3. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
4. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Use CSI Form 14.1A.

1. Organize list of spaces in sequential order, starting with exterior areas first.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

a. Project name.
b. Date.
c. Name of Architect.
d. Name of Contractor.
e. Page number.

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

1. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
g. Sweep concrete floors broom clean in unoccupied spaces.
h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
j. Remove labels that are not permanent.
k. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
l. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
m. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
n. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.

1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.

o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
p. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.

a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

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SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Product maintenance manuals.
5. Systems and equipment maintenance manuals.

B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:

1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.

a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
b. Enable inserted reviewer Comments on draft submittals.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.

1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.

3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Architect.
7. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
8. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

D. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

2.3 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUALS

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer

or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.

3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of operation and maintenance manuals.
2. Comply with requirements of newly prepared record Drawings in Section 017839 "Project Record Documents."

G. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

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SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

B. Related Requirements:

1. Section 017300 "Execution" for final property survey.
2. Section 017700 "Closeout Procedures" for general closeout procedures.
3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit copies of record Drawings as follows:

a. Initial Submittal:

1) Submit PDF electronic files of scanned record prints.
2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal:

1) Submit record digital data files and PDF electronic files of scanned record digital data file plots.

B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

E. Reports: Submit written report weekly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.4 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
b. Accurately record information in an acceptable drawing technique.
c. Record data as soon as possible after obtaining it.
d. Record and check the markup before enclosing concealed installations.
e. Cross-reference record prints to corresponding photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.
b. Revisions to details shown on Drawings.
c. Depths of foundations.
d. Locations and depths of underground utilities.
e. Revisions to routing of piping and conduits.
f. Revisions to electrical circuitry.
g. Actual equipment locations.
h. Duct size and routing.
i. Locations of concealed internal utilities.
j. Changes made by Change Order or Construction Change Directive.
k. Changes made following Architect's written orders.
l. Details not on the original Contract Drawings.
m. Field records for variable and concealed conditions.
n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
2. Format: DWG, Version matching Architect's version and operating system.
3. Format: Annotated PDF electronic file with comment function enabled.
4. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
5. Refer instances of uncertainty to Architect for resolution.
6. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.

    a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
    b. Architect will provide data file layer information. Record markups in separate layers.

C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:

    a. Project name.
    b. Date.
    c. Designation "PROJECT RECORD DRAWINGS."
    d. Name of Architect.
    e. Name of Contractor.

1.5 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
3. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as annotated PDF electronic file.

1.6 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, record Specifications, and record Drawings where applicable.

C. Format: Submit record Product Data as annotated PDF electronic file.

1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

1.7 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.8 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store record documents in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.
3. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

A. Attendance Record: For each training module, submit list of participants and length of instruction time.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:

   a. Name of Project.
   b. Name and address of videographer.
   c. Name of Architect.
   d. Name of Contractor.
   e. Date of video recording.

2. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
3. At completion of training, submit complete training manual(s) for Owner's use in PDF electronic file format on compact disc.

1.5 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.

1.6 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

a. System, subsystem, and equipment descriptions.
b. Performance and design criteria if Contractor is delegated design responsibility.
c. Operating standards.
d. Regulatory requirements.
e. Equipment function.
f. Operating characteristics.
g. Limiting conditions.
h. Performance curves.

2. Documentation: Review the following items in detail:

a. Emergency manuals.
b. Operations manuals.
c. Maintenance manuals.
d. Project record documents.
e. Identification systems.
f. Warranties and bonds.
g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

a. Instructions on meaning of warnings, trouble indications, and error messages.
b. Instructions on stopping.
c. Shutdown instructions for each type of emergency.
d. Operating instructions for conditions outside of normal operating limits.
e. Sequences for electric or electronic systems.
f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

a. Startup procedures.
b. Equipment or system break-in procedures.
c. Routine and normal operating instructions.
d. Regulation and control procedures.
e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

a. Diagnostic instructions.
b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.
b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:

a. Diagnosis instructions.
b. Repair instructions.
c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
d. Instructions for identifying parts and components.
e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
2. Owner will furnish an instructor to describe Owner's operational philosophy.
3. Owner will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner, through Architect, with at least seven days' advance notice.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

E. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. Video: Provide minimum 640 x 480 video resolution converted to format file type acceptable to Owner, on electronic media.

1. Electronic Media: Read-only format compact disc acceptable to Owner, with commercial-grade graphic label.
2. File Hierarchy: Organize folder structure and file locations according to project manual table of contents. Provide complete screen-based menu.
3. File Names: Utilize file names based upon name of equipment generally described in video segment, as identified in Project specifications.
4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the Equipment Demonstration and Training DVD that describes the following for each Contractor involved on the Project, arranged according to Project table of contents:

a. Name of Contractor/Installer.
b. Business address.

c. Business phone number.
d. Point of contact.
e. E-mail address.

B. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.

1. Film training session(s) in segments not to exceed 15 minutes.

a. Produce segments to present a single significant piece of equipment per segment.
b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.

C. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.

1. Furnish additional portable lighting as required.

D. Narration: Describe scenes on video recording by dubbing audio narration off-site after video recording is recorded. Include description of items being viewed.

END OF SECTION 017900

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SECTION 031000

CONCRETE FORMWORK

PART 1 - GENERAL

1.1 GENERAL

Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 SCOPE

Provide all labor, materials, equipment, services and transportation for formwork and related accessories required to complete all cast-in-place concrete work as shown on Drawings, as specified herein, and as required by the job conditions.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Division 1
Quality Control	Division 1
Quality Assurance: Structural Testing and Inspection	Section 014500
Concrete Reinforcement and Embedded Assemblies	Section 032000
Cast-In-Place Concrete	Section 033000
Thermal and Moisture Protection	Division 7

1.4 CODES AND STANDARDS

A. Building Code: Concrete work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.

B. Standards:

1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 237 – Self Consolidating Concrete.
3. ACI 301 –Specifications for Structural Concrete.
4. ACI 318 – Building Code Requirements for Structural Concrete and Commentary.
5. ACI 347 – Guide to Formwork for Concrete.
6. ACI 347.2R – Guide for Shoring/Reshoring of Concrete Multistory Buildings

C. Definitions:

1. See Section 033000.

1.5 CONTRACTOR QUALIFICATIONS

A. The work of this section shall be performed by a company specializing in the type of concrete formwork required for this Project, with a minimum of 10 years of documented successful experience and shall be performed by skilled workers thoroughly experienced in the necessary crafts.

B. Contractor's testing agency Services: Required as specified in Division 1, and herein.

C. Materials and installed work may require testing and retesting at any time during progress of work, as directed by Design Professionals. Tests, including retesting of rejected materials for installed work will be done at Contractor's expense.

1.6 SUBMITTALS

A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested.

(1) Submittal Schedule
(2) Shop Drawings
(3) Shoring/Reshoring Calculations
(4) Product Data
(5) Samples
(6) Compatibility Certification
(7) Hazardous Materials Notification
(8) **[LEED Submittals]**

1. **Submittal Schedule**: See Section 033000.
2. **Shop Drawings**:

a) Submit for action: Formwork shop drawings sealed and signed by a Professional Engineer licensed in the state where the project is located. Shop drawings shall clearly indicate but not be limited to the following:

1. Size, type and quality of form materials including conditions at tops and ends of walls. (If wood is used, indicate species.)
2. Form construction indicating structural stability and jointing including special form joints or reveals required by Contract Documents
3. Location and pattern of form tie placement, and other items that affect the appearance of concrete that will remain exposed to view.
4. Form finish clearly indicating proper locations and full coordination with concrete finishes required by Contract Documents.

5. Layout, procedures, and sequencing of shoring and reshoring that correlates with the information contained in the shoring/reshoring calculations described below.
6. Locations and dimensions of openings in structural members including floor slab, shear walls, columns and beams. See SUBMITTALS Section of Specification 033000.
7. Location of proposed construction joints in walls, floors, slabs, and beams. See SUBMITTALS Section of Specification 033000.

3. **Shoring/Reshoring Calculations**: Submit for record. Calculations sealed and signed by a Professional Engineer licensed in the state where the project is located. Calculations shall clearly address but not be limited to the following:

   a) Shoring removal and reshoring installation procedure including timing and sequencing.
   b) Concrete age and strength at the time of each shoring/reshoring operation.
   c) Description of construction loads assumed including concrete, formwork, and construction live load in accordance with ACI 347.
   d) Description of the distribution of construction loads between the shored/reshored levels.
   e) The total construction load imposed on all levels supporting shoring/reshoring at each stage of the shoring/reshoring cycle.
   f) A written statement by the Professional Engineer that the total construction load imposed on any level supporting shoring/reshoring, at all stages of the shoring/reshoring cycle, accounting for concrete age and relative strength at time of loading, meets the requirement of Section 3.2.

4. **Product Data**: Submit for action copies of manufacturers' product data and installation instructions for proprietary materials used in exposed concrete work, including form liners, release agents, manufactured form systems, ties, and accessories.
5. **Samples**: At request of Architect, submit for record samples of form ties and spreaders.
6. **Compatibility Certification**: Submit for record a written statement certifying that form release agent used is compatible with subsequent architectural finish materials applied to concrete surfaces. Submit along with manufacturer's data.
7. **Hazardous Materials Notification**: Submit for record. In the event no product or material is available that does not contain hazardous materials as determined by the Owner, a "Material Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.
8. **[LEED Submittals:]**

B. Submittal Process: See Section 033000.

C. SER Submittal Review: See Section 033000.

D. Substitution Request: See Section 033000.

E. Request for Information (RFI): See Section 033000.

1.7 FORMWORK DESIGN

A. Design of Formwork, Shoring/Reshoring, and its removal is the Contractor's responsibility.

B. Design, erect, support, brace and maintain formwork so that it will safely support vertical and lateral loads per SEI/ASCE 37-02 that might be applied, until such loads can be supported by the concrete structure.

C. Design Requirements:

1. Forms shall be designed for fabrication and erection in accordance with Design Professionals' requirements and recommendations of ACI 301, 318 and 347.
2. Design formwork in a manner such that the total construction load does not at any time exceed the total design load of new or existing construction and accounts for concrete age and relative strength at time of loading. See Section 3.2 for shoring/reshoring requirements.
3. Design formwork for loads and lateral pressures outlined in Section 2.2, ACI 347, and wind and seismic loads as specified by SEI/ASCE 37-02 unless otherwise controlled by local building code.
4. Design formwork to include loads imposed during construction, including weight of construction equipment, concrete mix, height of concrete drop, rate of filling of formwork, vibrator frequency, ambient temperature, foundation pressures, lateral stability, temporary imbalance or discontinuity of building components, and other factors pertinent to safety of structure during construction.
5. The use of flowing concrete (8" (200mm) to 10" (250mm) slump) of Self-Consolidating Concrete requires a review of the formwork design based on the rate of placement and setting time of the mix. Unless shown to be sufficient otherwise, formwork design shall conform to the requirements of ACI 237.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with General Conditions and Division 1, including the following:

1. Store forms and form materials clear of ground and protect from damage.

1.9 QUALITY ASSURANCE BY OWNER'S TESTING AGENCY

A. See Section 014500.

1.10 QUALITY CONTROL BY CONTRACTOR

A. See Section 033000.

1.11 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS

A. See Section 033000.

1.12 PERMITS AND WARRANTY

A. Permits: See Section 033000.

B. Warranty: See Section 033000. Failures include but are not limited to the following:

1. Discoloration of concrete scheduled to remain exposed to view.
2. Damage of concrete finishes caused by forms.
3. Damage of concrete caused by form stripping.
4. Non-compliance with form finishes required for designated architectural finishes.
5. Non-compatibility of form release agent with subsequent architectural finish materials applied to concrete surfaces.
6. Excessive and/or noticeable bowing in placed concrete members caused by deflection of formwork during concrete placement.

PART 2 - PRODUCTS

2.1 FORMWORK REQUIREMENTS

A. General Requirements:

1. Formwork shall meet construction safety regulations for the state where the project is located.
2. Forms shall be removable without impact, shock or damage to concrete surfaces, the structure and adjacent materials.
3. Forms shall be tight-fitting, designed and fabricated for required finishes and to withstand concrete weight and maintain tolerances as specified in ACI 117 for the following designations: (See architectural drawings for locations).

a) Class A – For surfaces prominently exposed to public view where appearance is of special importance.
b) Class B – Coarse-textured concrete-formed surfaces intended to receive plaster, stucco or wainscoting.
c) Class C – General Standard for permanently exposed surfaces where other finishes are not specified.
d) Class D - Minimum quality surface where roughness is not objectionable, usually applied where surfaces will be concealed.

4. Furnish forms in largest practicable sizes to minimize number of joints and to conform to joint system shown on Drawings, using form materials

with sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection.

5. Butt Joints: Shall be solid and complete with backup material to prevent leakage of cement paste.

B. Form Finishes for Exposed Surfaces:

1. Type: Straight, smooth, free of cement paste leaks at butt-joints, surface imperfections and other irregularities detrimental to appearance of finished concrete, fully coordinated with requirements for required finish material.
2. Form exposed areas of columns, beams, ledges, balcony fascias to achieve true alignment and level soffit of edge beams and concrete edges. All such areas must be sharp, straight and true to line and level. Edge beams and concrete canopies and ledges must have adequate shoring to prevent any visible amount of sag and sufficient bracing to prevent any lateral movement during construction.

2.2 FORM MATERIALS

A. General: Plywood, fiberglass, metal, metal-framed plywood faced, or other acceptable panel-type materials.

1. Provide materials with sufficient strength to prevent warping.

B. Plywood: Of species and grade suitable for intended use, sound undamaged sheets with clean true edges, minimum 5/8" (16mm) thick, complying with U.S. Product Standard PS-1.

1. Other Acceptable Sheet Materials: 14 gauge (2.0mm) sheet steel or fibrous glass reinforced resin.

C. Lumber: Construction grade or better consistent with calculation requirements, without loose knots or other defects.

1. Use only where entire width can be covered with one board 11-1/4" (285mm) or less in width.

D. Forms for Cylindrical Columns and Supports: Metal, glass-fiber reinforced plastic, or paper or fiber tubes that will produce smooth surfaces without joint indications.

1. Provide units with sufficient wall thickness to resist wet concrete loads without deformation.

E. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to support weight of placed concrete without deformation.

F. Chamfer for Form Corners:

1. Types: Chamfer strips of wood, metal, PVC or rubber fabricated to produce smooth form lines and tight edge joints, 3/4" (20mm) size, maximum possible lengths.
2. Required for all exposed corners of beam, walls and column forms.

G. Form Ties:

1. Type: Factory-fabricated metal, adjustable length, designed to prevent form deflection and to prevent spalling concrete upon removal.
2. Ties used for architecturally exposed concrete shall be galvanized.
3. Ties shall not leave metal closer than 1-1/2" (40mm) to exposed surface.
4. When removed, ties shall not leave holes larger than 1" (25mm) diameter in concrete surface.
5. Removable Ties: Use type with tapered cones, 1" (25mm) outside diameter, for concrete walls which will remain exposed to view and scheduled for architectural finishes.
6. Snap-Off Ties: Use for concrete walls below grade and walls which will not remain exposed to view and are not scheduled for architectural finishes.
7. Wire Ties: Not acceptable.

H. Nails, Spikes, Lag Bolts, Thru-Bolts, Anchorages:

1. Type: Of size, strength and quality to meet the required quality of formwork.

I. Form Release Agent:

1. Type: Commercial formulation form release agent of non-emulsifiable type which will not bond with, stain, or adversely affect concrete surfaces. Form release agent shall not impair subsequent treatment of concrete surfaces requiring bond or adhesion, or impede the wetting of surfaces to be cured with water or curing compounds. Form release agent shall be compatible with subsequent architectural finish materials applied to concrete surfaces. Apply in compliance with manufacturers' instructions.
2. Form release agent shall meet, at a minimum, all federal and state requirements for volatile organic compounds (VOC’s).
3. For Steel Forms: Non-staining rust-preventative type.

J. Reglets: Provide sheet metal reglets formed of same type and gauge as flashing metal, unless indicated otherwise on Drawings. Where resilient or elastomeric sheet flashing, or bituminous membranes are terminated in reglets, provide reglets of not less than 26 gauge (0.55mm) galvanized sheet metal. Fill reglet or cover face opening to prevent intrusion of concrete or debris.

K. Coordinate with materials as specified in Section 032000 Concrete Reinforcement and Embedded Assemblies.

PART 3 - EXECUTION

3.1 FORMWORK

A. General:

1. Inspect areas to receive formwork.
2. Construct forms to sizes, shapes, lines, and dimensions shown on Contract Documents, and to obtain accurate alignment, location, grades, level and plumb work in finished structures.
3. Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins, and to maintain alignment.
4. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, drips, bevels, chamfers, blocking, screeds, bulkheads, anchorages and inserts and other features required in the Work.
5. Comply with shop drawings, ACI 301, 318, 347 and Contract Documents.
6. Maintain formwork and finished work construction tolerances complying with ACI 301 and 117.
7. Provide shore and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations, using wedges or jacks or a combination thereof.
8. Erect forms for easy removal without hammering or prying against concrete surfaces.
9. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces.
10. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only.
11. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.
12. Chamfer exposed corners and edges as indicated on the architectural drawings, using wood, metal, PVC or rubber chamfer strips fabricated to produce smooth lines and tight edge joints.
13. Design, erect, support, brace and maintain formwork and shoring to support loads until such loads can be safely supported by the concrete structure.
14. Where specifically shown on the Contract Documents as monolithic, upturned beams, curbs and similar members in connection with slabs shall be formed so that they can be poured integrally with slabs.

B. Concrete Accessories and Embedded Items:

1. Install into forms concrete accessories, sleeves, inserts, anchor bolts, anchorage devices and other miscellaneous embedded items furnished by other trades or that are required for other work that is attached to or supported by cast-in-place concrete.

   a) Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached.

2. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated on drawings or required by other trades.
4. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces.
5. Coordinate with CONCRETE REINFORCEMENT AND EMBEDDED ASSEMBLIES Section in Specification 032000.
6. Install accessories and embedded items straight, level, plumb and secure in place to prevent displacement by concrete placement.

C. Temporary Openings:

1. Locate temporary openings in forms at inconspicuous locations.
2. For clean-outs and inspection before concrete placement, locate temporary openings where interior area of formwork would otherwise be inaccessible.
3. For cleaning and inspections, locate openings at bottom of forms to allow flushing water to drain.
4. Securely brace temporary openings and set tightly in forms to prevent loss of concrete.
5. Close temporary openings with tight fitting panels, flush with inside face of forms, neatly fitted so that joints will not be noticeable on exposed concrete surfaces.

D. Provisions for Other Trades: Coordinate and provide openings in concrete formwork to accommodate work of other trades.

1. Determine size and location of openings, recesses, chases, offsets, openings, depressions, and curbs from information provided by trades requiring such items.
2. Accurately place and securely support items built into forms.

E. Cleaning:

1. Normal Conditions:

a) Thoroughly clean forms and adjacent surfaces to receive concrete.
b) Remove chips, wood, sawdust, dirt, standing water or other debris just before placing concrete.
c) Flush with water or use compressed air to remove remaining foreign matter.
d) Verify that water and debris can drain from forms through clean-out ports.

2. During Cold Weather:

a) Remove ice and snow from within forms.
b) Do not use de-icing salts.
c) Do not use water to clean out completed forms, unless formwork and concrete construction will proceed within heated enclosure.
d) Use compressed air or other means to remove foreign matter.

F. Form Release Agents

1. Before placing reinforcing steel and miscellaneous embedded items, coat contact surfaces of forms with an approved non-residual, low VOC form release agent in accordance with manufacturer's published instructions.
2. Do not allow release agent to accumulate in forms or come into contact with reinforcement or concrete against which fresh concrete will be placed.

   a) Coat steel forms with nonstaining, rust-preventative material.

3. Remove form release agent and residue from reinforcement or surfaces not requiring form coating.

G. Before Placing Concrete:

1. Inspect and check completed formwork, shoring and bracing to ensure that work is in accordance with formwork requirements of this section and Contract Documents, and that supports, fastenings, wedges, ties, and parts are secure.

   a) Make necessary corrections or adjustment to formwork to meet tolerance requirements.

2. Retighten forms and bracing before concrete placement to prevent mortar leaks and maintain proper alignment.
3. Notify Testing Agency sufficiently in advance of placement of concrete to allow inspection of completed and cleaned forms.

H. During Concrete Placement:

1. Maintain a check on formwork to ensure that forms, shoring, ties and other parts of formwork have not been disturbed by concrete placement methods or equipment.
2. Use positive means of adjustment as required for formwork settlement during concrete placing operations.

I. Camber:

1. Provide camber in formwork as required for anticipated deflections due to weight and pressures of fresh concrete and construction loads.
2. Camber bottom forms where indicated on the drawings. Whenever forms are cambered, screeded levels for establishing top of concrete must be cambered to the same amount and to the same profiles such that

scheduled depth of member is not reduced by lifting of forms. Check camber and adjust forms before initial set as required to maintain camber.

J. Surface Defects:

1. Install forms that will not impair the texture of the concrete and are compatible with the specified finish type.

K. Formwork Loads on Grade

1. Where loads from formwork bear on grade, provide suitable load-spreading devices for adequate support and to minimize settlement. In no event shall frozen ground or soft ground be utilized directly as the supporting medium.

L. Footings and Grade Beams:

1. Provide forms for footings and grade beams if soil or other conditions are such that earth trench forms are unsuitable.
2. When trench forms are used, provide an additional 1” (25mm) of concrete on each side of the minimum design profiles and dimensions indicated.

M. For slabs-on-grade, secure edge forms in such a manner as to not move under weight of construction loads, construction and finishing equipment, or workers.

3.2 SHORES AND RESHORES

A. Comply with ACI 347.2R for shoring and reshoring in multistory construction, and as specified herein.

1. For non-post tensioned flat plate concrete structures of five supported levels or more, extend shoring/reshoring at least four levels below the floor or roof being placed (shore formwork, reshore three levels below)
2. For non-post tensioned flat plate concrete structures of less than five supported levels, extend shoring/reshoring to ground.
3. For all other concrete structures of four supported levels or more, extend shoring/reshoring at least three levels below the floor or roof being placed (shore formwork, reshore two levels below)
4. For all other concrete structures of less than four supported levels, extend shoring/reshoring to ground.
5. Reshores shall be placed as soon as practicable after stripping operations are complete but no later than the end of the working day in which the stripping occurs.
6. For shoring/reshoring placed on mud sills, adjustments shall be made by contractor to account for ground settlement.
7. Locate shores/reshores such that the factored (ultimate) construction load imposed onto any slab or beam at any time during the construction cycle does not exceed 90% of the factored (ultimate) design load for that slab or beam, scaled down to reflect effect on capacity of lower concrete strength at time of loading.

8. Construction load shall include the weight of wet concrete, total weight of formwork and shoring/reshoring, and a minimum construction live load of 50 psf (2.5kPa) (increase if construction operations will produce higher loading). Design load includes self-weight of the slab, and superimposed dead and live loads as indicated on the drawings.
9. For comparison of construction loads to design loads, compare factored (ultimate) construction loads to factored (ultimate) design loads. For construction dead and live loads, use the same load factors and load combinations as required by ACI 318 for design dead and live loads. The specified strength reduction factors from ACI 318 should also be applied during the strength evaluation of the partially completed structure.
10. For flat plate or flat slab construction “backshores” or “preshores” as defined in ACI 347 shall be permitted only if appropriate calculations and construction sequences are provided demonstrating that the accumulation of shore loads will not overload any slab. In the absence of such calculations and construction sequences, shores must be removed and reshores installed in a sequence such that each floor is permitted to deflect and carry its own weight prior to the installation of reshores.
11. Reshores shall not be removed until the concrete has attained its specified 28 day strength.

3.3 REMOVING FORMS

A. Formwork not supporting the weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50ºF (10ºC) for 12 hours after placing concrete, provided concrete is sufficiently hard to avoid damage by form-removal operations, and provided curing and protection operations are maintained after removal of formwork.

B. Formwork supporting the weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed until concrete has attained at least 75% of design compressive strength. If stripping occurs before 3 days, 100% strength must be achieved. For multistory buildings, enough shoring should be provided for a sufficient number of floors to be built to properly support the construction loading from reshoring.

C. Formwork supporting the weight of concrete for post-tensioned floor framing may not be removed until all post-tensioning operations have been completed and approved. For multistory buildings, enough shoring should be provided for a sufficient number of floors to be built to properly support the construction loading from reshoring. See General Notes in the drawings for the minimum compressive concrete strength required for stressing of tendons.

D. Where reshoring is required as part of the formwork removal process, refer to the Shores and Reshores section of this specification.

E. Determination of early age compressive strength of concrete at time of formwork removal shall be made by compression tests of field-cured cylinders or by the maturity method in accordance with ASTM C1074. If the maturity method is used, submit sufficient data using project materials to demonstrate correlation of

measurements on the structure with the compressive strength of laboratory-cured molded cylinders.

F. Remove formwork progressively using methods to prevent shock loads or unbalanced loads from being imposed on structure. Comply with ACI 347.

G. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against concrete surfaces.

H. Whenever formwork is removed during the curing period, the exposed concrete shall be cured per requirements of Section 033000.

I. All wood formwork, including that used in void spaces, pockets and other similar places shall be removed.

J. Form tie holes shall be filled as per approved samples submitted to the Design Professionals.

K. The Contractor shall assume responsibility for all damage due to removal of the forms.

3.4 RE-USING FORMS

A. Before forms can be re-used, surfaces that will be in contact with freshly poured concrete must be thoroughly cleaned, damaged areas repaired, and projecting nails withdrawn.

1. Split, frayed, delaminated or otherwise damaged form-facing material will not be acceptable.
2. Apply new form release agent on re-used forms.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joints to avoid offsets.

C. Forms for exposed concrete may be reused only if the surfaces have not absorbed moisture and have not splintered, warped, discolored, stained, rusted or peeled, subject to acceptance by the Design Professionals. The Design Professionals reserve the right to require the Contractor to remove and reconstruct such formwork as will produce subsequent areas that are acceptable. Do not use "patched" forms for exposed concrete surfaces, unless approved by the Design Professionals.

3.5 CORRECTIVE MEASURES

A. Where the Contractor requests that the Design Professionals develop the corrective actions or review corrective actions developed by others, the Design Professional shall be compensated as outlined in Part 3 – CORRECTIVE MEASURES section of Specification 033000.

END OF SECTION

SECTION 032000

CONCRETE REINFORCEMENT AND EMBEDDED ASSEMBLIES

PART 1 - GENERAL

1.1 GENERAL

Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 SCOPE

Provide all labor, materials, equipment, services and transportation for reinforcing steel, accessories, embedments and miscellaneous anchorage accessories, joint fillers, and waterstops for cast-in-place concrete work as shown on Drawings, as specified herein, and as required by the job conditions.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Division 1
Quality Control	Division 1
Quality Assurance: Structural Testing and Inspection	Section 014500
Concrete Formwork	Section 031000
Cast-In-Place Concrete	Section 033000
Thermal and Moisture Protection	Division 7

1.4 CODES AND STANDARDS

A. Building Code: Concrete work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.

B. Standards:

1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301 –Specifications for Structural Concrete.
3. ACI 315 – Details and Detailing of Concrete Reinforcement.
4. ACI 318 – Building Code Requirements for Structural Concrete and Commentary.
5. ACI 355.2 – Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary
6. ACI 355.4 – Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary

7. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein.
8. AWS D1.1 – Structural Welding Code-Steel.
9. AWS D1.4 – Structural Welding Code-Reinforcing Steel.
10. CRD C 572 – Specification for Polyvinylchloride Waterstops.
11. Concrete Reinforcing Steel Institute ”Manual of Standard Practice”
12. ASTM D3963 Fabrication and Jobsite Handling of epoxy Coated Steel Reinforcing Bars.

C. Definitions:

1. See Section 033000.

1.5 CONTRACTOR QUALIFICATIONS

A. The work of this section shall be performed by a fabricator specializing in the type of reinforcement fabrication required for this Project, with a minimum of 10 years of documented successful experience and shall be performed by skilled workmen thoroughly experienced in the necessary crafts.

1. Welders shall be qualified in accordance with applicable AWS Code within 12 months before starting the work.

a) Make qualification records available to the Design Professionals upon request.

B. Manufacturers shall specialize in manufacturing the types of concrete accessories required for cast-in-place concrete work, with a minimum of 10 years of documented successful experience and shall have the facilities capable of meeting all requirements of Contract Documents as a single-source responsibility and warranty for each type of accessory.

1.6 SUBMITTALS

A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested. Reproduction of Contract Drawings as shop drawings is not permitted.

(1) Submittal Schedule
(2) Shop Drawings
(3) Product Data
(4) Mill Reports
(5) Reinforcement Strain Test
(6) Hazardous Materials Notification
(7) **[LEED Submittals]**

1. **Submittal Schedule**: See Section 033000.

2. **Shop Drawings**: Submit for action shop drawings that shall clearly indicate, but not be limited to:

   a) All details, dimensions and information required for fabrication and placement of concrete reinforcement in accordance with Contract Documents, prepared in accordance with ACI 315 recommendations.
   b) Elevations, plans, sections, and dimensions of concrete work with required reinforcement clearances.
   c) Ledges, brackets, openings, sleeves, anchor rods, embedments, prefabricated bent-in dowel keyway systems, electrical conduit and items of other trades including interference with reinforcing materials.
   d) Sizes, grade designations, spacing, locations, and quantities of wire fabric, reinforcement bars, temperature and shrinkage reinforcement dowels.

      i. Do not use dimensions scaled from Contract Drawings to determine bar lengths.
      ii. Hooks and bends not specifically dimensioned shall be detailed per ACI 318.

   e) Bending and cutting schedules, assembly diagrams, splicing and connection requirements, details, and laps.
   f) Each type of supporting and spacing devices, including miscellaneous accessories.
   g) Construction joint type, details, and locations. Contractor shall coordinate construction joint type, details, and locations with concrete pour schedule. Submittal shall include details for each type of construction joint in accordance with Contract Documents.
   h) Locations and dimensions of openings in structural members including floor slab, shear walls, columns and beams. See SUBMITTALS Section of Specification 033000.
   i) Concrete accessories and embedded items. See SUBMITTALS Section of Specification 033000.

3. **Product Data**: Submit for action for each type of product identified in Part 2. Product Data shall be clearly marked to indicate all technical information which specifies full compliance with this section and Contract Documents, including published installation instructions and I.C.C reports, where applicable, for products of each manufacturer specified in this section.
4. **Mill Reports**: Submit for record.
5. **Reinforcement Strain Test**: For Grade 75 reinforcement, submit for record certification that steel has a yield strength of no less than 75 ksi as measured by both ASTM A615 and ACI 318 Section 3.5.3.2 procedures.
6. **Hazardous Materials Notification**: Submit for record. In the event no product or material is available that does not contain hazardous materials as determined by the Owner, a "Material Safety Data Sheet" (MSDS)

equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.

7. **[LEED SUBMITTALS]**

B. Submittal Process: See Section 033000.

C. SER Submittal Review: See Section 033000.

D. Substitution Request: See Section 033000.

E. Request for Information (RFI): See Section 033000.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with General Conditions and Division 1, including the following:

1. Deliver reinforcing steel to Project site bundled, tagged and marked.

a) Use weatherproof tags indicating bar sizes, lengths and other information corresponding to markings shown on placement diagrams.

2. Deliver welded wire fabric in sheets. Do not deliver in rolls.
3. During construction period, properly store reinforcing steel and accessories to assure uniformity throughout the Project.
4. Deliver and store welding electrodes in accordance with AWS D1.4.
5. Immediately remove from site materials not complying with Contract Documents or determined to be damaged.
6. Store reinforcing steel above ground so that it remains clean.

a) Maintain steel surfaces free from materials and coatings that might impair bond.
b) Keep covered.
c) Protect against corrosion or deterioration of any kind.

1.8 QUALITY ASSURANCE BY OWNER'S TESTING AGENCY

A. See Section 014500.

1.9 QUALITY CONTROL BY CONTRACTOR

A. See Section 033000.

1.10 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS

A. See Section 033000.

1.11 PERMITS AND WARRANTY

A. Permits: See Section 033000.

B. Warranty: See Section 033000. Failures include but are not limited to the following:

1. Bars with kinks or bends not indicated on Drawings or on approved shop drawings.
2. Bars damaged due to bending, straightening or cutting.
3. Bars heated for bending.

PART 2 - PRODUCTS

2.1 REINFORCEMENT

A. Reinforcing Steel:

1. Type: Deformed billet steel bars, ASTM A 615, Grade 60 or 75 as indicated on Drawings.
2. Size: As indicated on structural Drawings.
3. Where indicated on Drawings, reinforcing steel shall be hot-dipped galvanized after fabrication in accordance with ASTM A 767, Class II, with galvanizing material protected from embrittlement during galvanizing process in accordance with ASTM A 143.

a) Galvanized finish shall meet the bend and shear test requirements of ASTM A 615.

4. Epoxy-Coated: ASTM A 775 where indicated on Drawings.
5. Weldable reinforcement: ASTM A 706 where indicated on Drawings.

B. Welded Wire Reinforcement:

1. Type: steel wire, deformed, ASTM A1064.
2. Size: As indicated on structural Drawings.
3. Where indicated on Drawings, welded wire reinforcement shall be hot-dipped galvanized after fabrication in accordance with ASTM A 1060, , with galvanizing material protected from embrittlement during galvanizing process in accordance with ASTM A 143.

a) Galvanized finish shall meet the bend and shear test requirements of ASTM A 615.

4. Plain Steel Welded Wire Reinforcement: ASTM A 1064.
5. Deformed Steel Welded Wire Reinforcement: ASTM A 1064.
6. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884, Class A.

C. Headed Shear Stud Reinforcement At Slab-Column Connections:

1. Type: Stud assemblies consisting of either single-headed studs attached to a structural steel base rail by structural welding or double-headed studs attached to a non-structural steel shape/plate for alignment and for shear reinforcement at slab-column connections shall be in accordance with

ASTM A 1044. Headed shear studs per AWS D1.1 are not an acceptable substitution for headed shear stud reinforcement. A

a) Shear studs shall be in accordance with either ASTM A108 or ASTM A29, Grade 1010 through 1020. Yield strength shall be 51,000 psi minimum and tensile strength shall be 65,000 psi minimum.
b) Rails shall be in accordance with ASTM A36 or CSA 44W. Yield strength shall be 44,000 psi minimum and tensile strength shall be 65,000 psi minimum.
c) Studs shall be welded in accordance with AWS D1.1.
d) Acceptable Products:

i. Studrails by DECON, Inc.
ii. DSA by SureBuilt Manufacturing
iii. DSR by Dayton Superior Corporation
iv. Suncoast SRS by Suncoast Post-Tension, Ltd.

2. Size, quantity and spacing: As indicated on structural Drawings.
3. Installation: Per manufacturer's instructions.
4. Supports: Use plastic molded plastic chairs as provided by the manufacturer to maintain the bottom rebar cover as specified on the Drawings. Tie headed shear stud reinforcement to adjacent top bars to maintain vertical position.

D. Reinforcement Coating Repair Materials:

1. Apply repair coating in accordance with the manufacturer's written procedures.
2. Galvanized Repair Coating: Zinc-based solder, paint containing zinc dust or sprayed zinc complying with ASTM A780.
3. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying withD3963/D3963M referencing Annex A2 of ASTM A775/A775M.

a) The maximum amount of repaired damaged areas shall not exceed 2% of the surface area in each linear foot of each bar. If more than 2% of the surface area in each linear foot of bar is damaged, bar shall be replaced.

2.2 ACCESSORIES

A. Tie Wire:

1. Type: Minimum 16 gauge (1.5mm) annealed steel wire, ASTM A 510 and ASTM A 853.
2. Wire Bar Type: Comply with CRSI.

B. Mechanical Splicing Systems:

1. Mechanical tension and compression splicing systems shall be used where indicated on Drawings or at contractor's option. For seismic design categories D, E and F, in plastic hinge regions, only Type 2 mechanical splices are permitted.
2. Splices shall be installed in accordance with manufacturer's requirements.
3. Acceptable Products:

    a) Bartec Couplers by Dextra
    b) Griptec Couplers by Dextra
    c) Unitec Couplers by Dextra
    d) Lenton Couplers by Erico
    e) Lenton Cadweld by Erico
    f) Bar Lock Couplers by Dayton Superior
    g) Taper-Lock Couplers by Dayton Superior
    h) Grip-Twist by BarSplice
    i) ZAP Screwlok by BarSplice
    j) BPI Barsplicer by BarSplice
    k) BarGrip by BarSplice
    l) 400 and 500 Series by Headed Reinforcement Corp

4. Mechanical and welded tensile mechanical splicing systems shall be capable of developing 125% of the reinforcing steel ASTM specified minimum yield strength (Type 1) except where indicated as Type 2 (100% of specified tensile strength).
5. Mechanical compression splices shall be such that the compression stress is transmitted by end bearing held in concentric contact.

C. Headed Bars:

1. For bar sizes #11 (ø36) or smaller where specifically detailed on Drawings, mechanical bar terminators shall be used.
2. Headed bars shall meet the requirements of ASTM A970, Class HA.
3. Acceptable Products:

    a) Headed Bars by Dextra
    b) Lenton Terminator by Erico
    c) Grip-Twist Doughnut by Bar-Splice
    d) BPI ButtonHead by BarSplice
    e) Zap T-Lok by BarSplice
    f) Taper-Lock End Anchor Disc by Dayton Superior
    g) 100, 550 and 670 Series by Headed Reinforcement Corp

D. Weldable Bar Couplers:

1. Acceptable Products:

    a) Lenton Weldable Couplers by Erico
    b) DBDI Weldable Coupler by Dayton Superior
    c) BPI Structural Connector by BarSplice

E. Slip Dowel Bar/Plate Systems for Slab on Grade Joints

1. Acceptable Products:

a) Speed Dowel or Speed Plate by Sika Corporation
b) QuicDowel or QuicPlate by BoMetals, Inc.
c) Diamond Dowel System by PNA Construction Technologies

F. Supports for Reinforcement:

1. Types: Bolsters, chairs, spacers, clips, chair bars, and other devices for properly placing, spacing, supporting, and fastening the reinforcement, plastic, plastic protected steel, or epoxy coated to match supported reinforcement.
2. For Contact with Forms: Use types with not less than 3/32" (2.5mm) of plastic between metal and concrete surface.

a) Plastic tips shall extend not less than ½" (12mm) on metal legs.

3. Individual and continuous slab bolsters and chairs shall be of type to suit various conditions encountered and must be capable of supporting 300 pound (1.5kN) load without damage or permanent distortion.
4. Unless otherwise indicated on Drawings, bottom reinforcing bars in footings shall be supported by precast concrete bricks or individual high chairs with welded sand plates on bottom.
5. For Slabs on Grade: Use supports with sand plates or horizontal runners where base material will not support chair legs.

G. Deformed Bar Anchors:

1. Type: Automatic end welded, ASTM A 496 quality.
2. Size and Grade: As indicated on structural Drawings by Nelson Stud Welding.

H. Anchor rods and dowels:

1. Types and Sizes: Provide sizes and types of anchor rods and dowels as indicated on the Drawings. Each type of anchor shall be manufactured of structural quality steel, designed for cast-in-place concrete applications and be of sizes as indicated on Drawings, complete with washers, nuts, plates and miscellaneous accessories required to meet Contract Document requirements.
2. Adhesive Anchors for anchor rods and dowels in existing concrete: See Anchorage Accessories.

I. Prefabricated Bent-In Dowel Keyway Systems and Dowel Bar Replacements:

1. Type, Size and Grade as indicated on Drawings.
2. Dowels shall be installed in accordance with manufacturer's requirements
3. Acceptable Products:

a) Lenton Form Savers by Erico
b) Keyway Splice Box by Meadow Burke
c) Metalstrip by Dayton Superior
d) DBDI Splice System by Dayton Superior
e) D50 DBR Coupler System by Dayton Superior
f) BPI Barsplicer by BarSplice
g) 300 Series by Headed Reinforcement Corp

2.3 ANCHORAGE ACCESSORIES

A. General: Miscellaneous anchorage accessories for anchoring structural, architectural, electrical, and mechanical items to poured concrete shall include but not be limited to the following:

1. Concrete Anchors: Headed or bent studs ASTM A 108/Grade 1015 through 1020, minimum yield strength of 50,000 psi (345MPa), minimum tensile strength of 60,000 psi (415MPa).
2. Anchor Rods: ASTM F1554, Grade as noted on Drawings.
3. Shallow Embedment Internally Threaded Inserts with ¾” maximum embedment.

   a) Acceptable Products:

      i. Mini Undercut + by DeWalt (for post-tensioned slabs and precast hollow core slabs)
      ii. HDI-P TZ by Hilti (for post-tensioned slabs)

4. Adhesive Anchors:

   a) Basis of Design: See General Notes
   b) Substitution Request: As anchor capacities vary by manufacturer, the following anchors will be considered as a Substitution Request. Refer to project specifications for Substitution Request procedure

      i. HIT-RE 500-V3 by Hilti, Inc.
      ii. Epcon C6+ by ITW Red Head
      iii. Epcon G5 by ITW Red Head
      iv. Pure 110+ by DeWalt
      v. SET-3G by Simpson Strong-Tie Co.

   c) The adhesive anchor system used for post-installed anchorage to concrete shall conform to the requirements of ACI 355.4 and commentary and shall possess a current ICC- ES report demonstrating compliance with ACI 318.

5. Expansion Anchors:

   a) Basis of Design: See General Notes

b) Substitution Request: As anchor capacities vary by manufacturer, the following anchors will be considered as a Substitution Request. Refer to project specifications for Substitution Request procedure.

i. Kwik Bolt 1 (KB1) by Hilti, Inc.
ii. Power Stud+ SD1 or SD2 by DeWalt
iii. Power Stud + SD6 (SS) by DeWalt
iv. Trubolt by ITW CCNA
v. Strong-Bolt 2 by Simpson Strong-Tie Co.

c) The expansion anchors used for post-installed anchorage to concrete shall conform to the requirements of ACI 355.2 and commentary and shall possess a current ICC- ES or IAPMO UES report demonstrating compliance with ACI 318.

6. Threaded Screw Anchors:

a) Basis of Design: See General Notes
b) Substitution Request: As anchor capacities vary by manufacturer, the following anchors will be considered as a Substitution Request. Refer to project specifications for Substitution Request procedure.

i. Screw-Bolt + by DeWalt
ii. Tapcon + by ITW Red Head
iii. Titan HD by Simpson Strong-Tie Co., Pleasanton, CA

7. Inserts and Coil Rods: Yield strength 65,000 psi (450MPa), ASTM B 633, manufactured by Acrow-Richmond Limited or Dayton Superior
8. Welding Electrodes: AWS 5.5, Series E70.
9. Welded Deformed Bar Anchors: Welded by full-fusion process, as furnished by TRW Nelson Stud Welding Division or equivalent.

B. Dovetail Anchor Slots:

1. Type: Formed 22 gauge (0.85mm) galvanized steel
2. Acceptable Manufacturers:

a) Heckmann Building Products
b) Hohmann and Barnard,
c) BoMetals, Inc..

3. Location of Use: Continuous installation of anchor slots, full height of masonry walls, where masonry walls abut poured concrete walls.
4. Fill slot with temporary filler or cover face opening to prevent intrusion of concrete or debris.
5. Finish: Hot-dip galvanized or zinc-plated steel.
6. Stainless steel anchors are acceptable.

2.4 JOINT FILLERS

A. Permanent Compressible Joint Filler:

1. Acceptable Product: W. R. Meadows: “Ceramar” closed-cell expansion joint filler, ultraviolet stable, minimal moisture absorption, non-impregnated, nonstaining and nonbleeding, inert and compatible with cold-applied sealants.
2. Location of Use: Slabs and curbs as indicated on Drawings or required.
3. Thickness: As indicated on Drawings or required.

B. Temporary Compressible Joint Filler:

1. Type: White molded polystyrene beadboard.
2. Location of Use:

   a) In slabs, curbs, and walls which must be removed prior to joint sealant installation.
   b) Vertically to isolate walls from columns or other walls.

C. Semi Rigid Joint Filler:

1. Acceptable Product: Euclid Chemical Company “Euco 700” or “Euco QWIKjoint 200”
2. Acceptable Product: Sika Corporation “Sikadur 51 SL”
3. Acceptable Product: W.R. Meadows Sealtight “Rezi-Weld Flex”

D. Noncompressible Joint Filler:

1. Acceptable Product: Dow Chemical's "STYROFOAM 40" rigid closed-cell extruded polystyrene board, square edges, 40 psi (275kPa) compressive strength, ASTM C 578, Type IV.
2. Thickness: As indicated on Drawings.
3. Location of Use: As indicated on Drawings or required.

E. Asphalt-Impregnated Joint Filler:

1. Acceptable Product: W.R. Meadows Asphalt Expansion Joint Filler, preformed, ASTM D 994.
2. Thickness: ½” (12mm) maximum, as indicated on Drawings or required.
3. Location of Use: Sidewalks at foundation walls and as indicated on Drawings or required.

F. Asphalt-impregnated fiberboard expansion joint filler for interior work:

1. Type: ASTM D1751.

G. Self-expanding cork board expansion joint filler for exterior work:

1. Type: ASTM D1752.

H. Construction Joints:

1. Type: Tongue and groove type profile of galvanized steel, with knock-out holes at 6" (150mm) on center to receive dowelling, complete with anchorage.

2.5 WATERSTOPS

A. Preformed Swellable Waterproofing Strips especially formulated for concrete cold joints at footings, walls, or slabs.

1. Acceptable Products:

a) Volclay Waterstop RX by CETCO Building Materials Group
b) Adcor ES by GCP Applied Technologies
c) Hydrotite by Sika

2. Size: 3/4" (20mm) by 3/8" (10mm) strips minimum, 25 ft. (7.5m) long, and weighing at least 0.165 lbs/ft (0.245kg/m).
3. Location of Use: Concrete cold joints at footings, walls and slab joints.
4. Comply with manufacturer product application and installation instructions.

B. Polyvinyl Chloride Waterstops:

1. Type: PVC Waterstops for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections and directional changes. U.S. Corp of Engineers Specification CRD C 572.
2. Acceptable Products:

a) PVC Waterstops” by BoMetals
b) Greenstreak by Sika
c) Sealtight PVC Waterstops by W.R. Meadows

2.6 **[LEED REQUIREMENTS]**

PART 3 - EXECUTION

3.1 FABRICATION

A. Reinforcing Steel Fabrication:

1. Fabricate in accordance with approved shop Drawings, ACI 315 and Contract Documents.
2. Heating of Reinforcement: Will be permitted only with specific prior approval of the SER.
3. Welding: Comply with ANSI/AWS D1.4; use E9018 electrodes or approved electrodes.
4. Tolerances: Comply with ACI 117.
5. Unacceptable Materials: Reinforcement with any of following defects will not be permitted in Work.

a) Bar lengths, depths, and bends exceeding ACI fabrication tolerances.
b) Bends or kinks not indicated on Drawings or final shop drawings.
c) Bars with reduced cross-section due to excessive rusting or other cause.

B. Welded Wire Reinforcement:

1. Type: As fabricated in accordance with CRSI, unless otherwise noted.

C. Templates:

1. Required for all footing and column dowels, and where required for proper alignment of reinforcing.

D. Assemblies:

1. Fabricate and assemble structural steel items in shop in conformance with AISC and AWS D1.1. Shearing, flame cutting, and chipping shall be done carefully and accurately. Cut, drill, or punch holes at right angles to the surface of the metal. Do not make or enlarge holes by burning. Holes shall be clean-cut without torn or ragged edges.
2. Welding of deformed bar anchors and headed stud anchors shall be installed by full-fusion process equivalent to TRW Nelson Stud Welding Division or KSM Welding Services Division, Omark Industries or Tru-Weld Stud Welding, Medina, OH.
3. Welding of reinforcement shall be done in accordance with AWS requirements. Welding shall be performed subject to the observance and testing by Testing Agency.
4. Galvanizing where required, shall be applied after fabrication and prior to casting concrete.
5. Welding of crossing bars (tack welding) for assembly of reinforcement is not permitted without use of weldable reinforcement and express written consent of SER.

3.2 INSTALLATION OF REINFORCEMENT

A. General:

1. Perform the work of this section in accordance with approved shop drawings, ACI 318 and CRSI recommended practice for “Placing Reinforcing Bars”, for details and methods of reinforcement placement and supports, and as specified.
2. Before placing reinforcement steel, inspect forms for proper fitting and compliance with allowable tolerances.
3. Reinforcement shall be free of form coatings, sealers, powdered and scaled rust, loose mill scale, earth, ice, and other materials which will reduce or destroy bond with concrete.
4. Do not place concrete until the completed reinforcement steel work has been observed and accepted by Owner’s Testing Laboratory.
5. Reinforcement steel is not permitted to be “floated into position”.

6. Bend bars cold.

    a) Do not heat or flame cut bars.
    b) No field bending of bars partially embedded in concrete is permitted, unless specifically approved by the SER and tested by Testing Agency for cracks.

7. Weld only as indicated.

    a) Perform welding per ANSI/AWS D12.1 and/or ANSI/AWS D1.4.
    b) See structural Drawings for additional requirements.

8. Tag reinforcement steel for easy identification.

B. Placement of Reinforcement Bars:

1. Comply with approved shop drawings, ACI 318 and Contract Documents.
2. Accurately position, support and secure reinforcement in a manner to prevent displacement before and during placement of concrete.

    a) Place reinforcement bars within tolerances specified in ACI 117.
    b) Locate and support reinforcement by metal chairs, runners, bolsters, spacers, hangers and other accessories for fastening reinforcing bars and welded wire reinforcement in place.

3. If bars are displaced beyond specified tolerance when relocating the bars to avoid interference with other reinforcement or embedded items, immediately notify the Design Professionals for approval prior to concrete placement.
4. Avoid cutting or puncturing vapor retarder during reinforcement placement.

    a) Repair damages before placing concrete.

5. Concrete Coverage: Maintain concrete cover around reinforcement as indicated on Drawings.
6. Bar Supports: Use type specified in this section.
7. Tie Wires: After cutting, turn tie wires to the inside of section and bend so that concrete placement will not force ends to be exposed at face of concrete.

C. Placement of Wire Reinforcement:

1. Install in lengths as long as practicable.
2. Support in position adequately to prevent bending of reinforcement between supports before and during placement of concrete.
3. Overlap the wire reinforcement 6” (150mm) or one panel width + 2” (50mm), whichever is larger.

    a) Securely tie together with wire.

4. Offset laps of adjoining widths to prevent continuous laps in either direction.
5. Locate wire fabric in the top third of slabs, unless noted otherwise on structural Drawings.

D. At Construction Joints:

1. Reinforcement bars and wire reinforcement shall be continuous through construction joints, unless otherwise indicated on Drawings. See Drawings for scheduled lap splices.

E. At Expansion Joints:

1. Reinforcing bars and wire fabric shall NOT be continuous through expansion joints, unless otherwise indicated on Drawings.

F. Splicing:

1. Unless otherwise indicated on Drawings provide lap splices for bar sizes #11 (ø36) and smaller by lapping ends, placing bars in contact, and tying tightly with wire in accordance with requirements of ACI 318 for lap lengths indicated on Drawings.
2. At all #14 (ø43) and #18 (ø57) bars and where mechanical splices are specifically indicated on Drawings, comply with requirements specified in this Specification section under “Mechanical Splicing Systems”.
3. Do not splice reinforcement except as indicated on structural Drawings.
4. Tension couplers may be used and installed per manufacturer’s specifications where indicated on Drawings or as approved by Engineer.

G. Dowels in Existing Concrete:

1. Install dowels and dowel adhesive in accordance with manufacturer’s recommendations.
2. Minimum embedment length shall be 12 bar diameters, unless noted otherwise.

3.3 INSTALLATION OF POST-INSTALLED ADHESIVE ANCHORS

A. General:

1. Post-installed adhesive anchors shall be installed in accordance with the Manufacturer’s Printed Installation Instructions (MPII).
2. The adhesive anchors shall be supplied as an entire system. The contractor shall provide all equipment required to install the adhesive anchor in accordance with the MPII.
3. Anchors shall be installed in holes drilled with a rotary impact hammer drill with carbide bit. Contractor shall obtain prior written approval from SER before using rock drilling or core drilling installation methods.
4. Anchor holes shall be thoroughly cleaned and dry prior to adhesive injection, in accordance with the MPII. Anchors to be installed in the

adhesive shall be clean, oil-free, and free of loose rust, paint, or other coatings.

5. Concrete shall have a minimum compressive strength of 2500 psi (17MPa).
6. Concrete at time of adhesive anchor installation shall have a minimum of 21 days.
7. Concrete temperature at the time of adhesive anchor installation shall be at least equal to manufacture's requirements, or 50° F (10°C) if no requirement exists.
8. Support the anchor and protect it from disturbance or loading for the full cure time stated by the manufacturer at that base material temperature.
9. Unless specified otherwise in the contract documents, anchors shall be installed perpendicular to the concrete surface. Anchors displaced or disturbed prior to the adhesive cure time shall be considered damaged and reported to the SER (see Observations and Corrections section of 033000).
10. Locate, by non-destructive means, and avoid all existing reinforcement prior to installation of anchors. If existing reinforcement layout prohibits the installation of anchors as indicated in the drawings the contractor shall immediately notify the Design Professionals.
11. Reinforcement bars or all-threaded bars shall not be bent after being adhesively embedded in hardened, sound concrete, unless written approval is given by the SER.
12. All personnel installing anchors shall be trained by the manufacturer on proper installation techniques. Submit for record certificate from training documentation from the manufacturer for each installer on this Project
13. Installation of adhesive anchors horizontally or upwardly inclined and anchors that are designated with a (CERT) after the anchor call-out, shall be performed by personnel certified by the ACI/CRSI Adhesive Anchor Installer Certification program. Submit for record certificate from ACI-CRSI Adhesive Anchor Installation Certification Program for each certified installer on this Project.

3.4 INSTALLATION OF ACCESSORIES AND EMBEDDED ITEMS

A. Install concrete accessories in accordance with manufacturer's published instructions and Contract Documents.

1. Set and secure embedments, including embedded plates, bearing plates, and anchor rods, per approved setting drawings and in such a manner to prevent movement during placement of concrete and to allow removal of formwork without damage.
2. Tolerances: Anchor rod and other embedded items placement tolerances shall comply with AISC 303, “Code of Standard Practice”, Section 7.5.
3. Inspect locations to receive concrete accessories.
4. Immediately notify the Design Professionals in writing of conditions that will adversely affect the Work or fail to meet Contract Document requirements.
5. Do not place concrete until reinforcement, accessories and other built-in items have been inspected and accepted by Testing Agency.

B. Construction and Contraction (Control) Joints:

1. Construction and contraction (control) joints indicated on Drawings are mandatory and must not be omitted.

   a) Provide construction joints in accordance with ACI 318.
   b) Roughen surface at construction joints as indicated on the drawings.
   c) Where specifically indicated on drawings, provide 1-1/2” (40mm) deep key type construction joints at end of each placement for slabs, beams, walls and footings.

      i. Bevel forms for easy removal.

2. Provide waterstops in construction joints as indicated on the Contract Documents in sizes to suit joint.
3. Install waterstops to form continuous diaphragm in each joint.
4. Support and protect exposed waterstops during progress of Work.
5. Field-fabricate joints in waterstops according to manufacturer’s printed instructions.

C. Coordinate the installation of pipes, bolts, hangers, anchors, flashing and other embedded items with the work of other trades.

3.5 CORRECTIVE MEASURES

A. Where the Contractor requests that the Design Professionals develop the corrective actions or review corrective actions developed by others, the Design Professional shall be compensated as outlined in Part 3 – CORRECTIVE MEASURES section of Specification 033000.

END OF SECTION

SECTION 033000

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 GENERAL

Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 SCOPE

Provide all labor, materials, equipment, services and transportation required to complete all concrete work as shown on Drawings, as specified herein, and as required by the job conditions. This Specification is not intended to address the particular requirements of Architectural Concrete.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Division 1
Quality Control	Division 1
Quality Assurance: Structural Testing and Inspection	Section 014500
Concrete Formwork	Section 031000
Concrete Reinforcement and Embedded Assemblies	Section 032000
Thermal and Moisture Protection	Division 7

1.4 CODES AND STANDARDS

A. Building Code: Concrete work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.

B. Standards:

1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials except as modified by more stringent requirements in the Project Specifications and/or Drawings.
2. ACI 237 – Self Consolidating Concrete.
3. ACI 301 – Specifications for Structural Concrete.
4. ACI 318 – Building Code Requirements for Structural Concrete and Commentary.
5. American Concrete Institute “Manual of Concrete Practice”, various committee reports as referenced herein.
6. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein.

7. AASHTO T318 – Standard Method of Test for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying.

C. Definitions:

1. The term “Contract Documents” in this Specification is defined as the design Drawings and the specifications.
2. The term “SER” in this Specification is defined as the Structural Engineer of Record for the structure in its final condition.
3. The term “Design Professionals” in this Specification is defined as the Owner’s Architect and SER.
4. The term “Contractor” in this Specification is defined to include any of the following: General Contractor and their sub-contractors, Construction Manager, Concrete Contractor and their sub-contractors.
5. The term “Testing Agency” in this Specification is defined as an independent testing and inspection service engaged by the Owner for quality assurance testing and inspection of structural construction in accordance with applicable building code provisions and any additional activities listed in the Contract Documents.
6. The terms “for record” and “submit for record” in this Specification are defined as Contractor submittals that do not require a response from the Design Professionals.
7. The term “Working Days” in this Specification is defined as Monday through Friday, excluding federal or state holidays.
8. The term “Delegated Design” in this Specification is defined as a scope of work that meets performance and design criteria established in the Contract Documents and is to be completed by the Contractor’s licensed engineer.

1.5 CONTRACTOR QUALIFICATIONS

A. The work of this section shall be performed by a company specializing in the type of concrete work required for this Project, with a minimum of 10 years of documented successful experience and shall be performed by skilled workmen thoroughly experienced in the necessary crafts.

B. Contractor’s testing agency services: Required as specified in Division 1, and herein.

1.6 SUBMITTALS

A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested. Reproduction of Contract Drawings for shop drawings is not permitted. Building Information Models for contractor’s use may be provided as mutually agreed upon by Design Professionals.

(1) Submittal Schedule
(2) Mix Designs

(3) Concrete Travel Times to the Project Site
(4) Hot and Cold Weather Procedures
(5) Product Data
(6) Concrete Joint Locations
(7) Comprehensive Layout Drawings
(8) Preconstruction Survey
(9) Survey of Flat Plate or Flat Slab Concrete Floors during construction
(10) FF/FL Testing
(11) Structural Repairs
(12) Patching Defective Concrete Finishes
(13) Conduit and Pipes Embedded in Concrete
(14) Hazardous Materials Notification
(15) **[LEED Submittals]**

1. **Submittal Schedule**: The contractor shall submit for action a schedule at least twenty (20) working days prior to commencing submittals.

   a) This schedule shall include a list, in order of date to be submitted, of all drawings and other required submittal items scheduled to be submitted. The schedule shall list the proposed submittals for each week, as well as their formats. Once shop drawing submissions have commenced any modification or addition to this schedule must be submitted for action at least twenty (20) working days before the modification or addition is proposed to take place.
   b) If at any time the total number of shop drawings received in any one week period exceeds the amount in the approved schedule by more than 10% for that week, the Design Professionals have the right to add two days to the average turnaround time for each 20% increment in excess of the scheduled quantity for that week's submissions. For example if the weekly total exceeds the schedule by 10% to 20%, two days may be added; if it is exceeded by 21% to 40%, four days may be added. The return dates for subsequent submittals may be extended based on the additional review time stated above.
   c) For the purposes of developing a schedule, assume the following review rate, Shop drawings – 10 full size sheets per week.

2. **Mix Designs**: Submit for action concrete mix designs for each type and strength of concrete required for this Project at least thirty (30) days before placing concrete.

   a) Mix designs shall be prepared or reviewed by an approved independent testing agency retained by the Contractor in accordance with requirements of ACI 301 and ACI 318 and shall be coordinated with design requirements and Contract Documents.
   b) Before submitting to Testing Agency, submit complete mix design data for each separate mix to be used on the Project in a single submittal.

c) Provide a completed “Concrete Mix Design Submittal Form” (attached to the end of this Specification Section) for each proposed concrete mix.

d) Mix materials shall be from the same production facility that will be used for this Project.

e) Mix Design data shall include but not be limited to the following:

i. Locations on the Project where each mix design is to be used corresponding to Structural General Notes on the Drawings.

ii. Design Compressive Strength: As indicated on the Drawings.

iii. Proportions: ACI 301 and ACI 318.

iv. Gradation and quality of each type of ingredient including fresh (wet) unit weight, aggregates sieve analysis.

v. Water/cementitious material ratio.

vi. Evaluation and classification fly ash in accordance with ASTM D 5759.

vii. Report of chemical analysis of fly ash in accordance with ASTM C 618.

viii. Classification of slag cement in accordance with ASTM C 989.

ix. Slump: ASTM C 143.

x. Certification and test results of the total water soluble chloride ion content of the design mix - AASHTO T260 or ASTM C 1218 at age between 28 and 42 days.

xi. Air content of freshly mixed concrete by the pressure method, ASTM C 231, or the volumetric method, ASTM C 173.

xii. Density of Concrete: ASTM C 138.

xiii. Design strength at 28, 56 or 90 days, as indicated on Contract Documents: ASTM C 39.

(1) Document strength based on basis of previous field experience or trial mixtures per ACI 301. Proportioning by water-cement ratio alone, with no test results per the trial mixtures procedure is not permitted.

(2) Submit strength test records, mix design materials, conditions, and proportions for concrete used for record of tests, standard deviation calculation, and determination of required average compressive strength. Test records to support proposed mixtures shall be no more than 24 months old and use current cement aggregate sources. Test records to establish standard deviation may be older if necessary to have the required number of samples.

(3) If early concrete strengths are required, Contractor shall submit trial mixture results as required.

xiv. Manufacturer's product data for each type of admixture.
xv. Manufacturer's certification that all admixtures used are compatible with each other.
xvi. All information indicating compliance with Contract Documents including method of placement and method of curing.
xvii. Normalweight Concrete: Density per ASTM C 138. Design the mix to produce the strength, modulus of elasticity and density as indicated on the Contract Documents.
xviii. Lightweight Concrete: Density per ASTM C 138. Design the mix to produce the strength, modulus of elasticity and density as indicated on the Contract Documents.

(1) Where lightweight concrete members are used, provide split cylinder strength factor, fct, as indicated.

xix. Certification from a qualified testing agency indicating absence of potential for deleterious expansion of concrete due to alkali reactivity of the aggregate as determined by testing per ASTM C1260 in accordance with ASTM C 33. If potential for deleterious expansion exists, expansion reduction and mitigation measures per the guidelines of ASTM C1778 or US Army COE CRD-C662 shall be submitted for review by the SER.

3. **Concrete Travel Times to the Project Site:** Submit for record.
4. **Hot and Cold Weather Procedures**: Submit for record written procedures for placement of concrete in hot and cold weather conditions. Hot and Cold weather are as defined in the Concrete Placement section of this Specification.
5. **Product Data**: Submit for action product data clearly marked to indicate locations to be used and all technical information which specifies full compliance with this section and Contract Documents, including published application instructions, product characteristics, compatibility, and limitations for each of the following:

a) Bonding agents.
b) Curing compound and liquid sealer densifier. Submit for record to Design Professionals a written statement guaranteeing that the compound will not leave discoloration on concrete to be left exposed, or affect the bond for paint or other applied finishes. Include provision in written statement that in the event of failure of applied finishes to bond to membrane cured concrete, to remove the curing compound and leave suitable surfaces for bonding such finishes.
c) Absorptive covers and moisture retaining covers.
d) Vapor Retarder: See Division 7, Thermal and Moisture Protection.
e) Self-leveling concrete topping.

f) Grout: Submittal of grout by manufacturers not listed herein must be accompanied by independent certification of ASTM C 1107 compliance without modification of standard methods.
g) Other products proposed by Contractor.

6. **Concrete Joint Locations**: Submit for action plans indicating locations and details of construction joints, contraction joints, waterstops, sleeves, embedments, etc. that interact with the joints. Contractor to coordinate joint location with reinforcement shop drawings. Reinforcement shop drawings shall indicate additional reinforcement bars where required at construction joints.

   Joint locations for concrete slabs to receive a terrazzo or similar finish subject to reflective cracking must be coordinated with layout of finish drawings.

7. **Comprehensive Layout Drawings:** Submit for action comprehensive layout drawings (a single drawing per area/element):

   a) Drawings shall show openings in structural members, including floor slab, shear walls, columns and beams.
   b) Drawings shall consolidate the work of all trades and shall be coordinated by the Contractor.
   c) Drawings shall show concrete accessories and embedded items, including fabrication details of items to be placed (exclusive of reinforcement).
   d) Submit with or prior to reinforcement and formwork submittals for same element/area.

8. **Preconstruction Survey**: Submit for record. Where interface with existing construction occurs, before related shop drawings are prepared survey the existing construction and submit the survey prepared by a professional surveyor employed by the Contractor to the Design Professionals.
9. **Survey of Flat Plate or Flat Slab Concrete Floors during construction**: Submit for record. Survey requirements are described on Drawings. Based on survey results, SER may propose adjustments to formwork and camber.
10. **FF/FL Testing:** Submit for record. Testing Agency to test and report flatness (F_F), levelness (F_L) prior to shoring removal. Do not test slabs for levelness (F_L) that include camber, inclined surfaces or planned changes in floor surface slope. Perform F_F/F_L testing in accordance with ASTM E 1155 requirements.
11. **Structural Repairs**: Submit for action procedures, intended locations, and product information. Alterations to design shall be sealed and signed by a Professional Engineer licensed in the state where the project is located.
12. **Patching Defective Concrete Finishes**: Submit for action procedures, intended locations, and product information.

13. **Conduit and Pipes Embedded in Concrete:** Submit for action layout of embedded conduit and pipes.
14. **Hazardous Materials Notification**: Submit for record. In the event no product or material is available that does not contain hazardous materials as determined by the Owner, a "Material Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.
15. **[LEED Submittals:]**

B. Submittal Process

1. Submittal of shop drawings and other submittals by the Contractor shall constitute Contractor's representation that the Contractor has verified all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar data with respect thereto and reviewed or coordinated each drawing with other Drawings and other trades. The Contractor shall place their shop drawing stamp on all submittals confirming the above.
2. Shop drawings: Submit in complete packages so that individual parts and the assembled unit may be reviewed together. This Specification Section and the applicable Drawings used in the development of the shop drawings shall be referenced on each shop drawing to facilitate checking.
3. The Contractor shall submit to the Design Professionals one (1) electronic copy for shop drawing review. The naming convention of each drawing must follow the submittal numbering system and include the submittal number, Specification number, revision number and drawing number in the prefix of the drawing name.
4. The Contractor shall allow at least ten (10) working days between receipt and release by the SER for the review of shop drawings and submittals.
5. All modifications or revisions to submittals and shop drawings must be clouded, with an appropriate revision number clearly indicated. The following shall automatically be considered cause for rejection of the modification or revision whether or not the drawing has been approved by the Design Professionals:

   a) Failure to specifically cloud modifications
   b) Unapproved revisions to previous submittals
   c) Unapproved departure from Contract Documents

6. Resubmittals: Completely address previous comments prior to resubmitting a drawing. Resubmit only those drawings that require resubmittal. Do not include new content not previously reviewed.
7. Resubmittals Compensation: The Contractor shall compensate the Design Professionals for submittals that must be reviewed more than twice due to Contractors' errors. The Contractor shall compensate the Design Professionals at standard billing rates plus out-of-pocket expenses incurred at cost + 10%.
8. The Contractor shall deliver to the Design Professionals at the completion of the job two (2) copies of the electronic version of the final as-built shop

drawings on a CD-ROM or other media acceptable to the Design Professionals.

C. SER Submittal Review

1. The Design Professionals' review and approval of shop drawings and other submittals shall be for general conformance with the design intent of the work and with the information given in the Contract Documents only and will not in any way relieve the Contractor or the Contractor's Engineer from:

   a) Conforming to the Contract Documents.
   b) Coordination with other trades.
   c) Responsibility for all required detailing and proper fitting of construction work.
   d) The necessity of furnishing material and workmanship required by Drawings and Specifications which may not be indicated on the shop drawings.
   e) Control or charge of construction means, methods, techniques, sequences or procedures, for safety precautions and programs in connection with the work.

2. TYPE 1 – Structural Submittal Review Stamp: For shop drawings for building elements designed by the SER, the responses on the shop drawing review stamp used by the SER require one of the following actions:

   a) APPROVED indicates that the SER has found that the information presented on the shop or erection drawing appears to conform to the requirements of the Contract Documents. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the Contract Documents.
   b) APPROVED AS NOTED indicates that the SER requires the shop or erection drawing to be corrected to reflect the notes and comments shown. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the notations shown on the shop drawings and the Contract Documents. Promptly resubmit the corrected shop or erection drawing for record.
   c) REVISE and RESUBMIT indicates that the SER requires resubmission of the shop or erection drawing after correction per notes and comments. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed until the Contractor has received a returned shop drawing marked Approved or Approved as Noted.
   d) NOT APPROVED indicates that the shop or erection drawing does not conform to the Contract Documents and must be extensively revised before re-submittal. None of the elements of work shown on the shop drawing shall be fabricated,

manufactured or constructed until the Contractor has received a returned shop drawing marked Approved or Approved as Noted.

3. TYPE 2 – Delegated Design Review Stamp: For submittals for building elements which are not designed by the SER but are delegated design items, or for items that do not form part of the completed structural system but impose loads on the structure, or for construction items or activities which have an effect on the final structure. The responses on the stamp used by the SER require one of the following actions:

   a) NO EXCEPTIONS indicates that the SER has found that the information presented on the submittal appears to conform to the requirements of the Contract Documents. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the Contract Documents.
   b) EXCEPTIONS NOTED indicates that the SER requires the submittal be corrected to reflect the notes and comments shown. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the notations shown on the shop drawings and the Contract Documents. Promptly resubmit the corrected document for record.
   c) REJECTED indicates that the SER requires resubmission of the submittal after correction per notes and comments. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed. Contractor to revise and resubmit until SER response of No Exceptions or Exceptions Noted is received.

D. Substitution Request

1. Requests for any departure from Contract Documents must be submitted in writing by the Contractor and accepted in writing by the Design Professionals, prior to receipt of submittals.
2. All substitutions must be requested using the structural substitution request form included at the end of this section. Acceptance using the structural substitution request form indicates acceptability of the structural concept only. Contractor must submit shop drawings reflecting accepted substitutions for review in accordance with this Specification. The structural substitution request form, even if accepted, does not constitute a change order.
3. Accepted substitutions or modifications shall be coordinated and incorporated in the work at the sole expense of the Contractor.
4. The acceptance by the Design Professionals of a specific and isolated request by the Contractor to deviate from these requirements does not constitute a waiving of that requirement for other elements of, or locations in the project, unless specifically addressed as such and permitted by the Design Professionals in writing.

5. Compensation for Additional Services: Should additional work by Design Professionals such as design, documentation, meetings and/or site visits be required which are necessitated for the review and/or incorporation of the Contractor-requested substitution, including indirect effects on other portions of the work, the Contractor is responsible for paying for additional work performed by the Design Professionals at the standard billing rates plus out-of-pocket expenses incurred at cost + 10%. Additional costs for testing and inspection by the Owner shall also be compensated by the Contractor.
6. Contractor is responsible for means and methods and any impacts on other portions of the work that may arise from this substitution.

E. Request for Information (RFI)

1. RFIs shall be submitted by the Contractor. RFIs submitted by other entities will be returned with no response.
2. Limit RFI to one subject.
3. Submit RFI immediately upon discovery of the need for interpretation or clarification of the Contract Documents. Submit RFI within timeframe so as not to delay the Construction Schedule while allowing the full response time described below.
4. The response time for answering an RFI depends on the category in which it is assigned.

a) Upon receipt by the SER, each RFI will be assigned to one of the following categories:

i. No cost clarification
ii. Shown in Contract Documents
iii. Change to be issued in future document revision
iv. Previously answered
v. Information needs to be provided by others
vi. Request for corrective field work
vii. Request for substitution

b) RFIs in the first five categories listed above will be turned around by the SER on average of five (5) working days.
c) RFIs in the last two categories listed above will be immediately rejected and must be submitted as submittals or requests for substitution.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with General Conditions and Division 1.

B. Storage:

1. Store materials in accordance with ACI 304R.
2. Store cement in weather-tight buildings, bins or silos that will exclude moisture and contaminates.

3. Store admixtures to avoid contamination, evaporation, damage, and in accordance with manufacturer's temperature and other recommendations.
4. Keep packaged material in original containers with seals unbroken and labels intact until time of use.

C. Handling:

1. Handle fine and coarse aggregates as separate ingredients.
2. Arrange aggregate stockpiles to avoid excessive segregation, and prevent contamination with other materials or with other sizes of like aggregates.
3. Do not use frozen or partially frozen aggregates.
4. Allow sand to drain until it has reached relatively uniform moisture content before use.
5. Protect liquid admixtures from freezing and temperature changes that would adversely affect characteristics, and in accordance with manufacturer's recommendations.

1.8 PRE-CONCRETE CONFERENCE

A. At least 30 working days prior to the start of concrete construction, the Contractor shall hold a meeting to review the proposed concrete mix designs and to determine the procedures for producing proper concrete construction. The Contractor shall notify the Design Professionals of the meeting and require responsible representatives of every party who is concerned with the concrete Work to attend the conference, including but not limited to the following:

1. Contractor’s superintendent.
2. Testing Agency representative responsible for field quality control.
3. Concrete subcontractor.
4. Ready-mix concrete producer.
5. Admixture manufacturer(s).
6. Architect.
7. Structural Engineer.

B. Minutes of the meeting shall be recorded and distributed by the Contractor to all parties concerned within five working days of the meeting. One copy of the minutes shall also be furnished to the following:

1. Design Professionals.
2. Owner's Representative.

C. The minutes shall include a statement by the concrete contractor and admixture manufacturer(s) indicating that the proposed mix design and placing, finishing, and curing techniques can produce the concrete properties and quality required by these Specifications.

1.9 QUALITY ASSURANCE BY OWNER’S TESTING AGENCY

A. See Section 014500.

1.10 QUALITY CONTROL BY CONTRACTOR

A. The Contractor shall provide a program of quality control to ensure that the minimum standards specified herein are attained.

B. The Owner's general review during construction and activities of the Testing Agency are undertaken to inform the Owner of performance by the Contractor but shall in no way replace or augment the Contractor's quality control program or relieve the Contractor of total responsibility for quality control.

C. The Contractor shall immediately notify the Design Professionals of any deficiencies in the work which are departures from the Contract Documents. The Contractor shall propose corrective actions and their recommendations in writing and submit them for review by the Design Professionals. After proposed corrective action is accepted by the Design Professionals and Owner, the Contractor shall correct the deficiency at no cost to the Owner. Where the Contractor requests that the Design Professionals develop the corrective actions or review corrective actions developed by others, the Design Professional shall be compensated as outlined in the OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS section of this Specification.

D. Where SCC is used, the Ready Mix Producer shall have a Quality Control Representative on site during placements until mix consistency and stability is established.

1.11 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS

A. Observations: The Design Professionals will observe the construction for general compliance with the provisions of the Contract Documents during various phases of construction.

B. Corrections by Design Professionals: See Part 3 - CORRECTIVE MEASURES section of this Specification.

1.12 PERMITS AND WARRANTY

A. Permits: The Contractor shall apply for, procure, renew, maintain, and pay for all permits required by City, State, or other governing authorities, necessary to execute work under this Contract. Contractor shall furnish copies of all permits to the Owner and Design Professionals.

B. Warranty: Comply with General Conditions, agreeing to repair or replace specified materials or work that has failed within the warranty period. Failures include but are not limited to the following:

1. Oily, waxy or loose residue which may interfere with the bonding or discoloration of various applied Architectural finish materials.
2. Discoloration of concrete surfaces scheduled to remain exposed as a finish.
3. Areas which show surface failure or defects.
4. Areas which puddle water.

5. Areas which are not properly prepared to receive Architectural finish materials. If necessary, the Contractor, at his own expense, shall have the Testing Agency perform appropriate tests for bond and discoloration.
6. Patches that become crazed, cracked or sound hollow when tapped.
7. Self-leveling concrete topping that has cracked, spalled and/or not performed in accordance with manufacturer's design criteria.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS AND PRODUCTION

A. Portland Cement:

1. ASTM C150, Type I or Type II
2. ASTM C150, Type III, High-early Strength Portland Cement may be used subject to review and approval of the SER. The specified 28-day concrete compressive strength shall occur within 7 days for concrete using Type III Portland Cement.
3. ASTM C150, Type V
4. Provide the same brand of Portland Cement from a single source throughout the project, as required to meet Design Professionals' requirements.
5. Provide Portland Cement that is uniform in color.

B. Blended Hydraulic Cement:

1. ASTM C595, Type IL, Portland-Limestone Cement
2. ASTM C595, Type IS, Portland-Slag Cement
3. ASTM C595, Type IP, Portland-Pozzolan Cement
4. ASTM C595, Type IT, Ternary-Blended Cement
5. ASTM C595, Type IT (MS) for Exposure Class S1
6. ASTM C595, Type IT (HS) for Exposure Class S2
7. ASTM C595, Type IT (HS) plus pozzolan or slag cement for Exposure Class S3

C. Aggregates for Normalweight Concrete:

1. ASTM C 33
2. Fine Aggregate: Natural sand, or sand prepared from stone or gravel, clean, hard, durable, uncoated and free from silt, loam and clay.
3. Provide aggregates from a single source throughout the project for exposed concrete.
4. The acceptability of aggregates for the work will depend on proof that their potential alkali reactivity is not deleterious to the concrete.
5. Do not use fine or coarse aggregates that contain substances that cause spalling.
6. Maximum coarse aggregate size shall conform to the requirements as specified in ACI 301 but shall not exceed the following:

Size no. 57 (25mm max) for footings, drilled piers and caissons

Size no. 67 (20mm max) for all other locations
Size no. 467 or 457 for non-reinforced concrete at locations noted on Drawings.

7. Contractor shall furnish concrete with maximum 3/8" (10mm) aggregate at no additional cost to the Owner if areas of high reinforcement density require it for placement and consolidation.

D. Aggregates for Lightweight Concrete:

1. ASTM C 330: Except aggregates prepared by processing natural materials, such as pumice, scoria, or tuff.
2. Classification of Aggregates: As required to meet Design Professional's requirements.
3. Provide aggregates from a single source throughout the project for exposed concrete.
4. Aggregate shall contain the minimum absorbed moisture content recommended by the manufacturer for the project prior to batching.
5. Maximum coarse aggregate size shall conform to the requirements as specified in ACI 301 but shall not exceed ¾" (20mm)

E. Water: ASTM C 1602. Clean, and free from injurious amounts of oil, acids, alkali, salts, organic material, or other deleterious materials.

F. Supplementary Cementitious Material

1. Fly Ash: ASTM C 618, Class C or Class F.
2. Slag Cement: ASTM C 989.
3. Silica Fume (Microsilica): ASTM C1240.

a) Acceptable Products:

i. Force 10,000 D by GCP Applied Technologies, Inc.
ii. Eucon MSA by Euclid Chemical Company
iii. MasterLife SF 100 by Master Builders Solutions
iv. Sikacrete 950 DP by Sika Corporation

4. Metakaolin: ASTM C 618, Class N.

a) Acceptable Products:

i. MasterLife MK828 by Master Builders Solutions
ii. HRMK 100 by GCP Applied Technologies, Inc.
iii. Sikacrete M-100 by Sika Corporation

5. For concrete assigned to Exposure Classes F1 and F2, as defined in ACI 318, there is no limit to the maximum amount of supplementary cementitious materials included in the mix as a percentage of total cementitious materials by mass.
6. For concrete assigned to Exposure Class F3 as defined in ACI 318, limits to the maximum amount of supplementary cementitious materials

included in the mix as a percentage of total cementitious materials by mass are as follows:

a) Fly ash or other pozzolans conforming to ASTM C618 = 25%
b) Slag cement = 50%
c) Silica fume = 10%
d) Total of fly ash or other pozzolans and silica fume = 35%
e) Total of fly ash or other pozzolans, slag cement and silica fume = 50%
f) The maximum percentage limits listed above shall include the supplementary cementitious materials used in the manufacture of ASTM C595 blended cements.

7. The fly ash or natural pozzolan supplier shall have an effective quality control program in place to guard against contamination of the fly ash and assure compliance with Specifications.
8. Supplementary Cementitious Materials shall be from one source throughout the project. Substitution of sources will be acceptable only if testing of concrete mixes containing the substituted material show similar test results and if the color of concrete produced with the substituted material matches the color of previously poured concrete to the satisfaction of the Architect.

G. Ready Mixed Concrete:

1. Shall be batch-mixed and transported in accordance with ASTM C 94.

H. Self-Consolidating Concrete:

1. Produce in accordance with ACI 237R.
2. Perform the following tests and provide report prior to submitting mix design:

a) Resistance to Segregation: Achieve a maximum static segregation percentage of 15% when tested according to ASTM C 1610 with a VSI index of 1 maximum.
b) Slump Flow: ASTM C 1611 within a range **of** 20”-30” (500mm–750mm).
c) Passing Ability: ASTM C 1621 with a maximum difference of 2” (50mm) between testing with and without the J-Ring.

2.2 CONCRETE MIX DESIGN

A. Concrete Strength:

1. Shall be as indicated on the Structural Drawings
2. Where concrete strength is not indicated on the drawings, the minimum concrete strength for exposure classes as defined in ACI 318 are as follows:

a) F0, S0, W0, C0, C1 = 2500 psi

b) F1 = 3500 psi
c) S1, W1 = 4000 psi
d) F2, S2, S3, = 4500 psi
e) F3, C2 = 5000 psi

B. Concrete Density (Unit Weight):

1. Shall be as indicated on the Structural Drawings

C. Air Entrainment

1. For concrete exposed to freeze/thaw cycles and/or deicing chemicals (ACI 318 Exposure Classes F1, F2, F3), and concrete intended to be watertight, provide entrained air content of 6% ± 1.5%, unless specified otherwise. This includes, but is not limited to, concrete at the following locations:

   a) Concrete at the exterior of the structure with at least one surface exposed to weather, such as exterior face of grade beams, foundation walls, exterior walls and parapets, exposed columns and edge beams.
   b) Floor framing and ramps in parking garages.
   c) Loading docks.
   d) Balconies and terraces with no waterproofing membrane.

2. For lightweight concrete less than 120 pcf (19 kN/m³) density, air content may be up to 7% regardless of exposure condition.
3. For concrete with a specified compressive strength (f'c) greater than 5000 psi (35MPa), required air content may be reduced to 5% ± 1.5%.
4. Entrained air content noted above shall occur at point of delivery.
5. No entrained air content is required for foundations with no surface exposed to weather.
6. All interior steel trowel finished, normal weight slabs shall have a maximum air content of 3%.

D. Water-Cementitious Material Ratio (w/cm) for Normalweight Concrete

1. The total combined weight of Portland cement and all other supplementary cementitious material shall be used to determine the w/cm.
2. The w/cm shall not exceed the values indicated below, including any water added to meet specified slump in accordance with the requirements of ASTM C 94.
3. Based on Exposure Class, as defined in ACI 318, the following maximum w/cm shall be provided:

   a) Exposure Class F0, S0, W0, C0, C1, no maximum
   b) Exposure Class F1, max w/cm=0.55
   c) Exposure Class S1, W1, max w/cm=0.50
   d) Exposure Class F2, S2, S3, max w/cm=0.45
   e) Exposure Class F3, C2, max w/cm=0.40

4. Concrete used in slab on grade shall have a maximum w/cm ratio of 0.45.

E. Slump

1. Concrete design mixes shall be proportioned to meet the following slump limitations. Slump should be measured as described in the Testing Agency responsibilities:

a) Concrete with high range or mid range water-reducing admixture: Concrete slump prior to addition of high range water-reducing admixture shall not exceed 3" +/- 1” (75mm) for normalweight concrete and 4" +/- 1” (100mm) for lightweight concrete. After addition of water-reducing admixture, the concrete shall have a maximum slump of 9" +/- 1” (225mm) unless otherwise approved by the SER.

b) Concrete without a water-reducing admixture: Slump shall not exceed 4” +/- 1”.

F. Self-Consolidating Concrete Slump/Flow: Use for concrete exposed to view and heavily reinforced areas where indicated on the plans, and where conventional mixtures do not provide adequate consolidation. Minimum slump/flow diameter of 20” (500mm) or as required by the successful test placement onsite, which shall verify proper workability, finish, and setting time. All self-consolidating concrete shall contain the specified high range water-reducing admixture. All self-consolidating concrete shall contain viscosity modifying admixture as required unless proper quantity and grading of fines can be achieved.

G. Chloride Ion Content

1. The total water-soluble chloride ion content of the mix including all constituents shall not exceed the limits defined in ACI 318 unless corrosion inhibiting admixtures are added to the mixture to offset the additional chloride.
2. If the specified level of water-soluble chloride ion content cannot be maintained, appropriate level of corrosion inhibiting admixture shall be added to the mix in accordance with the manufacturer’s recommendation to offset the excess amount of chloride at no additional cost to the Owner.

2.3 ADMIXTURES

A. General:

1. Admixtures specified below can be used only when established in the mix design with Design Professionals' prior written approval.
2. Each admixture approved by Design Professionals shall be used in strict compliance with manufacturer's published instructions.
3. Concrete supplier shall certify all admixtures to be compatible with each other. (See Submittals Section in Part 1)

B. Air Entraining Admixture:

1. ASTM C 260
2. Acceptable Products:

    a) MasterAir Series by Master Builders Solutions
    b) Darex Series or Daravair Series by GCP Applied Technologies, Inc.
    c) EUCON AEA –92 or EUCON Air Series by Euclid Chemical Company
    d) AIR Series or AEA-14 by Sika Corporation

C. Water-Reducing Admixture:

1. ASTM C 494, Type A
2. Acceptable Products:

    a) MasterPozzolith Series by Master Builders Solutions
    b) EUCON NW or EUCON WR 91 by Euclid Chemical Company
    c) WRDA Series, Zyla Series or Mira Series by GCP Applied Technologies, Inc.
    d) Plastocrete Series by Sika Corporation

D. Retarding Admixture:

1. ASTM C 494, Type B
2. Acceptable Products:

    a) MasterSet R Series or MasterSet DELVO Series by Master Builders Solutions
    b) EUCON RETARDER 100 by Euclid Chemical Company
    c) Daratard 17 by GCP Applied Technologies, Inc.
    d) Plastiment Series by Sika Corporation

E. Non Corrosive Accelerating Admixture:

1. ASTM C 494, Type C
2. Acceptable Products:

    a) MasterSet FP 20 or MasterSet NC 534 by Master Builders Solutions
    b) ACCELGUARD 80, ACCELGUARD NCA or ACCELGUARD 90 by Euclid Chemical Company
    c) Daraset” Series, Polarset, or DCI by GCP Applied Technologies, Inc.
    d) Sikaset Series or Rapid-1 by Sika Corporation

F. Water-Reducing and Retarding Admixture:

1. ASTM C 494, Type D
2. Acceptable Products:

a) MasterSet R Series or MasterSet DELVO Series by Master Builders Solutions
b) EUCON RETARDER 75 or EUCON DS by Euclid Chemical Company
c) Daratard 17 or Recovery Series by GCP Applied Technologies, Inc.
d) Plastiment Series by Sika Corporation

G. Water-Reducing and Accelerating Admixture:

1. ASTM C 494, Type E
2. Acceptable Products:

a) MasterSet FP 20 by Master Builders Solutions
b) ACCELGUARD 80 or ACCELGUARD 90 by Euclid Chemical Company
c) Libricon NCA by GCP Applied Technologies, Inc.
d) Sikaset NC by Sika Corporation

H. Mid-Range Water-Reducing Admixture:

1. ASTM C 494, Type A
2. Acceptable Products:

a) MasterPolyheed Series by Master Builders Solutions
b) Daracem or Mira by GCP Applied Technologies, Inc.
c) Sikaplast Series or Sikament Series by Sika Corporation
d) Eucon MR or Eucon MRX by Euclid Chemical Company

I. High-Range Water-Reducing Admixture:

1. ASTM C 494, Type F
2. Acceptable Products:

a) MasterGlenium Series by Master Builders Solutions
b) EUCON 37 or PLASTOL SERIES by Euclid Chemical Company
c) Daracem or ADVA Series by GCP Applied Technologies, Inc.
d) Viscocrete Series or Sikament Series by Sika Corporation

J. High-Range Water-Reducing Admixture for production of Control Flow Concrete:

1. ASTM C494 Type A and F and ASTM C1017 Type I
2. Acceptable Product:

a) CONCERA SA8080 by GCP Applied Technologies, Inc.

K. High-Range Water-Reducing and Retarding Admixture:

1. ASTM C 494, Type G
2. Acceptable Products:

a) EUCON 537 by Euclid Chemical Company

b) Daracem Series or Adva Series by GCP Applied Technologies, Inc.

L. Workability Retaining Admixture:

1. ASTM C494, Type S
2. Acceptable Products:

a) MasterSure Z-60 by Master Builders Solutions
b) Visco Flow-2020 by Sika Corporation

M. Permeability-Reducing Admixture:

1. ASTM C494, Type S
2. Shall be a Portland cement based crystalline capillary waterproofing admixture that reacts in concrete to form non-soluble crystalline hydration products in the capillary pores of concrete,
3. Acceptable Products:

a) MasterLife 300D and 300C by Master Builders Solutions
b) Eucon Vandex AM-10 by Euclid Chemical Company
c) Admix C-Series by Xypex

N. Viscosity Modifying Admixture (VMA) for Self-Consolidating Concrete (SCC):

1. ASTM C 494, Type S
2. Acceptable Products:

a) MasterMatrix VMA Series by Master Builders Solutions
b) V-MAR3 by GCP Applied Technologies, Inc.
c) EUCON ABS or EUCON WO or VISCTROL by Euclid Chemical Company
d) Sika Stabilizer-4R by Sika Corporation

O. Corrosion Inhibiting Admixtures:

1. Calcium Nitrite Based: ASTM C 1582 and ASTM C 494, Type C, 30% + 2% solution

a) Acceptable Products:

i. DCI or DCI-Sby GCP Applied Technologies, Inc.
ii. MasterLife CI 30 by Master Builders Solutions
iii. EUCON CIA by Euclid Chemical Company
iv. Sika-CNI by Sika Corporation

2. Amine Carboxylate Based: ASTM C 1582, which includes ASTM C-494 amine carboxylate

a) Acceptable Product:

i. MCI 2005, MCI 2005 NS, MCI 2006 or MCI 2006 NS by Cortec Corporation

3. Amino Alcohol Based:

a) Acceptable Product:

i. FerroGard 901 by Sika Corporation
ii. MasterLife CI 222 by Master Builders Solutions

P. Shrinkage Reducing/Compensating Admixtures:

1. ASTM C 494, Type S
2. Acceptable Products:

a) Eclipse Floor 200 or Eclipse 4500 (for use with air-entrained concrete) by GCP Applied Technologies, Inc.
b) Conex or EUCON SRA Floor or EUCON SRA-XT (for use with air-entrained concrete) by Euclid Chemical Company
c) MasterLife SRA Series or MasterLife CRA 007 by Master Builders Solutions
d) SikaControl 75 by Sika Corporation
e) PREVent-C by PremierCPG

Q. Alkali-Silica Reaction Inhibiting Admixture:

1. ASTM C 494, Type S
2. Shall contain a nominal lithium nitrate content of 30 percent.
3. Dosage to be determined in accordance with US Army COE CRD-C662
4. Acceptable Products:

a) MasterLife ASR 30 by Master Builders Solutions
b) Eucon Integral ARC by Euclid Chemical Company
c) RASIR by GCP Applied Technologies

R. Porosity Inhibiting Admixture:

1. ASTM C494, Type S
2. Sodium silicate free
3. Manufacturer must be able to provide a flooring adhesion guarantee and life of the concrete vapor transmission warranty. In order to obtain warranty, product must be installed in compliance with the manufacturer's published data sheet including but not limited to proper on-site representation, mix design review, concrete testing and installation of vapor retarder for slabs on ground.
4. Acceptable Products:

a) Barrier One by Concrete Moisture Solutions, Inc.
b) MVRA 900 by ISE LOGIK Industries

S. Carbon Dioxide ($C0_2$) Mineralization:

1. Where called for on the drawings or when approved by the SER, provide concrete that has undergone carbonization treatment with carbon dioxide ($C0_2$) during mixing, such that $C0_2$ is chemically mineralized into the concrete.
2. $C0_2$ injected into the mix must be post-industrial $C0_2$ sourced from a nearby emitter. Provide concrete producer's certificate outlining quantity, location and supplier of $C0_2$.
3. Acceptable Product:

    a) Carbon Cure by CarbonCure Technologies.

2.4 FIBER REINFORCEMENT

A. General:

1. Fiber reinforcement specified below can be used only with Design Professional's prior written approval.
2. See Drawings for location of Fibers.
3. Where macro synthetic fiber reinforcement is proposed as a substitution request to replace welded wire reinforcement, Contractor shall demonstrate that proposed material and dosage rate provides equivalent performance to the welded wire reinforcement indicated on Drawings.
4. Fiber reinforcement shall not replace reinforcing bars shown on Drawings.
5. Where macro synthetic fiber reinforcement is proposed, concrete contractor to review finishing approach with macro fiber supplier before installation. Where finishing results in a fuzzy top of slab with exposed macro fibers, contractor to burn off any exposed slabs with fibers protruding from the surface with a weed burner wand held about 3 to 4 inches above the concrete surface to melt but not scorch the fibers. Contractor to follow manufacturer's recommendations.

B. Synthetic Fibrillated or Monofilament Micro Fibers (low volume synthetic used for reduction of plastic shrinkage cracking)

1. ASTM C 1116, Type III polyolefin fibers engineered and designed for use in making fiber-reinforced concrete.
2. Acceptable Products:

    a) SINTA F38, SINTA M2219 by GCP Applied Technologies, Inc.
    b) PSI Fiberstrand by Euclid Chemical Company
    c) Fibermesh 150-e3 or 300-e3 by Sika Corporation
    d) MasterFiber F Series or MasterFiber M Series by Master Builders Solutions
    e) FiberForce 100, 150, 300, 350 by ABC Polymer Industries, LLC

C. Synthetic Macro Fibers (high volume synthetics used for reduction of plastic and drying shrinkage cracking)

1. ASTM C 1116, Type III polyolefin fibers engineered and designed for use in making fiber-reinforced concrete.

2. The fibers shall provide a minimum equivalent flexural residual strength (fe_3) of 150 psi (1.0 MPa), unless otherwise noted on the drawings, when tested in accordance with ASTM C1609.
3. When synthetic macro fibers are used as a replacement for welded wire reinforcement in composite slabs, contractor shall submit documentation that the fibers are Underwriters Laboratories (UL) certified for the fire ratings as indicated on the drawings. Provide dosage of fibers as required to meet the fire resistance rating but not less than 4 pounds per cubic yard (2.4 kg/m^3).
4. Acceptable Products:

    a) Strux 90/40 by GCP Applied Technologies, Inc.
    b) Tuf-Strand SF by Euclid Chemical Company
    c) Fibermesh 650-e3 by Sika Corporation
    d) MasterFiber MAC 100 by Master Builders Solutions
    e) FORTA-FERRO by Forta Concrete Fiber
    f) FiberForce 650 and 750 by ABC Polymer Industries, LLC

D. Synthetic Hybrid Fibers

1. ASTM C1116, Type III polyolefin fibers engineered and designed for use in making fiber-reinforced concrete.
2. The fibers shall provide a minimum equivalent flexural residual strength (fe_3) of 150 psi (1.0MPa), unless otherwise noted on the drawings, when tested in accordance with ASTM C1609.
3. When synthetic macro fibers are used as a replacement for welded wire reinforcement in composite slabs, contractor shall submit documentation that the fibers are Underwriters Laboratories (UL) certified for the fire ratings as indicated on the drawings but not less than 4 pounds per cubic yard (2.4 kg/m^3).
4. Acceptable Products:

    a) MasterFiber MAC 360 FF by Master Builders Solutions
    b) Novomesh 950 by Sika Corporation

E. Carbon Steel Fibers (smooth or deformed)

1. ASTM C1116, Type I containing steel fibers designed for use in making fiber reinforced concrete meeting the criteria of ASTM A820, Type I, II or V
2. The fibers shall provide a minimum equivalent flexural residual strength (fe_3) of 200 psi (1.4 MPa), unless otherwise noted on the drawings, when tested in accordance with ASTM C1609.
3. When steel fibers are used as a replacement for welded wire reinforcement in composite slabs, contractor shall submit documentation that the fibers are Underwriters Laboratories (UL) certified for the fire ratings as indicated on the drawings but not less than 25 pounds per cubic yard (14.8 kg/m^3).
4. Acceptable Products:

    a) Dramix 3D, 4D, 5D by Bakaert Corporation

b) CAR-25-CDM by Fibercon International Inc.
c) Novocon CHE7560H by Sika Corporation
d) PSI Steel Fiber 6560 by Euclid Chemical Company]
e) CFS 100-2 or CFS-150-5 by Concrete Fiber Solutions
f) Helix Micro Rebar by Helixsteel
g) FiberForce T1-60 by ABC Polymer Industries, LLC]

2.5 ADHESIVES

A. Epoxy Bonding Agent for bonding hardened concrete to hardened concrete (existing concrete damp or dry, at least 28 days old, no surface water):

1. ASTM C 881 Type IV, Grade 1, 2 or 3, Class B or C as appropriate for field temperature conditions.
2. Acceptable Products:

a) Acceptable Product: Dural 452 Series by Euclid Chemical Company
b) Rezi-Weld 1000 by W. R. Meadows
c) Sure Bond J58 by Dayton Superior

B. Epoxy Bonding Agent for bonding freshly mixed concrete to hardened concrete (existing concrete damp or dry, less than 28 days old, no surface water):

1. ASTM C 881, Type V, Grade 1, 2, or 3, Class B or C as appropriate for field temperature conditions.
2. Acceptable Products:

a) Dural 452 Gel or 452 MV by Euclid Chemical Company
b) Sikadur 32 Hi-Mod by Sika Corporation
c) Rezi-Weld 1000 by W. R. Meadows
d) Sure Bond J58 by Dayton Superior

C. Anti-Corrosive Epoxy Modified Cementitious Bonding Compound and Corrosion Protection of Reinforcement (bonding agent for existing concrete saturated surface dry, no surface water):

This adhesive shall be a water-based epoxy/cementitious compound for adhesion and corrosion protection of reinforcing members (20 hour maximum open time).

1. Acceptable Products:

a) DURALPREP AC by Euclid Chemical Company
b) ARMATEC 110 EpoCem by Sika Corporation
c) MasterEmaco P124 by Master Builders Solutions
d) Perma Prime 3C by Dayton Superior

2.6 CURING COMPOUNDS AND SEALERS

A. Interaction with finishes:

1. See architectural Drawings for finish material applied over concrete.
2. Use only curing and sealer compounds that are compatible with finish, waterproofing or roofing material.

B. Curing and Sealing Compound (VOC Compliant, 350 g/l) :

1. ASTM C1315, Type I, Class A and/or ASTM C 309, Type 1, Class A or B
2. Water based acrylic, clear, 25% solids curing and sealing compound.
3. Acceptable Products:

a) Super Diamond Clear VOX by Euclid Chemical Company
b) Cure & Seal 1315 J22WB by Dayton Superior
c) VOCOMP-25 by W. R. Meadows
d) Dress & Seal WB 30 or Lumiseal WB by Laticrete International, Inc.
e) MasterKure CC 1315WB by Master Builders Solutions

C. Curing Compound-Dissipating/Strippable (VOC Compliant, 350 g/l):

1. ASTM C 309, Type I, Class A or B
2. Water based resin, clear curing compound that begins to dissipate when exposed to UV light and traffic.
3. Acceptable Products:

a) Kurez DR VOX by Euclid Chemical Company
b) Clear Resin Cure J11W by Dayton Superior
c) 1100 by W. R. Meadows

D. Surface Applied Vapor Emission Mitigation

1. Shall conform to state and federal VOC regulaions with zero VOC content.
2. Shall provide a 15 year warranty against flooring failure due to negative-side moisture vapor migration of moisture-born alkalinity.
3. Acceptable Products:

a) CS2000 by Creteseal

E. Liquid Densifier/Sealer:

1. The liquid densifier compound shall be a silicate based compound that penetrates and chemically hardens concrete surfaces.
2. Acceptable Products:

a) Euco Diamond Hard by Euclid Chemical Company
b) Acceptable Product: Dayton Superior “Densifier J13”
c) MasterKure HD 200WB by Master Builders Solutions
d) Liqui-Hard by W. R. Meadows

F. Evaporation Retarder:

1. Acceptable Products:

a) MasterKure ER50 by Master Builders Solutions
b) Eucobar by Euclid Chemical Company
c) Sika Film by Sika Corporation

2.7 DRY SHAKE HARDENERS

A. Mineral Aggregate Hardener:

1. The specified mineral aggregate hardener shall be a factory-blended mixture of specially processed graded non-metallic aggregate.
2. Acceptable Products:

a) Euclid Chemical Company, "Surflex" to be used with “Kurez DR VOX”
b) MasterTop 100 to be used with “MasterKure CC 200WB by Master Builders Solutions
c) Quartzplate FF to be used with Dress & Seal WB 30 by Laticrete International, Inc.

B. Non-Oxidizing Metallic Hardener:

1. The specified non-oxidizing metallic floor hardener shall be a mixture of specially processed non-rusting aggregates.
2. Acceptable Products:

a) Euclid Chemical Company, “Diamond-Plate” to be used with “Kurez DR VOX”
b) MasterTop 210COR to be used with “MasterKure CC 200WB by Master Builders Solutions
c) Emeryplate FF to be used with Lumiseal WB by Laticrete International, Inc.

2.8 MISCELLANEOUS CONCRETE AND CONCRETE RELATED PRODUCTS

A. Cementitious Non-Shrink Grout:

1. Provide pre-packaged high-precision, non-shrink, non metallic grout.
2. See General Notes for grout minimum compressive strength.
3. ASTM C 1107
4. Acceptable Products:

a) MasterFlow 928 by Master Builders Solutions
b) Dry Pack Grout or HI-FLOW GROUT by Euclid Chemical Company
c) Five Star Grout by Five Star Products
d) Sikagrout 328 by Sika Corporation
e) Duragrout by Latticrete International, Inc.

B. Self-Leveling Concrete Topping - Underlayment for Interior Applications:

1. Use self-leveling underlayment concrete formulated to level concrete floors without shrinking, cracking or spalling, and capable of being placed from feathered edge to 1" (25mm) thickness without aggregate in one pour. If greater than 1" (25mm) thickness is required, aggregate shall be extended with aggregate in accordance with manufacturer's requirements. Appropriate primer shall be utilized for all underlayment applications.
2. Acceptable Products:

    a) K-15 by Ardex
    b) Flo-Top or Super Flo-Top by Euclid Chemical Company
    c) Sika Level Series by Sika Corporation

C. Moisture-Retaining Covers:

1. ASTM C171
2. A naturally colored, non-woven polypropylene fabric with a non-perforated reflective polyethylene coating containing stabilizers to resist degradation from ultraviolet light. Fabric shall exhibit low permeability and high moisture retention.
3. Acceptable Products:

    a) Hydracure S-16 by PNA Construction Technologies, Inc.
    b) Transguard 4000 by Amorlon a Division of Reef Industries , Inc.
    c) UltraCure NCF by Sika Corporation
    d) Top Cure by Transhield

D. Expanded Polystyrene (EPS) used as Fill - Geofoam

1. Material: Rigid, closed cell polystyrene blocks formed by expansion of polystyrene beads by steam.
2. Comply with the requirements of ASTM D 6817
3. Unless noted otherwise on the drawings, provide the following types of EPS:

    a) Fill between a lower slab and a raised slab area: EPS12 -2.2 psi (15 kPa) compressive resistance minimum at 1% deformation, 10 psi (70 kPa) flexural strength minimum
    b) Fill below exterior floor slabs or slabs with truck loading: EPS19 - 5.8 psi (40 kPa) compressive resistance minimum at 1% deformation, 30 psi (200 kPa) flexural strength minimum

4. Thickness as indicated on Drawings.
5. Execution: Conform to manufacturer’s instructions regarding preparation, installation and protection
6. Gripper plates shall be used as needed to restrain EPS from moving laterally in multi-layer applications
7. Contractor shall sequence soil or concrete topping placement to avoid EPS block shift or flotation.
8. Submit the following for review:

a) Manufacturer's product literature including physical properties in compliance with ASTM D 6817 and type specified
b) 10 year physical property warranty
c) Proposed plan layout of fill blocks showing gaps between blocks where required for stabilizing and/or load bearing reinforced concrete ribs as shown on drawings, in details or in notes.

9. Submit the following for record:

a) Summary of test compliance with specified performance characteristics and physical properties
b) Product Certificates showing evidence of third party quality control

10. Acceptable Manufacturers:

a) ACH Foam Technologies
b) Atlas EPS
c) Universal Construction Foam

E. Vapor Retarder: See Division 7, Thermal and Moisture Protection

1. Minimum 15-mil thick polyolefin membrane
2. Manufactured with prime virgin resins
3. Water Vapor Retarder: ASTM E 1745, meets or exceeds Class A
4. Water Vapor Transmission Rate: ASTM E 96, 0.008 gr./ft2/hr. (0.086 gr./m²/hr) or lower
5. Permeance Rating: ASTM E 96, 0.03 Perms or lower for new material and after conditioning tests in accordance with applicable sections of ASTM E 154
6. Puncture Resistance: ASTM E 1745,minimum 2200 grams
7. Tensile Strength: ASTM E 1745, minimum 45.0 lbs./in (8.0 kg/cm).
8. Acceptable products:

a) Floprufe 120 by GCP Applied Technologies, Inc.
b) Perminator by W. R. Meadows
c) Stego Wrap by Stego Industry LLC
d) Raven Vapor Block 15 by Raven Industries
e) Husky Yellow Guard 15 Mil by Poly-America]

F. Non-Slip Aggregate:

1. Abrasive crushed and graded aggregate, high in aluminum oxidegregate which is unaffected by moisture or cleaning compounds.
2. Acceptable Products:

a) Non-Slip Aggergate by Euclid Chemical Company
b) Emery Non-Slip by Dayton Superior
c) A-H Emery Emerundum by Anti-Hydro International, Inc.

2.9 CONCRETE REPAIR MATERIALS

A. Polymer-Modified Repair Mortar

1. The following patching mortars may be used when color match of the adjacent concrete is not required. Prior approval by the Design Professionals is required.
2. Acceptable Products-Horizontal Surfaces:

   a) Tammspatch II or Tamms Thin Patch by Euclid Chemical Company
   b) Sikatop 122 Plus by Sika Corporation
   c) Meadow-Patch T1 or T2 or Meadow-Crete GPS by W. R. Meadows
   d) Duracrete by Laticrete International, Inc.

3. Acceptable Products-Vertical and Overhead Surfaces:

   a) MasterEmaco N400 by Master Builders Solutions
   b) Verticoat, Vertacoat Supreme or Dualtop Gel by Euclid Chemical Company
   c) SikaTop 123 Plus by Sika Corporation
   d) Meadow-Crete GPS by W. R. Meadows

B. Crack Repair:

   a) Euco Qwikstitch or Dural 50 LM by Euclid Chemical Company
   b) MasterSeal 630 by Master Builders Solutions
   c) T78 Methyl Methacrylate Crack Sealer by Transpo Industries, Inc.

C. High Strength Flowing Repair Concrete:

1. For forming and pouring large volume repairs, provide shrinkage compensated repair concrete with integral corrosion inhibitor.
2. Minimum compressive strength 8000 psi (56MPa) @ 28-days
3. Prior approval by the Design Professionals is required for cold weather applications
4. Acceptable Products:

   a) Eucocrete by Euclid Chemical Company
   b) MasterEmaco S 466 CI by Master Builders Solutions
   c) Meadow-Crete FNP by W. R. Meadows

D. Epoxy Injection:

1. ASTM C881
2. Acceptable Products:

   a) MasterInject 1380 by Master Builders Solutions
   b) Dural Injection Gel by Euclid Chemical Company
   c) Sikadur 35 LV LPL by Sika Corporation

d) Rezi-Weld LV State by W. R.Meadows

E. Pressure-Injected Foam Resin:

1. Acceptable Products:

a) De Neef Sealform PURe by GCP Applied Technologies
b) Crack-Pac Flex-H2O by Simpson Strong-Tie
c) SikaFix HH LV by Sika Corporation

F. Semi Rigid Joint Filler:

1. Acceptable Products:

a) MasterSeal CR 190 by Master Builders Solutions
b) Euco 700 or Qwikjoint UVR by Euclid Chemical Company
c) MM-80 by Metzger/McGuire
d) Rezi-Weld Flex by W. R, Meadows

G. Methyl Methacrylate (MMA)

1. Acceptable Products:

a) MasterSeal 630 by Master Builders Solutions
b) Transpo Industries, Inc. “T-78 Methyl Methacrylate Polymer Crack Healer/Sealer”
c) MMA #884 by Epoxy Systems

H. Sealant:

1. Silicone or Polyurethane Sealant (as selected based on project requirements such as loading, traffic, bond, coatings, etc.).
2. Joint to be routed and cleaned per manufacturer’s written directions.
3. Acceptable Products:

a) MasterSeal Sealants by Master Builders Solutions
b) Sikaflex-1C SL and Loadflex 524 EZ by Sika Corporation
c) Pourthane NS by W. R. Meadows
d) Eucolastic 1NS by Euclid Chemical Company

2.10 **[LEED REQUIREMENTS]**

PART 3 - EXECUTION

3.1 TOLERANCES

A. Work shall conform to all requirements of ACI 117 except as modified by more stringent requirements in the Project Specifications and/or Drawings.

3.2 PREPARATION

A. Subgrade:

1. Dampen subgrades not covered with membrane by sprinkling immediately before placing concrete.

   a) Omit when subgrade is already damp.

2. Do not place on water-saturated subgrade unless placing can be done without damage to subgrade (surface is stable) and loading the subgrade does not drive free water to the surface.
3. Do not place concrete on frozen ground.

B. Forms:

1. Coordinate with Section 031000 Concrete Formwork.
2. Remove dirt, sawdust, nails and other foreign material from formed space.
3. Dampen wood forms by sprinkling immediately before placing.
4. Cool metal forms by sprinkling immediately before placing.

C. Concrete Accessories:

1. Coordinate with Section 031000 Concrete Formwork.

D. Dewatering:

1. Remove water from concrete formwork.
2. Divert any flowing water to sump and remove by pumping.
3. Refer to Division 1 for additional dewatering requirements.

E. Vapor Retarder Placement: See Division 7, Thermal and Moisture Protection.

1. Vapor retarder installation shall be in accordance with manufacturer’s instructions and ASTM E 1643.
2. Place vapor retarder under slabs-on-grade in position with longest dimension parallel with direction of pour.
3. Joints: Lap 6" (150mm) minimum and seal with manufacturer’s recommended mastic or pressure-sensitive tape.
4. Prevent damage to moisture barrier.
5. If moisture barrier is damaged, place a piece of moisture barrier over damaged area (6" (150mm) larger all around) and tape in place with type of tape recommended by moisture barrier manufacturer.
6. Seal laps and intersections of walls with compatible trowel mastic or pressure-sensitive sealing tape.
7. Seal around pipes and other penetrations with compatible trowel mastic.
8. The vapor barrier installation must be approved prior to concrete placement.

3.3 JOINTS IN CONCRETE

A. Locate construction and contraction joints as indicated on Drawings and on approved joint location submittal.

1. Do not use contraction joints in framed floors or composite slabs.
2. Locate and install construction joints so they do not impair strength or appearance of the structure, as acceptable to Design Professionals.
3. Coordinate location of construction and contraction joints with locations of joints in finish materials where they exist.

    a) Construction and contraction joints in slabs or slab on grade with terrazzo finish must be reviewed and approved by the Design Professionals.

4. Maximum joint spacing is as indicated on Drawings.

B. Construction Joints:

1. Construction joints shall be located within the central third of the span. Any concrete spilling over or through the bulkhead shall be removed at the completion of the pour. All surfaces of the concrete shall have reinforcing extending through the joint.
2. Horizontal Joints: Horizontal construction joints other than those shown on the Drawings will not be permitted unless approved by the Architect.
3. Joint Preparation: Forms shall be removed in time to permit roughening of construction joints of structural members by chipping and wire brushing to remove all loose and foreign material and roughen as indicated on the Drawings. The existing concrete at joints shall either be (a) dampened to the point that the surface is saturated, but all standing water has been removed, promptly followed by placement and vibration of fresh concrete, or (b) not required to be dampened, with one of the specified bonding compounds applied as appropriate for the joint condition, following manufacturer recommendations, with placement and vibration of fresh concrete to follow while the epoxy bonding agent is still tacky. Joints without epoxy bonding agent require fresh concrete with slump 7 inches (180mm) or greater at horizontal joints, and fresh concrete confined to maintain pressure against the joint at vertical joints. Where such conditions are not present, or where applying water to dampen the surface is impractical, use epoxy bonding agent suitable for dry surfaces

C. Isolation Joints:

1. Interrupt structural continuity resulting from bond, reinforcement or keyway at points of contact between slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls and other locations, as indicated.

D. Contraction Joints in Floor Slabs-on-Grade:

1. Maximum slab area controlled by jointing is 400 square feet (35 square meters).
2. Space joints at 36 times slab thickness unless a smaller spacing is indicated on the Drawings, located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).
3. Contraction joints can be provided by sawcuts, formed joints or appropriately detailed construction joints.
4. Sawcuts shall be made as soon as possible after slab finishing as may be safely done without dislodging aggregate. The Soff-Cut saw shall be used to a depth of ¼ of slab thickness immediately after final finishing. Conventional saw shall be used as soon as possible after final finish without raveling to a depth as indicated on the Drawings.
5. Where contraction joints coincide with construction joints, detail joint as indicated on Drawings.

E. Joint Fillers: Coordinate with Section 032000 Concrete Reinforcement and Embedded Assemblies and Division 7 requirements.

3.4 MIXING

A. Measurement of Materials: Conforming to ASTM C 94.

B. Mixing: All concrete shall be ready-mixed conforming to ASTM C 94 except as follows:

1. Provide concrete materials, proportions and properties as herein specified in lieu of ASTM C 94.
2. Water, beyond that required by the mix design, shall not be added at the Project site. Addition of water at the Project site shall be made only in the presence of the Testing Agency.
3. Furnish delivery ticket with each load of concrete delivered to the site to the Contractor conforming to the requirements of ASTM C 94.

C. High range water reducing agents (superplasticizer), if added at the batch plant, may be added again at the Project site.

1. If superplasticizers are added at the batch plant, the concrete mix design must account for the delivery time, workability, finishability, and setting time required on the jobsite for proper placing and finishing procedures.
2. If the superplasticizer is redosed at the jobsite in air entrained concrete, air content must be checked after mixing.

D. Discharge of the concrete shall be completed within 1-1/2 hours , after the introduction of the mixing water to the cement and aggregates or the introduction of the cement to the aggregates. If the 1-1/2 hour limit cannot be achieved due to project location or other project specific conditions, hydration control measures to extend the proper workability up to 4 hours maximum can be proposed for approval by the SER. The increased time period along with redosing of the high range water reducer and/or use of hydration controlling/workability retaining admixtures should be agreed upon at the pre-concrete conference.

3.5 CONCRETE PLACEMENT

A. Prior to Concrete Placement:

1. Mechanical vibrators are required and must be available for placing concrete.
2. Remove debris from space to be occupied with concrete.
3. Notify Design Professionals and Testing Agency 48 hours prior to starting concrete placement.
4. Approved mix designs must be maintained on file in Contractor's Field Office.
5. Reinforcement and accessories shall be in proper locations, clean, free of loose scale, dirt or other foreign coatings that may reduce bond to concrete, and in accordance with Section 032000 and Drawings.
6. Do not place concrete having a slump outside of allowable slump range.
7. Place concrete before initial set has occurred, but in no event after it has been discharged from the mixer more than 30 minutes. All concrete shall be placed upon clean, damp surfaces, free from puddled water, or upon properly consolidated fills or upon Controlled Low-Strength Material with a strength between 50 and 1200 psi. Placement upon soft mud or dry earth is not permitted.
8. Unless adequate protection is provided, concrete shall not be placed during rain.
9. Rain water shall not be allowed to increase mixing water or to damage the surface finish.
10. At surfaces left exposed to view, do not use equipment in placing and finishing concrete that contain aluminum in the finishing edges that come in contact with the concrete surface.
11. Keep subgrade moisture uniform without puddles or dry areas.
12. Place vapor retarder directly below slabs on grade as specified in Contract Documents.

B. For Conduits and Pipes Embedded in Concrete:

1. For concrete slab, wall, beam or column, conform to requirements of ACI 318. For variations from these requirements, submit a written request for Design Professionals' review and response.
2. Conduits and pipes shall not be embedded in concrete slabs on steel deck without approval of Design Professional.
3. Provide sleeves for pipes passing vertically through concrete.
4. Do not embed aluminum materials.
5. Do not cut, bend or displace the reinforcement to facilitate placement of embedded pipes and conduits.

C. Pumping: Pumping shall be done in strict accordance with ACI 304.2R.

D. Placing Concrete in Forms:

1. Clean and prepare forms as specified in Section 031000/Concrete Formwork.

2. Place concrete continuously without interruption between predetermined construction and contraction joints in walls.
3. Deposit concrete in forms in horizontal layers no deeper than 24” (600mm) and in a manner to avoid inclined construction joints.
4. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
5. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping.

    a) Use equipment and procedures for consolidation of concrete in accordance with ACI 309R.

6. Do not use vibrators to move fresh concrete laterally inside forms from discharge point; shift discharge point as needed.
7. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine.
8. Place vibrators to rapidly penetrate placed layer and at least 6" (150mm) into preceding layer.
9. Do not insert vibrators into lower layers of concrete that have begun to set.
10. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
11. Do not vibrate Self-Consolidating Concrete (SCC).

E. Placing Concrete Slabs:

1. Place concrete continuously without interruption between predetermined construction and contraction joints in floors.

    a) Place slabs on grade by the long strip cast method. Refer to ACI 302.1R for recommended methods of placement.

2. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until completing placement of a panel or section.
3. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners.
4. Bring slab surfaces to correct level with a straightedge and strike off.

    a) Use highway straight edges, bullfloats or darbies to smooth surface free of humps or hollows.
    b) Do not disturb slab surfaces prior to beginning finishing operations.

5. Maintain reinforcing in proper position on chairs during concrete placement.
6. Do not place materials on slabs or impose loads during period of setting.

F. Placing Concrete on Steel Decks

1. Exercise care during concrete placement on steel decks to prevent concentrated loads or high pile-ups of concrete and to avoid impacts caused by dumping or dropping of concrete on steel decks.
2. Do not use buggies on unprotected areas of deck. If buggies are used to place concrete, furnish and install planked runways to protect deck from damage.

G. Placing Concrete at Construction Joints:

1. To secure full bond at construction joints, surfaces to receive concrete in a subsequent placement shall be left in a roughened state or intentionally roughened by raking while plastic or brushing and chipping immediately after removal.
2. Before new concrete is placed in contact, surfaces of hardened concrete already placed shall be thoroughly cleaned of foreign materials and laitance.
3. At hardened concrete at joints where no bonding agents are used, dampen concrete to achieve a saturated surface dry condition. Leave no standing water. Place and vibrate concrete (slump 7 inches (180mm) or greater) against horizontal joints. Place and vibrate flowing concrete (slump 8 to 10 inches (200 to 250mm)) while maintaining pressure against vertical joints by confinement.
4. At hardened concrete with joints not meeting conditions required for no bonding agents, apply appropriate specified bonding agent for conditions present including age and moisture per manufacturer's specifications. Place new concrete while the bonding agent is still tacky.

H. Floor Topping Slabs:

1. Place concrete topping slab to required lines and levels.
2. Minimum topping slab thickness is 2" (50mm).
3. Place dividers, edge strips and other items to be cast in place.
4. At all topping slabs, remove deleterious material before placing topping slab.
5. All topping slabs shall be bonded unless noted as unbonded on the drawings.
6. Bonded topping slabs should be placed directly against a properly prepared base slab. Proper preparation of the base slab consists of cleaning and removal of all deleterious material roughening the surface to a concrete surface profile of CSP5 or CSP6 and overnight prewetting of the newly cleaned, exposed surface with no standing water present. The surface abrasion method should not cause micro cracking of the top of the base slab.
7. Immediately before placing the bonded topping slab, scrub an even, 1/16" to 1/8" layer of portland cement/sand/water bonding grout over the entire surface to receive the topping slab. Do no allow the bonding grout to dry to a whitish appearance before the topping slab is placed.
8. Where topping slab is noted on Drawings as unbonded the topping should be placed on bond breaker consisting of two sheets of plastic film.
9. Topping mix shall have a maximum water/cement ratio of 0.45.

10. Topping mix shall have a maximum shrinkage of 0.04% at 28 days. If the topping slab is to be exposed and polished, the maximum shrinkage shall be 0.02%.
11. The topping mix shall contain a minimum of 4 lbs. per cubic yard (2.4 kg/m3) of macro synthetic fibers. The fibers shall provide a minimum equivalent flexural residual strength (fe_3) of 150 psi (1.0 MPa) measured in accordance with ASTM C1609, unless a higher dosage is noted on the plans.
12. The topping slab shall be moist cured for a minimum of 36 hours after placement.
13. Bonded topping slabs shall have contraction joints located to match any joints in the base slab. All topping slabs shall be jointed to eliminate restraint conditions such as re-entrant corners and to isolate the slab from columns, walls, etc. and to limit the maximum distance between joints to 15 feet (4570mm).

I. Cold-Weather Placement:

1. Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306R and as specified in this section.
2. When air temperature has fallen to or is expected to fall below 40°F (4°C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F (10°C), and not more than 80°F (27°C), at point of placement.
3. Do not use frozen materials or materials containing ice or snow.

    a) Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

4. Remove frost, snow and ice from forms, reinforcement and other embedments immediately prior to concrete placement.
5. Use only the specified non-corrosive accelerating admixture previously approved as part of the cold weather mixture. Addition of calcium chloride, salt, thiocyanates or admixtures containing more than 0.05 percent chloride ions is not permitted.
6. Freeze Resistant Concrete per ASTM C1622 and Chapter 9 of ACI 212.3R may be used if approved by SER. The contractor shall prepare a plan for placing, finishing and curing procedures that assure the specified hardened properties are achieved.

J. Hot-Weather Placement:

1. Hot weather is defined as air temperature which exceeds 90°F (32°C) or any combination of high temperature, low humidity and/or high wind velocity which causes a rate of evaporation in excess of 0.2 pounds per square feet per hour (1.0 kg/m² per hour) as determined by ACI 305R.
2. When hot weather conditions exist that would impair quality and strength of concrete, place concrete in compliance with ACI 305R and as specified in this section.

3. Cool ingredients before mixing to maintain concrete temperature at time of placement below 95°F (35°C).
4. Mixing water may be chilled, or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water.
5. Use of liquid nitrogen to cool concrete is Contractor's option.
6. Fog spray forms, reinforcement, and subgrade just before pouring concrete.
7. When concrete placement will occur late in the day and reinforcing steel will be heated by the sun, cover reinforcing steel with water-soaked burlap so that steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
8. When concrete operations must be performed in direct sun, wind, high temperatures, low relative humidity, or other adverse placing conditions, the specified evaporation retarder shall be applied one or more times during the finishing operation to prevent plastic cracking.

3.6 CONCRETE FINISHES

A. General:

1. Comply with recommendations for concrete finishing established by ACI 302.1R and ACI 304R.
2. Comply with dimensional tolerance limitations given by ACI 117.
3. For shored floor or slab on grade construction: Floor flatness/floor levelness tolerance compliance testing is to be performed prior to the removal of shores and forms but not later than 72 hours of concrete placement by Testing Agency.
4. See architectural Drawings for locations of the various finishes listed below.
5. Comply with the specified overall SOF_F and SOF_L values listed below:

    a) The specified overall area shall be each individual floor.
    b) F_F/F_L shall be measured in accordance with ASTM E 1155.
    c) The specified minimum local values of MLF_F/MLF_L shall be 3/5 of the SOF_F/SOF_L values listed below.
    d) If an individual test section measures less than either of the specified minimum local MLF_F/ MLF_L numbers, that section may be rejected and remedial measures may be required as specified in CONCRETE SURFACE REPAIRS.
    e) If the composite value of the test surface measures less than either of the specified overall SOF_F/SOF_L numbers, then the entire slab may be rejected and remedial measures may be required.
    f) F_L numbers shall only apply to supported slabs if the tested with all of the original shoring in place, prior to shoring removal/reshoring.
    g) F_L numbers shall not apply to unshored slabs or shored slabs with camber.

B. Finish for monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile and other bonded applied cementitious finish flooring material, as indicated on architectural Drawings:

1. Scratch Finish.

a) Finish surface to overall value of SOF_F=20 and SOF_L=15.
b) Slope surfaces uniformly to drains where required.
c) After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.

C. Finish for monolithic slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, sand-bed terrazzo as indicated on architectural Drawings:

1. Float Finish.

a) After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating.
b) Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both.
c) Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units.
d) Finish surfaces to overall value of SOF_F=20 and SOF_L=15.
e) Cut down high spots and fill low spots.
f) Uniformly slope surfaces to drains.
g) Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

D. Finishes for Pedestrian Sidewalks and Ramps, Exterior Platforms, Steps, as indicated on architectural Drawings:

1. Sidewalks and Curbs: Light-to-medium broom finish applied with fiber-bristle broom perpendicular to direction of main traffic route immediately after float finishing.
2. Ramps: Scored finish as applied perpendicular to direction of main traffic route immediately after float finishing.
3. Finish surface to overall value of SOF_F=20 and SOF_L=15.
4. Texture shall be approved by the Design Professionals from sample panels.

E. Finish for interior floor slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, paint or another thin film-finish coating system, as indicated on architectural Drawings:

1. Trowel Finish.

a) After floating, begin first trowel-finish operation using a power-driven trowel.

b) Begin final troweling when surface produces a ringing sound as trowel is moved over surface.
c) The final hand-troweling operation shall result in a smooth surface, free of trowel marks, uniform in texture and appearance.
d) Grind smooth any surface defects that would telegraph through applied floor covering system.

2. Finish surface to overall value of SOF_F=25 and SOF_L=20.
3. Floor Slopes: Where drains occur, slope floor slabs uniformly to drains, maintaining scheduled slab thickness.
4. Floor Edges at Expansion Joints: Tool edges minimum 3/8" (10mm).
5. Defects: Remove defects of sufficient magnitude to show through floor covering by grinding.
6. Floor Hardener: Use only where scheduled and in accordance with manufacturer's published instructions.
7. Dry Cement: Shall not be used during finishing.

F. Finish for thin set ceramic tile or thin set epoxy terrazzo, as indicated on architectural Drawings:

1. Trowel and Fine Broom Finish:

a) Apply a trowel finish as specified.
b) Immediately follow by slightly scarifying the surface with a fine broom.

2. Finish surface to overall value of SOF_F=35 and SOF_L=25.

G. Finishes for Parking Garage Deck, Ramps, Loading Docks:

1. Highway straight edge immediately after screeding concrete.
2. Finish surface to overall values of SOF_F=20 and SOF_L=15. SOF_L should not be tested for parking slabs that include inclined surfaces or planned changes in floor surface slope.
3. For Slabs Not Receiving Deck Coating: Medium broom finish with ridges not to exceed 1/8" (3mm) in height. Texture shall be as approved by the Design Professionals from sample panels.
4. For Slabs Scheduled to Receive Deck Coating: Smooth floated finish which must be verified with coating manufacturer before finishing the slab.

a) Coordinate with deck coating specified in Division 7.

5. Auto Ramps: Rough texture applied perpendicular to direction of traffic. Texture shall be as approved by the Design Professionals from sample panels.

H. Finishes Equipment and Housekeeping Pads

1. Coordinate finish surface to meet equipment manufacturer requirements, if any, for flatness and levelness.

I. Tolerances at Slab Discontinuities

1. Within 2 ft (600mm) of slab boundaries, construction joints, isolation joints, block-outs, penetrations or other similar discontinuities, where required for travel paths, installation of finishes and partitions, or any other requirements indicated in the Contract Documents, the following equivalent straightedge tolerances shall apply:

   a) Specified local MLF_F = 12, use ¼” (6mm) over 4 ft (1200mm), no offset greater than 1/16” (2mm)
   b) Specified local MLF_F = 15, use 1/8” (3mm) over 4 ft (1200mm), no offset greater than 1/32” (0.8mm)

J. Dry Shake Finish:

1. Non-slip aggregate where indicated on Drawings.
2. Non-oxidizing metallic hardener on loading docks at a rate of 1.5 lbs. per sq. ft. (7.3 kg/m²) and in other locations so noted on the Drawings.
3. Mineral aggregate hardener at a rate of 1.2 lbs. per sq. ft. (5.8 kg/m²) where noted on the Drawings.
4. Final finish type, method and tolerance as applicable by location and use.
5. Dry shake finish will be applied only where scheduled and in accordance with the manufacturer's published instructions and the methods and procedures agreed upon at the pre-installation conference.

K. Rough Formed Finish:

1. Acceptable for formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated.
2. Concrete surface shall have texture imparted by form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4” (6mm) in height rubbed down or chipped off.

L. Architectural Concrete Finish:

1. Using self-consolidating concrete, provide smooth, uniform finish upon form removal with no patching, stoning or other form of repair except washing permitted unless otherwise noted for walls, columns and other surfaces exposed to view. The surface shall match the approved jobsite mock-up panel.

M. Smooth Formed Finish:

1. Required for formed concrete surfaces exposed to view, or scheduled to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or other similar system, as indicated on architectural Drawings:

2. Surface is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
3. Repair and patch tie holes and defects. Remove fins and other projections completely.

N. Smooth Rubbed Finish:

1. "Smooth Rubbed" finish shall consist of a finish free of fins, joint marks smoothed off, blemishes removed and surfaces left smooth and unmarred.
2. Provide smooth rubbed finish to scheduled concrete surfaces, as indicated on architectural Drawings, which have received smooth form finish treatment not later than one day after form removal.
3. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced.

   a) Do not apply cement grout other than that created by the rubbing process.

O. Grout-Cleaned Finish:

1. Provide grout-cleaned finish on scheduled concrete surfaces, as indicated on architectural Drawings, that have received smooth-formed finish treatment.
2. Combine one part Portland Cement to one and one-half parts fine sand by volume, and a 50:50 mixture of acrylic or styrene butadiene-based bonding admixture and water to form the consistency of thick paint.
3. Blend standard Portland Cement and white Portland Cement in amounts determined by trial patches so that final color of dry grout will match adjacent surfaces.
4. Thoroughly wet concrete surfaces, apply grout to coat surfaces, and fill small holes.
5. Remove excess grout by scraping and rubbing with clean burlap.
6. Keep surface damp by fog spray for at least 36 hours after rubbing.

P. Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.7 CURING AND PROTECTION

A. Normal Conditions:

1. Protect concrete from premature drying, excessive hot or cold temperature, and damage.

2. Concrete shall be kept continuously moist and above 50°F (10°C) for seven days (ASTM C 150 Type I cement) or for 10 days (ASTM C 150 Type II cement). High early strength concrete usage shall be maintained over 50°F (10°C) for three days.
3. Concrete and concrete patching materials shall be cured according to manufacturers published recommendations.
4. Begin curing as soon as free water has disappeared from concrete surface and finishing has been completed.
5. Curing Methods: Cure concrete by curing compound, moist curing, moisture-retaining cover curing, or by combining these methods, as specified. Under extreme hot/dry or windy/dry conditions, moist curing and/or moisture-retaining cover curing should be used.

    a) Curing compound is an acceptable form of curing if all of the following requirements are met:

        i. Apply curing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). In accordance with all manufacturer’s instructions.
        ii. Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions.
        iii. Recoat areas subjected to heavy rainfall within 3 hours after initial application.
        iv. Maintain continuity of coating and repair damage during curing period.
        v. Use curing and sealing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.
        vi. Floors to receive covering shall be cleaned thoroughly using a power scrubber and industrial strength detergent. Hand-brooming and sweeping is not sufficient.
        vii. Strippable curing compound may be used in lieu of a moist curing method when approved by the Design Professionals.

    b) Provide moist curing by the following methods:

        i. Keep concrete surface continuously wet by covering with water.
        ii. Use continuous water-fog spray.
        iii. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with a 4” (100mm) lap over adjacent absorptive covers.

    c) Provide moisture-retaining cover curing as follows:

i. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3” (75mm) and sealed by waterproof tape or adhesive.

(1) Immediately repair any holes or tears during curing period using cover material and waterproof tape

6. Cure slabs on grade, concrete toppings, concrete pour strips, supported slabs, walls and columns, not subject to conditions of hot or cold weather concreting, in accordance with ACI 308.
7. Cure surfaces exposed to deicing salts, brackish water, etc., such as loading dock slabs, parking garage slabs and ramps in accordance with ACI 308 recommendations for moist curing.
8. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by leaving forms in place for the full curing period (equivalent to moist curing).

a) If forms are removed prior to completion of full curing period, continue curing by methods specified above for Unformed Surfaces, as applicable.

B. Cold-Weather Protection:

1. When concrete is placed under conditions of cold weather concreting (defined as a period when the mean daily temperature drops below 40°F (4°C) for more than 3 successive days), take additional precautions as specified in ACI 306R when placing, curing, monitoring and protecting the fresh concrete.

C. Hot-Weather Protection:

1. When concrete is placed under conditions of hot weather concreting, provide extra protection of the concrete against excessive placement temperatures and excessive drying throughout the placing and curing operations with an evaporation retarder.

a) Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.

2. Hot weather curing is required if hot weather conditions occur within a 24-hour period after completion of concrete placement.

D. Floor surfaces, wherever indicated by weather conditions, shall be sprinkled during the interval between finishing operation and the start of curing to positively ensure against the possibility of surface drying.

3.8 CONCRETE REPAIRS

A. Perform patching and repairs in accordance with ACI 301.

B. Contractor shall submit patching and repair methods and materials for review by Design Professionals.

C. When complete, all patches and repairs shall match color and texture of adjoining surfaces.

D. At surfaces that are exposed to view, prepare test areas at inconspicuous locations for review by Design Professionals to verify repair color and texture match before proceeding with repair.

E. Apply all patching and repair materials in accordance with manufacturer's specifications.

F. Repairing Cracks In Formed and Unformed Surfaces:

1. Contractor shall notify Design Professionals of all cracks wider than 0.02" (0.50mm) and all cracks wider than 0.01" (0.25mm) that occur in a group of at least three cracks within twelve inches (300mm), in concrete. If Design Professionals deem repairs necessary, Contractor shall be responsible for repairing all such cracks per Design Professionals recommendation at no expense to the Owner. Repairs will generally require one or more of the following: Epoxy Injection, Semi-Rigid Epoxy, Pressure Injected Foam Resin, Methyl Methacrylate and/or Sealant with joint routed and cleaned. See Concrete Repair Materials section of this Specification for acceptable products

G. Repairing Formed Surfaces

1. Immediately after stripping forms, patch all honeycombing, defective joints, voids, etc. before the concrete is thoroughly dry.
2. Remove all burrs, fins, and ridges before the concrete is thoroughly dry.
3. Remove stains from rust, grease and oils, from release agents, etc.
4. Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of the Design Professionals.

   a) Surface defects, include color and texture irregularities, cracks as defined above, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
   b) Chip away defective areas, honeycomb, rock pockets, voids over 1/4" (6mm) in any dimension and holes left by tie rods and bolts, down to solid concrete but in no case to a depth less than 1" (25mm) and saw-cut edges to prevent feather edging of fill material.

5. Repair concealed formed surfaces, where possible, containing defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.
6. Clean out form tie holes and fill with dry pack mortar or precast cone plugs secured in place with bonding agent.

7. If honeycombing exposes reinforcement, chip to provide clear space at least 3/4" (20mm) wide all around steel to allow proper bond.

H. Repairing Unformed Surfaces:

1. High and Low areas in concrete surfaces which are in excess of specified tolerances shall be leveled or ground-smooth.

a) Correct high areas by grinding after concrete has cured at least 14 days.
b) Correct low areas by applying leveling material. Finish leveling material as specified in this section.

2. Repair surfaces containing defects that affect durability of concrete.

a) Surface defects include crazing, cracks as defined above, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.

3. Repair defective areas, except random cracks and single holes not exceeding 1" (25mm) in diameter, by cutting out and replacing with fresh concrete.

a) Remove defective areas with clean, square cuts and expose reinforcing steel with at least 3/4" (20mm) clearance all around.

I. Filling In: Fill in holes and openings left in concrete for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place.

3.9 EVALUATION AND ACCEPTANCE OF CONCRETE

A. In accordance with ACI 301, except where otherwise specified.

B. If, at any time during construction, the concrete resulting from the approved mix design deviates from Specification requirements for any reason, such as lack of workability, or insufficient strength, the Contractor shall have his laboratory verify the deficiency and modify the mix design, until the specified concrete is obtained. Modified mix to be submitted for approval per Part 1 - SUBMITTALS.

3.10 CORRECTIVE MEASURES

A. Conflicts: The Contractor shall be solely responsible for errors of detailing, fabrication, and placement of reinforcement steel; placement of inserts and other embedded items; and the structural adequacy of all formwork.

B. Compensation for Additional Services: Should additional work by Design Professionals such as design, documentation, meetings and/or site visits be required which are necessitated by failure of the Contractor to perform the work in accordance with the Contract Documents either developing corrective actions or reviewing corrective actions developed by others, the Contractor is responsible for paying for additional work performed by the Design Professionals at their standard firm-wide billing rates plus out-of-pocket expenses incurred at

cost + 10%. Additional costs for testing and inspection by the Owner shall also be compensated by the Contractor.

[Balance of page blank; see form on next page]

CONCRETE MIX DESIGN SUBMITTAL FORM

Project: _____

City: _____

General Contractor: _____

Concrete Contractor: _____

Concrete Strength: _____

Use/Location on Job: _____

Supplier's Mix Designation: _____

Design Mix Information	**(Please check one):**	*Refer to ACI 301 for requirements of data used to substantiate strength calculations.*
Field Experience (Based on Standard Deviation Analysis):	_____	
Trial Mixture Test Data:	_____	

Design Characteristics:

Density:	_____	Pcf (kg/m3)
Strength:	_____	Psi (MPa) (28 day)
Air:	_____	% (specified)

Materials:	**Type/Source**	**Specific Gravity**	**Weight (lb)**	**Absolute Vol. (cu. ft.) (cu. m)**
Cement:				
Fly ash:				
Slag (GGBFS)				
Microsilica:				
Coarse Aggregate:				
Fine Aggregate:				
Water:				
Air:				
Other:				
TOTAL:				27.0 cu. ft. (1.0 m3)
Water/Cementitious Material Ratio (lbs. (kg) water / lbs. (kg) cementitious material) =				%

Admixtures:	Manufacturer	ASTM	Dosage (oz/cwt)
Water Reducer:			
Air Entraining Agent:			
High Range Water Reducer			
Non-corrosive Accelerator:			
Other:			

Slump before HRWR: _____ Inches (mm)

Slump after HRWR: _____ Inches (mm)

Standard Deviation Analysis (from experience records):

No. of Test Cylinders Evaluated: _____

Standard Deviation: _____

Required Average Strength f'cr

Average Strength by Tests

Equation Used (ACI Chapter 5)

(Refer to ACI 318 for increased deviation factor when less than 30 tests are available)

TRIAL MIXTURE TEST DATA

Compressive Strength:	Age (days)	Mix #1	Mix #2	Mix #3
	28 [56] [90]	psi (MPa)	psi (MPa)	psi (MPa)
	28 [56] [90]	psi (MPa)	psi (MPa)	psi (MPa)
	28 [56] [90]	psi (MPa)	psi (MPa)	psi (MPa)
	Average	psi (MPa)	psi (MPa)	psi (MPa)
Required Average Strength f'cr				
Average Strength by Tests				
Equation Used (ACI Chapter 5)				

REQUIRED ATTACHMENTS	***Please check***
Coarse Aggregate Gradation Report	
Fine Aggregate Gradation Report	
Fly Ash (or other Supplementary Cementitious Material) Certification	
Concrete Compressive Strength Data or Trial Mixture Test Data	
Admixture Compatibility certification letters	
Chloride Ion Content Certification	
Alkali Aggregate Reactivity Certification	
Shrinkage Test Reports	

SUBMITTED BY:

Name: _____

Address: _____

_____

Phone no.: _____

Main Plant Location: _____

Miles from Project: _____

Secondary Plant Location: _____

Miles from Project: _____

_____

Date: _____

Certification by Concrete Supplier:
Signature: _____

Print Name:

_____

PE License Number and Expiration Date (print or stamp) _____

Structural Substitution Request Form – to be completed by Contractor

Project:		Substitution Request #
Date:		
Requesting Contractor:		Pages Attached (including this form)

1. Description of Requested Substitution:

2. Related Drawings and Specification Sections:

3. Rationale or Benefit Anticipated:

4. Effect on Construction Schedule[1] (check one): ☐NONE ☐See Attached

5. Effect on Owner's Cost[2] attach data (check one): ☐CREDIT TO OWNER ☐EXTRA

6. Effect on Construction Documents[3] (design work anticipated): ☐NONE ☐See Attached

7. Requesting Contractor Agrees to Pay for Design Changes (check): ☐YES ☐NO ☐NOT APPLICABLE

8. Effect on Other Trades[4]:

9. Effect of Substitution on Manufacturer's Warranty (check): ☐NONE ☐See Attachment

Signature[5]: Date:

Company:

General Contractor Signature[5]: Date:

Notes:

1. Contractor is responsible for means and methods and any problems that may arise from making the requested substitution.
2. This is **NOT A CHANGE ORDER FORM**. A separate form is required to adjust costs and/or schedules.
3. Contractor is responsible for any design impacts that may arise from this substitution, including redesign efforts.
4. Contractor is responsible for effects on other trades from this substitution;
   General Contractor must review and agree effects on other trades are fairly represented in items 4-9.
5. Signature by a person having authority to legally bind his/her company to the above terms. Otherwise this request is void
6. All items in form must be completed for substitution request to be considered.

Request Review Responses (completed by Architect and/or Engineer(s)):

ACCEPTED	ACCEPTED AS NOTED	REJECTED	INSUFFICIENT DATA TO SUPPORT REQUEST	ENGINEER / ARCH / MEP SIGNATURE	DATE

Engineer/Architect Comments:

END OF SECTION

SECTION 042000 – UNIT MASONRY ASSEMBLIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Concrete unit masonry.
2. Mortar and Grout
3. Masonry joint reinforcement.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Section 081113: “Steel Doors and Frames”.
2. Section 055000: “Metal Fabrications”.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s product data for each type of masonry unit, accessory, mortar mix, and other manufactured products, including certifications that each type complies with specified requirements.

B. Shop Drawings: Show fabrication and installation details for the following:

Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, “Details and Detailing of Concrete Reinforcement,” Show elevations of reinforced walls.

C. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

1. Each type of masonry unit required.
2. Include size variation data for brick, verifying that actual range of sizes falls within specified tolerances.
3. Include test data, measurements, and calculations establishing net-area compressive strength of masonry units.
4. Each cement product required for mortar and grout, including name of manufacturer, brand, type, and weight slips at time of delivery.
5. Each material and grade indicated for reinforcing bars.
6. Each type and size of joint reinforcement.
7. Each type and size of anchor, tie, and metal accessory.

1.4 QUALITY ASSURANCE

A. Standards: Comply with the following:

1. National Concrete Masonry Association (NCMA), including “TEK Bulletins”.

2. American Concrete Institute (ACI), ACI 530-02/ASCE 5-02/TMS 402; and ACI 530.1-02/ASCE 6-02/TMS 602.
3. Portland Cement Association (PCA), “Concrete Masonry Handbook”.

B. Field Constructed Mock-Ups:

1. Not Required- However, notify Architect/Owner of initial CMU installation for review and acceptance.

C. Fire Performance Characteristics: Where indicated, provide materials and construction which are identical to those of assemblies whose fire endurance has been determined by testing in compliance with ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by another means, as acceptable to authority having jurisdiction.

D. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.

E. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source of producer for each aggregate.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery masonry materials to project in undamaged condition.

B. Store and handle masonry units off the ground, under cover and in a dry location to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion or other causes. If units become wet, do not place until units are in an air-dried condition.

1. Do not store masonry on freshly finished concrete slabs until concrete design strength has been attained. Obtain approval of Architect and Engineer-of-record for storage of masonry on framed structure.

C. Store cementitious materials off the ground, under cover and in dry location.

D. Store aggregates where grading and other required characteristics can be maintained.

E. Store masonry accessories including metal items to prevent deterioration by corrosion and accumulation of dirt and oil.

PART 2 – PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. General: Comply with referenced standards and other requirements indicated below applicable to each form of concrete masonry unit required.

1. Provide special shapes where required for lintels, corners, control joints, bonding and other special conditions.
2. Provide square-edged units for outside corners, unless otherwise indicated.
3. Provide fire-rated units for fire-rated walls which are rated product of manufacturer listed in latest revision of building materials list, published by UL. In lieu of above rating, furnish fire resistive units on basis of examination, tests and report by nationally recognized testing agency acceptable

to governing authorities and codes having jurisdiction. Report must state that units proposed to be furnished are equivalent in fire rating to those products furnished by producers in above UL building materials list.

B. Concrete Masonry Units: ASTM C 90 and as follows:

1. Weight Classification: Normal weight.
2. Provide Type II, nonmoisture-controlled units.
3. Size: Manufactured to the actual dimensions listed below (within tolerances specified in the applicable referenced ASTM specification) for the corresponding nominal sizes indicated on drawings:
    a. 8 inch nominal: 7 5/8 inch actual.
4. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.
5. Compressive strength: Refer to structural drawings for this information.
6. Do not use "stucco block" – (interior walls are exposed/painted).

2.2 MORTAR AND GROUT MATERIALS

A. Masonry Cement: ASTM C 91:

1. Non-pigmented, natural color.

B. Aggregate for Mortar: ASTM C 144

C. Water: Clean and potable.

D. Aggregate for Grout: ASTM C 404

2.3 REINFORCING STEEL

A. Steel Reinforcing Bars: Material and grade as follows:

1. Billet steel complying with ASTM A 615.

    a. Grade 60

B. Deformed Reinforcing Wire: ASTM A 496, with ASTM A 153, Class B-2 zinc coating.

C. Use materials with a recycled content such that the sum of post consumer recycled content plus one-half of the per-consumer content constitutes 95%.

2.4 JOINT REINFORCEMENT, TIES AND ANCHORING DEVICES

A. Materials: Comply with ASTM A 951 and requirements indicated below for basic materials and with requirements indicated under each item of joint reinforcement, tie and anchor, for size and other characteristics:

1. Hot-dip galvanized steel wire: ASTM A 82 for uncoated wire and with ASTM A 153, Class B-2 (1.5 oz. Per sq. ft. of wire surface) for zinc coating applied after prefabrication into units.

B. Provide welded wire units prefabricated in straight lengths of not less than 10', with matching corner and tee units. Fabricate from cold-drawn steel wire complying the ASTM A 82, with deformed continuous side rods and plain cross rods, into units with widths of approximately 2" less than nominal width of walls and

partitions as required to position side rods for full embedment in mortar with mortar coverage of not less than 5/8” on joint faces exposed to exterior, and not less than ½” elsewhere.

Provide the following type of joint reinforcing unless otherwise indicated.

1. For single wythe walls, provide ladder type with cross rods spaced not more than 16” o.c.
2. Minimum wire size for side and cross rods: No. 9

C. Dovetail Slots and Anchors: Maintain continuity of brick anchoring system at all formed and poured reinforced concrete columns by providing dovetail slots and anchors.

1. Dovetail slots to be 22 gauge, hot-dipped galvanized steel, spaced 16” o.c. maximum. Slots shall extend the full height of the brick veneer. Provide Dur-O-Wal D/A 100 slots or equal.
2. Dovetail anchors to be triangular units, 3/16” diameter by 4 ½” in length from dovetail or in length as required to position outside of anchor at approximate center of brick veneer. Anchors shall be hot-dip galvanized. Provide Dur-O-Wal D/A 724 anchors or equal.

D. Anchor Bolts: Provide steel bolts with hex nuts and flat washers complying with ASTM A 307, Grade A, hot-dip galvanized to comply with ASTM C 153, Class C, in sizes and configurations indicated, unless noted otherwise.

E. Manufacturers: Subject to compliance with requirements, provide products of one of the following:

1. AA Wire Products Co.
2. Dur-O-Wal, Inc.
3. Heckman Building Products, Inc.
4. Hohmann & Barnard, Inc.
5. Masonry Reinforcing Corp. of America
6. National Wire Products Corp.

2.5 EMBEDDED FLASHING MATERIALS

A. Flexible, self-sealing wall flashing.

1. Description: Self-sealing, self-healing, fully adhering, composite flexible flashing consisting of 32 mil thick pliable and highly adhesive rubberized asphalt compound bonded completely and integrally to 8 mil thick, high-density, four plies of cross-laminated polyethylene film to produce an overall 40 mil thickness in rolls 75 feet long; protected from contamination from dust or dirt by a silicone-coated release sheet, to be removed immediately before installation.
2. Width: 12, 18, or 36 inches as required by flashing conditions and details.
3. Manufacturer: W.R. Grace – “Perm-A-Barrier Wall Flashing.”

B. Termination Mastic

1. Description: Rubberized asphalt-based mastic for use in sealing flashing membrane terminations and punctures.
2. Manufacturer: W.R. Grace – “Bituthene Mastic”.

2.6 MISCELLANEOUS MASONRY ACCESSORIES

A. Bond Breaker Strips: Asphalt-saturated organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

B. Weepholes: Wicking material to be cotton sash cord in length required for flush installation on outside of brick and 18” in cavity between wythes.

C. Cavity Drainage Material: 2 inch thick, free-draining mesh; made from polyethylene strands and shaped to avoid being clogged by mortar droppings. Provide one of the following:

1. Mortar Break; Advanced Building Products, Inc.
2. CavClear Masonry Mat; CavClear
3. Mortar Net; Mortar Net USA, Ltd.
4. Mortar Stop; Polytite Manufacturing Corp.

2.7 MORTAR AND GROUT MIXES

A. General: Do not use admixtures including air-entraining agents, accelerators, retarders, water repellent agents, anti-freeze compounds or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.

B. Mixing: Combine and thoroughly mix cementitious materials, water and aggregates in a mechanical batch mixer; comply with referenced ASTM standards for mixing time and water content.

C. Mortar for Unit Masonry: comply with ASTM C 270, Proportion Specification, for types of mortar required, unless otherwise indicated.

Use Type M or S mortar for all concrete masonry applications.

D. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 5 of ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.
3. Minimum compressive strength: 3000 p.s.i. at 28 days.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine conditions, with installer present, for compliance with requirements for installation tolerances and other specific conditions, and other conditions affecting performance of unit masonry. Do not proceed until unsatisfactory conditions have been corrected.

1. Verify that reinforcing dowels are properly placed.

B. Examine rough-in and built-in construction to verify actual locations of piping connections.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls, and other masonry construction to the full thickness shown. Build single-wythe walls to the actual widths of the masonry units, using units of widths indicated.

B. Cut masonry units with motor-driven saw designed to cut masonry with clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining work. Use full-size units without cutting where possible. Use dry cutting saws to cut concrete masonry units.

C. Select and arrange units for exposed unit masonry to produce a uniform blend of color and texture.

1. Mix units from several pallets or cubes as they are placed.

D. Matching Existing Masonry: Match coursing and bonding of existing masonry where new masonry walls abut existing masonry walls.

3.3 CONSTRUCTION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces of columns, walls and arises, do not exceed ¼" in 10', or 3//8" in a story height not to exceed 20', nor ½" in 40' or more. For external corners, expansion joints, control joints and other conspicuous lines, do not exceed ¼" in any story or 20' maximum, nor ½" in 40' or more. For vertical alignment of head joints, do not exceed plus or minus ¼" in 10', ½" maximum.

B. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed ¼" in any by or 20' maximum, nor ½" in 40' or more. For top surface of bearing walls, do not exceed 1/8" between adjacent floor elements in 10', or 1/16" within width of a single unit.

C. Variation of Linear Building Line: For position shown in plan and related portion of columns, walls, and partitions, do not exceed ½" in any bay or 20' maximum, nor ¾" in 40' or more.

D. Variation in Cross-Sectional Dimensions: For columns and thickness of walls from dimensions shown, do not exceed minus ¼" nor plus ½".

E. Variation in Mortar Joint Thickness: Do not exceed bed joint thickness indicated by more than plus or minus 1/8", with a maximum thickness limited to ½". Do not exceed head joint thickness indicated by more than plus or minus 1/8".

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half- size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Lay exposed masonry in the following bond pattern; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs. See drawings for patterns other than running bond.

1. One-half running bond with vertical joint in each course centered on units in courses above and below, for concrete unit masonry and standard modular size brick masonry.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: In each course, rack back one-half-unit length for one-half running bond or one-third-unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly if required, and remove loose masonry units and mortar before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.

F. Fill space between hollow-metal frames and masonry solidly with mortar, unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.

H. Fill cores of hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof deck above, unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. At fire-rated partitions, install firestopping in joint between top of partition and underside of structure above to comply with Division 7 Section “Firestopping”.

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on footings and foundation walls and in all courses adjacent to cells or cavities to be filled with grout. For starting courses on footings where cells are not grouted, spread out full mortar bed, including areas under cells.

B. Joints: Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not otherwise indicated, lay walls with 3/8” joints. Tool all exposed joints slightly concave when thumbprint hard using a jointer larger than joint thickness. Rake out mortar in preparation for application of caulking or sealants where shown.

3.6 CAVITIES

A. Keep cavities clean of mortar droppings and other materials during construction.

3.7 HORIZONTAL JOINT REINFORCEMENT

A. Provide continuous horizontal joint reinforcement at 16” o.c. vertically as shown and specified. Fully embedded longitudinal side rods in mortar for their entire length with a minimum cover of 5/8” on exterior side of walls and ½” at other locations. Lap reinforcement a minimum of 6”. Provide continuity at corners by use of prefabricated “L” sections.

B. At intersecting or abutting walls, unless vertical expansion or control joints are shown at juncture, provide continuity with horizontal joint reinforcement using prefabricated “T” units.

C. Reinforce masonry openings greater than 1’-0” wide, with horizontal joint reinforcing placed in 2 horizontal joints approximately 8” apart, both immediately above lintels and below sills. Extend reinforcing a minimum of 2’-0” beyond jambs of the opening except where control joints are provided in masonry:

D. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

3.8 LINTELS

A. Provide masonry lintels where shown and wherever openings of more than 1’-0” for brick size units and 2’-0” for block size units are shown without structural steel or other supporting lintels. Provide precast or formed-in-place masonry lintels. Cure precast lintels before handling and installation. Provide minimum of 8” bearing at each end of lintel.

3.9 FILLED CELL MASONRY

A. All filled cell masonry shall be built to preserve the unobstructed vertical continuity of the cells to be filled with grout.

B. Units shall be laid with full-face shell mortar beds. All head (end) joints shall be continuously filled with mortar for a distance from the face of the wall or unit not less than the thickness of the longitudinal face shells. Cross webs adjacent to vertical cores to be filled shall be fully bedded with mortar to prevent leakage of grout.

C. Bond of masonry units shall be provided by lapping units in alternate courses.

D. All mortar fins or other obstructions or debris shall be removed from the insides of the walls of the cells to be filled with grout. All cells to be filled shall be filled solidly with grout.

E. Grout shall be poured or pumped in lifts of 5 foot maximum height, and shall be consolidated at time of pouring by rodding or vibrating, followed by reconsolidation later, before plasticity is lost.

F. When grouting is to be stopped for 1 hour or longer between lifts, horizontal construction joints shall be formed by stopping the pour 1-1/2 inches below the top of the uppermost unit.

3.10 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joints in unit masonry where indicated. Build-in items as masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.

3.11 REPAIR, POINTING AND CLEANING

A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge any voids or holes and completely fill with mortar. Point-up all joints at corners, openings and adjacent work to provide a neat uniform appearance, properly prepared for application of caulking or sealant compounds.

C. Clean exposed masonry units as work progresses by dry brushing at the end of each day's work and after final pointing to remove mortar spots and droppings.

D. For exposed concrete masonry units, comply with masonry manufacturer's directions and recommendations in NCMA TEK 8-2.

E. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.

F. Protection: Provide final protection and maintain conditions in a manner acceptable to installer, which ensures unit masonry work being without damage and deterioration at time of substantial completion.

END OF SECTION 042000

SECTION 042113 - BRICK MASONRY

1. GENERAL

1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

2. SUMMARY

A. Section Includes:
1. Face brick.
2. Mortar and grout.
3. Ties and anchors.
4. Embedded flashing.
5. Miscellaneous masonry accessories.

B. Related Sections:

1. Division 03 Section "Cast-in-Place Concrete" for installing dovetail slots for masonry anchors.
3. Division 05 Section "Metal Fabrications" for furnishing steel lintels and shelf angles for brick masonry.
4. Division 07 Section "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

3. SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Verification: For each type and color of the following:
1. Face brick, in the form of straps of five or more bricks.
2. Pigmented and colored-aggregate mortar.
3. Weep holes and vents.
4. Accessories embedded in masonry.

E. Material Certificates: For each type and size of the following:

1. Brick Masonry

a. Include data on material properties.

b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
c. For exposed brick, include test report for efflorescence according to ASTM C 67.

2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Pre-blended, dry mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.
5. Anchors, ties, and metal accessories.

F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

4. QUALITY ASSURANCE

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

C. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

5. DELIVERY, STORAGE, AND HANDLING

A. Store Brick Masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver pre-blended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store pre-blended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

6. PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls and hold cover securely in place.
2. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe and hold cover in place.

B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed. Immediately remove grout, mortar, and soil that come in contact with such Brick masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

7. PRODUCTS

1. MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2. BRICK

A. Regional Materials: Provide brick that has been manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

B. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units.

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
5. Brick Corbel/ pilaster per plan elevations and details

C. Face Brick: Facing brick complying with ASTM C 216.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

Brick Type I – Glen-Gery Brick – Hometown Series= “Serendipity Modular”

~~Brick Type II – Grand Blanc Cement Products – “C” Brick, “3 Scored” - Color = “Firestorm Blend”~~

~~Brick Type III – Grand Blanc Cement Products – “C” Brick - Sill (10x8x16)~~

~~a. Basis for Design: Grand Blanc Cement Products “C” Brick~~

2. Grade: SW.
3. Type: FBX or HBX
4. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67.
5. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
6. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet (3 m) or shall have a history of successful use in Project's area.
7. Color and Texture: As selected by Architect.

3. MORTAR MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C 91.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Capital Materials Corporation; Flamingo Color Masonry Cement.
b. Cemex S.A.B. de C.V.
c. Essroc, Italcementi Group
d. Holcim (US) Inc.
e. Lafarge North America Inc.
f. Lehigh Cement Company
g. National Cement Company, Inc.; Coosa Masonry Cement.

E. Mortar Cement: ASTM C 1329.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Lafarge North America Inc.

F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Davis Colors; True Tone Mortar Colors.
b. Lanxess Corporation; Bayferrox Iron Oxide Pigments.
c. Solomon Colors, Inc.; SGS Mortar Colors.

G. Colored Cement Product: Packaged blend made from portland cement and hydrated lime masonry cement or mortar cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Colored Portland Cement-Lime Mix:

1) Capital Materials Corporation; Riverton Portland Cement Lime Custom Color.
2) Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
3) Lafarge North America Inc.; Eaglebond Portland & Lime.
4) Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.

b. Colored Masonry Cement:

1) Capital Materials Corporation; Flamingo Color Masonry Cement.
2) Cemex S.A.B. de C.V.; Richcolor Masonry Cement.
3) Essroc, Italcementi Group; Brixment-in-Color.
4) Holcim (US) Inc.; Rainbow Mortamix Custom Color Masonry Cement.
5) Lafarge North America Inc.; U.S. Cement Custom Color Masonry Cement.

6) Lehigh Cement Company; Lehigh Custom Color Masonry Cement.
7) National Cement Company, Inc.; Coosa Masonry Cement.

2. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
3. Pigments shall not exceed 10 percent of portland cement by weight.
4. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.

H. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

I. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Euclid Chemical Company (The); Accelguard 80.
b. Grace Construction Products, W. R. Grace & Co. - Conn.; Morset.
c. Sonneborn Products, BASF Aktiengesellschaft; Trimix-NCA.

J. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer.

1. Products: Subject to compliance with requirements,:

a. ACM Chemistries, Inc.; RainBloc for Mortar.
b. BASF Aktiengesellschaft; Rheopel Mortar Admixture.
c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.

4. REINFORCEMENT

A. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

B. Masonry Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized, carbon steel continuous wire.

5. TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch (16-mm) cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches (50 mm) parallel to face of veneer.

C. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 01.05-inch- (2.66-mm-) thick, steel sheet, galvanized after fabrication.

2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch (25 mm) of masonry face, made from 0.25-inch- (6.35-mm-) diameter, hot-dip galvanized steel wire.

D. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:

a. Structural Performance Characteristics: Capable of withstanding a 100-lbf (445-N) load in both tension and compression without deforming or developing play in excess of 0.05 inch (1.3 mm).

6. MISCELLANEOUS ANCHORS

A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.

B. Dovetail Slots in Concrete: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from 0.034-inch (0.86-mm), galvanized steel sheet.

7. EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with Division 07 Section "Sheet Metal Flashing and Trim" and as follows:

1. Fabricate through-wall metal flashing embedded in masonry from stainless steel with ribs at 3-inch (76-mm) intervals along length of flashing to provide an integral mortar bond.

a. Products: Subject to compliance with requirements, [available products that may be incorporated into the Work include, but are not limited to, the following:

1) Cheney Flashing Company.
2) Keystone Flashing Company, Inc.; Keystone 3-Way Interlocking Thruwall Flashing.
3) Sandell Manufacturing Co., Inc.; Mechanically Keyed Flashing.

2. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches (76 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
3. Metal Expansion-Joint Strips: Fabricate from stainless steel to shapes indicated.

B. Flexible Flashing: Use one of the following unless otherwise indicated:

1. Copper-Laminated Flashing: 5-oz./sq. ft. (1.5-kg/sq. m) copper sheet bonded between 2 layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) Advanced Building Products Inc.
2) Dayton Superior Corporation, Dur-O-Wal Division; Copper Fabric Thru-Wall Flashing.
3) Hohmann & Barnard, Inc.; H & B C-Fab Flashing.
4) Phoenix Building Products; Type FCC-Fabric Covered Copper.
5) Sandell Manufacturing Co., Inc.; Copper Fabric Flashing.
6) York Manufacturing, Inc.; Multi-Flash 500.

2. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.030 inch (0.76 mm).

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) Advanced Building Products Inc.; Peel-N-Seal.
2) Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
3) Dayton Superior Corporation, Dur-O-Wal Division; Dur-O-Barrier Thru-Wall Flashing.
4) Fiberweb, Clark Hammerbeam Corp.; Aquaflash 500.
5) Grace Construction Products, W. R. Grace & Co. - Conn.; Perm-A-Barrier Wall Flashing.
6) Heckmann Building Products Inc.; No. 82 Rubberized-Asphalt Thru-Wall Flashing.
7) Hohmann & Barnard, Inc.; Textroflash.
8) W. R. Meadows, Inc.; Air-Shield Thru-Wall Flashing.
9) Polyguard Products, Inc.
10) Sandell Manufacturing Co., Inc.; Sando-Seal.
11) Williams Products, Inc.; Everlastic MF-40.

b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

C. Solder and Sealants for Sheet Metal Flashings: As specified in Division 07 Section "Sheet Metal Flashing and Trim."

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

8. MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane.

B. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

C. Weep/Vent Products: Use[one of] the following unless otherwise indicated:

1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe, in color selected from manufacturer's standard.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) Advanced Building Products Inc.; Mortar Maze weep vent.
2) Blok-Lok Limited; Cell-Vent.
3) Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.
4) Heckmann Building Products Inc.; No. 85 Cell Vent.
5) Hohmann & Barnard, Inc.; Quadro-Vent.
6) Wire-Bond; Cell Vent.

D. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Advanced Building Products Inc.
b. Archovations, Inc.; CavClear Masonry Mat.
c. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
d. Mortar Net USA, Ltd.; Mortar Net.

9. MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Diedrich Technologies, Inc.
b. EaCo Chem, Inc.
c. ProSoCo, Inc.

10. MORTAR MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar.
2. Use portland cement-lime mortar unless otherwise indicated.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide Type N unless another type is indicated.

D. Pigmented Mortar: Use colored cement product.

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.
3. Mix to match Architect's sample.
4. Application: Use pigmented mortar for exposed mortar joints with the following units:

a. Concrete facing brick.
b. Face brick.
c. Stone trim units.
d. Cast stone trim units.

E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

1. Mix to match Architect's sample.
2. Application: Use colored aggregate mortar for exposed mortar joints with the following units:

a. Concrete facing brick.
b. Face brick.
c. Stone trim units.
d. Cast stone trim units.

EXECUTION

1. EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

2. INSTALLATION, GENERAL

A. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

1. Mix units from several pallets or cubes as they are placed.

D. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3. TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm); do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
2. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).
3. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.5 mm) from one masonry unit to the next.

4. LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

5. MORTAR BEDDING AND JOINTING

A. Lay hollow brick as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With entire units, including areas under cells, fully bedded in mortar at starting course on footings.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

6. ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than 2 inches (50 mm) wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 16 inches (610 mm) o.c. vertically and 16 inches (915 mm) o.c. horizontally.

7. ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to wall framing and concrete backup with masonry-veneer anchors to comply with the following requirements:

1. Fasten anchors through sheathing to wall framing and to concrete backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Insert slip-in anchors in metal studs as sheathing is installed. Provide one anchor at each stud in each horizontal joint between sheathing boards.
3. Embed connector sections and continuous wire in masonry joints. Provide not less than 2 inches (50 mm) of air space between back of masonry veneer and face of sheathing.
4. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
5. Space anchors as indicated, but not more than 16 inches (458 mm) o.c. vertically and 16 inches (610 mm) o.c. horizontally, with not less than 1 anchor for each 2 sq. ft. (0.2 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 8 inches (203 mm), around perimeter.
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8. EXPANSION JOINTS

A. General: Install expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span expansion joints without provision to allow for in-plane wall or partition movement.

B. Form expansion joints in brick as follows:

1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches (100 mm) in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
2. Build flanges of factory-fabricated, expansion-joint units into masonry.
3. Build in compressible joint fillers where indicated.
4. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch (10 mm) for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants."

C. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 07 Section "Joint Sealants," but not less than 3/8 inch (10 mm).

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

9. LINTELS

A. Install steel lintels where indicated – Refer to structural drawings typ.

B. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

10. FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches (200 mm); with upper edge tucked under building paper or building wrap, lapping at least 4 inches (100 mm).
3. At lintels and shelf angles, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
4. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Division 07 Section "Joint Sealants" for application indicated.
5. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Division 07 Section "Joint Sealants" for application indicated.
6. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal drip edge.
7. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
8. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

D. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:

1. Use specified weep/vent products to form weep holes.
2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.

3. Space weep holes 24 inches (600 mm) o.c. unless otherwise indicated.
4. Space weep holes formed from plastic tubing or wicking material 16 inches (400 mm) o.c.
5. Trim wicking material flush with outside face of wall after mortar has set.

E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

F. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products to form vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

11. FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.

B. Inspections: Level 1 special inspections according to the "International Building Code."

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.

C. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

12. REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.

3. Protect adjacent stone and non masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in "BIA Technical Notes 20."
6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
7. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
8. Clean stone trim to comply with stone supplier's written instructions.
9. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook."

13. MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 4 inches (100 mm) in each dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Division 31 Section "Earth Moving."
3. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042113

SECTION 051200

STRUCTURAL STEEL

PART 1 - GENERAL

1.1 GENERAL

Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 SCOPE

The work covered by this Section shall include all labor, material, equipment, permits, engineering and other services necessary for the fabrication and installation of structural steel and related work, complete, in accordance with the Drawings and as specified herein.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Division 1
Quality Control	Division 1
Quality Assurance: Structural Testing and Inspection	Section 014500
Concrete Reinforcement and Embedded Assemblies	Section 032000
Cast-In-Place Concrete	Section 033000
Steel Deck	Section 053000
Miscellaneous Metals	Division 5
Fireproofing	Division 7
Painting	Division 9
Elevators	Division 14

1.4 CODES AND STANDARDS

A. Building Code: Structural steel work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.

B. Standards:

1. American Institute of Steel Construction (ANSI/AISC 360) "Specification for Structural Steel Buildings" per Structural General Notes.
2. American Institute of Steel Construction (AISC 303), "Code of Standard Practice" (COSP). Due to potential conflicts between the governing contracts and parts of Section 1 through 5 of the COSP, Sections 1 through 5 are excluded from these Contract Documents. Prior to bid, the Owner and Contractor, in consultation with the Design Professionals, can

discuss and determine if any excluded provisions are appropriate to include in the Contract Documents.

3. American Welding Society, AWS D1.1, "Structural Welding Code".
4. Research Council on Structural Connections (RCSC) - "Specification for Structural Joints Using High Strength Bolts".
5. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein.
6. The Society for Protective Coatings (formerly Steel Structures Painting Council, “SSPC”) "Steel Structures Painting Manual".

C. Definitions:

1. The term “Contract Documents” in this Specification is defined as the design Drawings and the Specifications.
2. The term “SER” in this Specification is defined as the Structural Engineer of Record for the structure in its final condition.
3. The term “Design Professionals” in this Specification is defined as the Owner’s Architect and SER.
4. The term “Contractor” in this Specification is defined to include any of the following: General Contractor and their sub-contractors, Construction Manager, Structural Steel Fabricator or Structural Steel Erector.
5. The term “Heavy Sections” in this Specification is defined to include hot rolled steel shapes with flanges exceeding 1 1/2 inches (38mm) in thickness and built up cross sections with plates exceeding 2 inches (50mm) in total thickness.
6. The term “High Restraint Weld” describes welds in which there is almost no freedom of movement for members joined due to geometry or material thickness.
7. The term “Testing Agency” in this Specification is defined as an independent testing and inspection service engaged by the Owner for quality assurance testing and inspection of structural construction in accordance with applicable building code provisions and any additional activities listed in the Contract Documents.
8. The terms “for record” and “submit for record” in this Specification are defined as Contractor submittals that do not require a response from the Design Professionals.
9. The term “Working Days” in this Specification is defined as Monday through Friday, except for federal or state holidays.
10. The term “Delegated Design” in this Specification is defined as a scope of work that meets performance and design criteria established in the Contract Documents and is to be completed by the Contractor’s licensed engineer.

1.5 CONTRACTOR QUALIFICATIONS

A. Qualification Data: Submit for record qualification data (personnel and firm resumes, and project lists with references) for the Structural Steel Fabricator (“Fabricator”), Structural Steel Detailer (“Detailer”), Contractor’s Engineer(s) and Structural Steel Erector (“Erector”).

B. The Fabricator shall have 10 years of comparable experience in installations of this type and shall employ labor and supervisory personnel familiar with the type of installation, experienced in fabrication and erection of structural steel for projects of similar size and complexity. At the time of bid the Fabricator shall be AISC certified to the Standard for Steel Building Structures (BU) and must submit proof of these qualifications. The Fabricator's qualifications shall be subject to review by the Design Professionals and Owner.

C. The Detailer shall have 10 years experience preparing detailed steel shop drawings and CNC downloads for structures of this type and complexity. The detailer's qualifications shall be subject to review by the Design Professionals and Owner. All detailing shall be performed with 3D modeling software, such as TEKLA STRUCTURES, SDS-II or equivalent. Model shall be maintained to be current throughout the construction and in a form useable by the Design Professionals.

D. The Contractor's Engineer(s) shall be qualified to perform the type of work required by the project. The Engineer shall be a Professional Engineer licensed in the state where the project is located. The Contractor's Engineer(s) shall have 10 years of experience being in responsible charge of work of this nature. The proposed Engineer(s) shall be subject to approval of Design Professionals and Owner.

E. The Erector shall have 10 years of successful experience erecting structural steel for structures of this type and complexity in the region of the project. At the time of bid the Erector shall be an AISC Certified Steel Erector (CSE) and must submit documentation of this qualification.

F. Welding: Qualify the welding procedures, shop welders, field welders, welding operators and tackers in accordance with AWS D1.1 and for the following periods of effectiveness of certification:

1. Certification and qualification, including period of effectiveness of welding personnel shall be as specified by AWS D1.1. Certification shall remain in effect for duration of work provided welders are continuously engaged in performing the type of welding for which they are certified, unless welders fail to perform acceptable welding, as determined by the Testing Agency. Certification and re-certification of welding personnel is subject to verification by the Testing Agency. Re-testing for re-certification will be the Contractor's responsibility.

1.6 SUBMITTALS

A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested. Reproduction of structural drawings for shop drawings is not permitted. Building Information Models for contractor's use may be provided as mutually agreed upon by Design Professionals.

(1) Submittal Schedule

(2) Calculations, Shop Drawings and Erection Drawings
(3) Submittal Letters
(4) Pre-construction Survey
(5) Quality Control Program
(6) Product Data
(7) Samples
(8) Welding Procedures Specification (WPS)
(9) Welder Certifications
(10) Mill Reports
(11) As-built surveys
(12) **[LEED Submittals]**

1. **Submittal Schedule**: The contractor shall submit for action a typical connection design calculation and shop drawing submission schedule at least twenty (20) working days prior to commencing submission of connection design calculations and shop drawings.

   a) This schedule shall include a list, in order of date to be submitted, of all drawings and other required submittal items scheduled to be submitted. The schedule shall list the proposed submittals for each week, including but not limited to the number of calculation sheets, erection drawings, and piece drawings, as well as their formats. Once shop drawing submissions have commenced any modification or addition to this schedule must be submitted for action at least twenty (20) working days before the modification or addition is proposed to take place.
   b) If at any time the total number of connection design calculations, erection drawings and shop drawings received in any one week period exceeds the amount in the approved schedule by more than 10% for that week, the Design Professionals have the right to add two days to the average turnaround time for each 20% increment in excess of the scheduled quantity for that week's submissions. For example if the weekly total exceeds the schedule by 10% to 20%, two days may be added; if it is exceeded by 21% to 40%, four days may be added. The return dates for subsequent submittals may be extended based on the additional review time stated above.
   c) For the purposes of developing a schedule, assume the following review rates:
      Calculations – 100 – 8 ½' x 11" sheets per week
      Shop drawings – 300 pieces per week

2. **Calculations, Shop Drawings and Erection Drawings** (including Field Work drawings): Submit for action required connection calculations, shop drawings and erection drawings for all structural steel indicated on the Contract Documents.

   a) Material shall not be fabricated or delivered before the shop and erection drawings have been approved or approved as noted by the Design Professionals and returned to the Contractor.

b) Connection design calculations: Calculations are required for all details that are not indicated on the Drawings as “Completely Designed.” Each calculation package shall be sealed and signed by the Contractor’s Engineer.

c) Structural Steel Shop Drawings: Submitted shop drawings shall include layouts and details for each member showing the steel type and grade, size, connections, cuts, copes, holes, bolts, welds, surface treatments (cleaning, shop paint, etc.) and provisions for the connection of other work. Steel type, grade and size for all attached elements shall also be shown.

d) Shop and erection drawings shall contain complete dimensional and geometric information, based on established dimensions shown on Contract Documents, and shall not be scaled from Contract Documents. The shop drawings shall clearly distinguish between shop and field welds and bolts, identify pretensioned high strength bolts and identify surface preparation requirements at slip critical connections.

e) Welds: All welds shall be indicated by standard welding symbols in the "Standard Code for Arc and Gas Welding in Building Construction" or as accepted by the SER. Shop and erection drawings shall show the size, length, and type of each weld, including the electrode type to be used.

f) Bolts: Details for bolt assemblies shall indicate bolt size, length, type and the presence, type and location of washers where required as part of the assembly; distinguish between N and X bolts, distinguish between slip-critical and bearing bolts; specify approved slip critical coatings; and distinguish between shop and field bolts. Also, indicate bolt orientation where required by the Contract Documents.

g) Erection Drawings: The erection drawings shall include plans showing exact locations of base and bearing plates, and/or anchor rods and other embedded items. All field connections not specifically shown on shop drawings shall be shown on erection drawings, including field bolt size, type, number, location and any special installation requirements, and field weld size, type, length and location.

3. **Submittal Letters:** The Contractor shall submit for record letters from the Contractor's Engineer supervising the preparation of connection designs on shop and erection drawings.

a) A letter shall be submitted along with the first submission of Connection design calculations. It shall be sealed and signed by the Contractor's Engineer, and shall include the following:

"All Connection design calculations for this project have been developed, and all details and connections for this project will be designed, by me, or by qualified personnel under my direct supervision, to resist the loads and reactions indicated on the Contract Documents, except for those connections which are designated as completely designed on the Contract Drawings."

b) A second letter shall be submitted upon the satisfactory submission, review and/or approval of all shop and erection drawings. It shall be sealed and signed by the Contractor's Engineer and include the following:

"All details and connections as shown on the final shop and erection drawings for this project have been designed by me, or by qualified personnel under my direct supervision, to resist the loads and reactions indicated on the Contract Documents, except for those connections which are designated as completely designed on the Contract Drawings."

4. **Preconstruction Survey**: Submit for record. Where interface with existing construction occurs, before related shop drawings are prepared survey the existing construction and submit the survey prepared by a professional surveyor employed by the Contractor to the Design Professionals. For all steel construction, before steel erection commences, perform and submit to the Design Professionals a complete survey for position and alignment at all points where construction by other trades will support steel elements, including but not limited to pockets, embedded plates, anchor rods and base plates. Include plan location positions relative to the building gridlines and elevations of bearing surfaces and tops of bolts relative to building Datum elevation. Immediately notify the SER of elements that are not within tolerance.
5. **Quality Control Program**: Submit for record complete details of the Contractor's quality control program including the names of the personnel responsible for this work.
6. **Product Data**: Submit for action manufacturers' specifications, test reports and applicable standards for all products listed under Part 2: Products. Standard literature shall be edited to suit job conditions.
7. **Samples**: Submit for record (2) samples each, (2) of shop painted products and (2) of field touch-up painted products. Samples shall be steel material.
8. **Welding Procedures:** Submit for record all Welding Procedure Specifications (WPS) and Procedure Qualification Records (PQR):

   a) All Welding Procedures shall be Signed and Sealed by the Contractor’s Engineer or Certified Welding Engineer, confirming all essential variables meet design requirements as applicable on the Contract Documents and weld electrode manufacturer’s recommendations.
   b) The Contractor’s Engineer or Certified Welding Engineer shall develop all Special Welding Procedures for Heavy Sections and High Restraint Welds. Special Procedures shall be Signed and Sealed by the Contractor’s Engineer or Certified Welding Engineer. Use of AWS D1.1, Annex E forms are recommended for Special Procedure submittals.

9. **Welder Certification**: Submit for record certification that the welders have passed qualification tests acceptable to the governing authority using AWS procedures.

a) A certification shall be submitted in standard AWS format.
b) Each certification shall state that the welder has been doing satisfactory welding of the required type within the six-month period prior to the subject work.

For any welder whose period of certification effectiveness has lapsed or whose workmanship is subject to question in the opinion of the Design Professionals or Testing Agency, immediate testing for recertification will be required. Tests, when required, shall be conducted at the sole expense of the Contractor.

10. **Mill Reports**: Submit for record certified copies of all mill reports to the Design Professionals and to the Testing Agency, covering the chemical and physical properties of all structural steel and accessories (as defined in this Specification) for the project. Where required on the Contract Documents or by the AISC Code, reports shall include results of Charpy V-notch tests.

    a) Such certificates shall be obtained from the mills producing the steel and shall certify in a cover letter submitted with the certificates, that the steel meets the minimum requirements as to physical properties, inspection, marking and tests for structural steel as defined by the current edition of the relevant ASTM Standard Specifications. Any steel that does not meet the ASTM requirements must be clearly identified in a cover letter submitted with the certificates.
    b) Prior to commencing steel erection, the contractor shall deliver certificates to the Owner in number and form as may be required by the local Building Department or other local and State agencies having jurisdiction.

11. **As-Built Surveys**: Execute and submit for record a comprehensive survey of steel structure at each level adequate to assess if the structure has been built within the tolerances specified in the Contract Documents. Each certified survey, performed by a professional surveyor employed by the Contractor, shall be submitted to the Contractor’s Engineer for their approval before proceeding to the next stage of erection. If deviations from the tolerances are discovered, the Contractor shall present corrective measures to the Design Professionals within 48 hours of completion of that stage of erection. Upon completion of steel erection, submit the complete package of steel surveys for record to the Design Professionals and the Owner.
12. **[LEED Submittals:]**

B. Submittal Process

1. Submittal of shop and erection drawings and other submittals by the Contractor shall constitute Contractor's representation that the Contractor has verified all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar data with respect thereto and reviewed or coordinated each drawing with other

Drawings and other trades. The Contractor shall place their shop drawing stamp on all submittals confirming the above.

2. Connection design calculations: Calculations are required for all details that are not indicated on the Drawings as “Completely Designed.” The Contractor shall submit connection design calculations and receive an action of approval prior to submitting shop drawings related to those calculations. The shop drawings shall incorporate all comments provided on the calculations.
3. Shop and erection drawings: Submit in complete packages so that individual parts and the assembled unit may be reviewed together. This Specification Section and the applicable drawings used in the development of the shop and erection drawings shall be referenced on each shop and erection drawing to facilitate checking. Unless the piece marks are self-indexing, furnish index sheets with the shop drawings, relating piece marks for all beam, girder and column details to the sheet numbers on which they are located.
4. The Contractor shall submit to the Design Professionals one (1) electronic copy for shop drawing review. The naming convention of each drawing must follow the submittal numbering system and include the submittal #, specification #, revision # and drawing # in the prefix of the drawing name.
5. The Contractor shall allow at least ten (10) working days between receipt and release by the SER for the review of shop and erection drawings and submittals other than connection design calculations. The Contractor shall allow at least fifteen (15) working days between receipt and release by the SER for the review of connection design calculations.
6. All modifications or revisions to submittals, shop drawings, connection design calculations and erection drawings must be clouded, with an appropriate revision number clearly indicated. The following shall automatically be considered cause for rejection of the modification or revision whether or not the drawing has been approved by the Design Professionals:

    a) Failure to specifically cloud modifications
    b) Failure to submit calculations for the modifications
    c) Unapproved revisions to previous submittals
    d) Unapproved departure from Contract Documents

7. The Contractor shall deliver to the Design Professionals at the completion of the job two (2) electronic versions of the final as-built shop drawings on a CD-ROM or other media acceptable to the Design Professionals.
8. Resubmittals: Completely address previous comments prior to resubmitting a drawing. Resubmit only those drawings that require resubmittal.
9. Resubmittals Compensation: The Contractor shall compensate the Design Professionals for submittals that must be reviewed more than twice due to contractors’ errors. The Contractor shall compensate the Design Professionals at the standard billing rates plus out-of-pocket expenses incurred at cost + 10%.

C. SER Submittal Review

1. The review of connection design and the review and approval of shop and erection drawings and other submittals by the Design Professionals shall be for general conformance with the design intent of the work and with the information given in the Contract Documents only and will not in any way relieve the Contractor or the Contractor's Engineer from:

    a) Responsibility for the adequacy of the design of the connections designed by the Contractor's Engineer.
    b) Responsibility for all required detailing.
    c) Responsibility for the proper fitting of construction work in strict conformance with the contract requirements.
    d) The necessity of furnishing material and workmanship required by contract Drawings and Specifications which may not be indicated on the shop and erection drawings.
    e) Conforming to the Contract Documents.
    f) Coordination with other trades.
    g) Control or charge of construction means, methods, techniques, sequences or procedures, for safety precautions and programs in connection with the work.

2. TYPE 1 – Structural Submittal Review Stamp: For shop drawings for building elements designed by the SER, the responses on the shop drawing review stamp used by the SER require one of the following actions:

    a) APPROVED indicates that the SER has found that the information presented on the shop or erection drawing appears to conform to the requirements of the Contract Documents. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the Contract Documents.
    b) APPROVED AS NOTED indicates that the SER requires the shop or erection drawing to be corrected to reflect the notes and comments shown. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the notations shown on the shop drawings and the Contract Documents. Promptly resubmit the corrected shop or erection drawing for record.
    c) REVISE and RESUBMIT indicates that the SER requires resubmission of the shop or erection drawing after correction per notes and comments. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed until the Contractor has received a returned shop drawing marked Approved or Approved as Noted.
    d) NOT APPROVED indicates that the shop or erection drawing does not conform to the Contract Documents and must be extensively revised before re-submittal. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed until the Contractor has received a returned shop drawing marked Approved or Approved as Noted.

3. TYPE 2 – Delegated Design Review Stamp: For submittals for building elements which are not designed by the SER but are delegated design items, or for items that do not form part of the completed structural system but impose loads on the structure, or for construction items or activities which have an effect on the final structure. The responses on the stamp used by the SER require one of the following actions:

   a) NO EXCEPTIONS indicates that the SER has found that the information presented on the submittal appears to conform to the requirements of the Contract Documents. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the Contract Documents.
   b) EXCEPTIONS NOTED indicates that the SER requires the submittal be corrected to reflect the notes and comments shown. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the notations shown on the shop drawings and the Contract Documents. Promptly resubmit the corrected document for record.
   c) REJECTED indicates that the SER requires resubmission of the submittal after correction per notes and comments. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed. Contractor to revise and resubmit until SER response of No Exceptions or Exceptions Noted is received.

D. Substitution Request

1. Requests for any departure from Contract Documents must be submitted in writing by the Contractor and accepted in writing by the Design Professionals, prior to receipt of submittals.
2. All substitutions must be requested using the structural substitution request form included at the end of this section. Acceptance using the structural substitution request form indicates acceptability of the structural concept only. Contractor must submit shop drawings reflecting accepted substitutions for review in accordance with this Specification. The structural substitution request form, even if accepted, does not constitute a change order.
3. Such substitutions or modifications, if acceptable to the Design Professionals shall be coordinated and incorporated in the work at the sole expense of the Contractor.
4. The acceptance by the Design Professionals of a specific and isolated request by the contractor to deviate from these requirements does not constitute a waiving of that requirement for other elements of, or locations in the project, unless specifically addressed as such and permitted by the Design Professionals in writing.
5. Compensation for Additional Services: Should additional work by Design Professionals such as design, documentation, meetings and/or site visits be required which are necessitated for the review and/or incorporation of the Contractor-requested substitution, including indirect effects on other

portions of the work, the Contractor is responsible for paying for additional work performed by the Design Professionals at the standard billing rates plus out-of-pocket expenses incurred at cost + 10%. Additional costs for testing and inspection by the Owner shall also be compensated by the Contractor.

6. Contractor is responsible for means and methods and any impacts on other portions of the work that may arise from this substitution.

E. Request for Information (RFI)

1. RFI shall originate with the Contractor. RFI submitted by entities other than that Contractor will be returned with no response.
2. Limit RFI to one subject.
3. Submit RFI immediately upon discovery of the need for interpretation or clarification of the Contract Documents. Submit RFI within timeframe so as not to delay the Construction Schedule while allowing the full response time described below.
4. The response time for answering an RFI depends on the category in which it is assigned.

   a) Upon receipt by the SER, each RFI will be assigned to one of the following categories:

      i. No cost clarification
      ii. Shown in Contract Documents
      iii. Change to be issued in future bulletin
      iv. Previously answered
      v. Information needs to be provided by others.
      vi. Request for corrective field work
      vii. Request for substitution

   b) RFIs in the first five categories listed above will be turned around by the SER on average of five (5) working days.
   c) RFIs in the last two categories listed above will be immediately rejected and must be submitted as submittals or requests for substitution.

1.7 TEMPORARY SUPPORT OF STRUCTURAL STEEL FRAME

The structure as shown on the Contract Documents is designed to withstand the design loads only when all structural elements are installed and fully connected. The contractor shall be responsible for the analysis of all components and assemblies for stresses and displacements that may be imposed by fabrication, shipping, handling, erection, temporary conditions, construction loads, etc. The analysis of such shall be performed by the Contractor’s Engineer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Unload all structural steel promptly upon arrival and store in an area designated and approved by the Owner at the site of the work. The Contractor shall be responsible for any charges from failure to unload material promptly.

B. Storage: Store structural steel to drain properly. Provide weep holes and clean out as required to keep steel free from water. Provide adequate protection and shoring to prevent distortion and other damage. Store structural steel on timber; do not lay on mud, directly on ground or cinders, or otherwise handle in a manner that damages finishes. Stored sections shall be readily accessible for inspection.

C. Store fasteners in a protected place.

D. Welding materials to be in moisture resistant, undamaged package. Maintain packages effectively sealed until electrode is required for use. Storage and handling shall be per AWS D1.1.

1.9 CONNECTION DESIGN AND DETAILING CONFERENCE

A. At least 20 working days prior to starting connection design and detailing, the Fabricator shall hold a meeting to verify all connection design assumptions and procedures and shop drawing preparation and submittal procedures.

B. The Contractor shall prepare an agenda and require responsible representatives of every party who is concerned with the connection design and detailing to attend this meeting, including but not limited to:

1. General Contractor
2. Fabricator
3. Detailer
4. Connection Engineer
5. Design Professionals
6. Erector

C. The Fabricator shall prepare an agenda prior to the meeting, and shall distribute meeting minutes to all parties within 5 working days of the meeting.

1.10 DESIGN OF CONNECTIONS

A. The contractor is responsible to design all connections not completely designed on the Contract Documents. A Completely Designed connection is only one that is specifically designated as such by the statement “COMPLETELY DESIGNED” on the Contract Documents. All connections not indicated as “COMPLETELY DESIGNED” shall be designed for the forces and/or connection design criteria called for in the Contract Documents.

B. Connection concepts shown on the Drawings that are not “COMPLETELY DESIGNED” show only the minimum requirements to convey design intent.

C. All connections and details shown on shop and erection drawings shall be prepared under the supervision of the Contractor's Engineer, in accordance with AISC "Load and Resistance Factor Design Specification for Structural Steel Buildings."

D. The contractor shall design and provide any stiffener plates, doubler plates, reinforcing plates, etc. and their connections that may be required to develop

and/or transfer the forces and/or connection design criteria called for in the Contract Documents.

E. Design connections to withstand the combined effects of shears, axial forces, moments and torques and as required by applicable code(s) and the Contract Documents.

F. All forces shown on the Drawings are to be assumed reversible unless noted otherwise and must be checked for both directions. If no transfer/pass-through forces are shown on the Contract Documents, the most critical combinations of member forces and directions shall be assumed for the connection design.

G. Use types of shop and field connections shown on Contract Documents or, in absence of such indication, propose appropriate type for Design Professionals review.

H. Welding of High Restraint Welds: Use double bevels in lieu of single bevels where practical. Detail joints to allow for weld shrinkage. In cases of plates in more than one plane, show welding operation sequence on the drawings. In general, start welding at the most restrained part of the weldment and proceed to the least restrained.

I. All welded connection must utilize pre-qualified joints or joints that have been qualified by AWS D1.1: 2015, section 3.

J. Comply with all connection notes on Drawings in conjunction with these Specifications.

K. The connection design calculation submittals shall meet the following criteria:

1. Number each calculation in a logical and orderly system. Once submitted for review, calculations shall not be renumbered. Resubmitted calculations shall be indicated by using the same number with an “R” suffix. All changes must be clouded.
2. Provide sketches for results of each calculation, with all pertinent dimensions relating to the calculations (including pitch, gage, edge distance, unbraced lengths, Whitmore lengths, etc.) clearly shown. Geometry must be shown accurately and to scale. Provide enough sketches to clearly document the full range of geometric conditions applicable to each connection design calculation proposed.
3. For repetitive connections provide a spreadsheet or computer program summary table for each specific location, and a standard calculation which shows how the spreadsheet or program calculation applies.
4. Provide drawings showing the overall locations of the connections that are keyed/referenced to each connection calculation.
5. Calculations shall be typed, or performed by spreadsheet, or by computer program, or by other method approved by the SER. All spreadsheet calculations shall show the input and results for every calculation step and include appropriate text and sketches explaining all calculation assumptions.

6. Provide calculation checks for all forces shown on the Drawings. All AISC code requirements apply. Provide calculations for each check. “OK by inspection” is not permitted.

1.11 STRUCTURAL STEEL PRE-ERECTION CONFERENCE:

A. At least twenty (20) working days prior to the commencing of steel erection the Contractor shall hold a meeting to review the detailed requirements of the steel erection.

B. The Contractor shall prepare an agenda and require responsible representatives of every party who is concerned with the steel erection to attend the conference, including but not limited to the following:

1. General Contractor/Construction Manager
2. Steel Erector / Steel Fabricator
3. Erector’s Surveyor
4. Roof Deck Contractor
5. All Testing and Inspection Agencies
6. Design Professionals
7. Owner
8. Precast or Cladding Contractor as appropriate.

C. Minutes of the meeting shall be recorded, typed and distributed by the Contractor to all parties listed above within 5 working days of the meeting.

D. The minutes shall include a detailed outline of the erection procedure including a schedule of milestone dates for surveys and sign-offs on erection stages which represents an agreement reached by all parties involved. It shall also include the surveying program and submission schedule for approval.

E. Notwithstanding any provision of the Specification, the SER shall not be responsible for and not have charge over any safety programs or precautions at the site of the Project.

1.12 QUALITY ASSURANCE BY OWNER’S TESTING AGENCY

A. See Section 014500.

1.13 QUALITY CONTROL BY CONTRACTOR

A. The Contractor shall provide a program of quality control to ensure that the minimum standards specified herein are attained.

B. The Owner's general review during construction and activities of the Testing Agency are undertaken to inform the Owner of performance by the Contractor but shall in no way replace or augment the Contractor's quality control program or relieve the Contractor of total responsibility for quality control.

C. The Contractor shall immediately notify the Design Professionals of any deficiencies in the work which are departures from the Contract Documents which may occur during construction. The Contractor shall propose corrective

actions and their recommendations in writing and submit them for review by the Design Professionals. After proposed corrective action is accepted by the Design Professionals and Owner, the Contractor shall correct the deficiency at no cost to the Owner. Where the Contractor requests that the Design Professionals develop the corrective actions or review corrective actions developed by others, the Design Professional shall be compensated as outlined in the OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS section of this Specification.

1.14 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS

A. Observations: The Design Professionals will observe the construction for general compliance with the provisions of the Contract Documents during various phases of construction.

B. Corrections by Design Professionals: See Part 3 - CORRECTIVE MEASURES section of this Specification.

1.15 PERMITS AND WARRANTY

A. Permits: The Contractor shall apply for, procure, renew, maintain, and pay for all permits required by City, State, or other governing authorities, necessary to execute work under this Contract. Contractor shall furnish copies of all permits to the Owner and Design Professionals.

B. Warranty: Comply with General Conditions, agreeing to repair or replace specified materials or work that has failed within the warranty period.

PART 2 - PRODUCTS

2.1 STRUCTURAL STEEL

A. Structural steel shall conform to the requirements listed on the Structural General Notes.

B. “Heavy Sections” as defined in this Specification require minimum Charpy impact values per the Structural General Notes and grinding of re-entrant corners/internal radii per this specification, in addition to any other members stated in the Notes.

2.2 SHOP COATINGS

A. Standard Primer: Rust inhibitive, universal phenolic alkyd metal primer 2-4mls. Color to be determined by Architect. Primer shall be compatible with, and from the same manufacturer as, top coats specified in Division 9 specification.

B. Zinc Rich Primer: SSPC-Paint 20, Type I or Type II, Zinc rich primer utilizing either an organic or inorganic binder with a minimum zinc content of 80 percent by weight in the dry film. The primer shall provide a surface meeting AISC Slip Critical Class B (slip coefficient =0.50 min) requirements. Color to be determined

by Architect. Primer shall be compatible with, and from the same manufacturer as, top coats specified in Division 9 specification.

C. Hot Dip Galvanizing: ASTM A123, weight of coating shall average not less than 2.3 oz per square foot (0.70 kg/ m²), with no individual thickness less than 2.0 oz per square foot (0.61 kg/m²).

D. Galvanizing Repair Paint: ZRC Cold Galvanizing Compound, or other coating complying with SSPC-Paint 20.

2.3 ACCESSORIES

A. High Strength Bolts: Conform to the provisions of the Research Council on Structural Connections (RCSC) "Specification for Structural Joints Using High-Strength Bolts" except that nuts shall be ASTM A563 Grades DH or DH3 (hardened) for both A325 and A490 bolts. Twist off type bolts (Tension Control bolts) shall additionally conform to ASTM F1852 or ASTM F2280.

B. All bolts shall be new, and not re-used.

C. Where A325 galvanized bolts nuts and washers are required, they shall be in accordance with ASTM F2329 and ASTM A153, Class C. Where A588 steel is used, bolts, nuts and washers shall be Type 3.

D. Direct Tension Indicators: Meet requirements of ASTM F959.

E. Anchor Rods: Per structural General Notes.

F. Washers:

1. Round washers shall conform to American Standard B 27.2 type b
2. Washers in contact with high-strength bolt heads and nuts shall be hardened in accordance with ASTM Standard F436.
3. Beveled washers shall be square, smooth and sloped so that contact surfaces of the bolt head and nut are parallel.
4. The diameter of the hole of square beveled washers shall be 1/16 inch (1.5mm) greater than the bolt size for bolts smaller than one inch (25mm), and shall be 1/8 inch (3.0mm) greater than the bolt size for bolts larger than one inch (25mm).
5. Comply with requirements of RCSC for all washers including thickness, size and hardness, depending on connection details.

G. Welding Electrodes: Electrodes shall be low hydrogen type and shall have material strength matching characteristics (E70, E80, or E90) as selected from AWS D1.1, Table 3.2. Comply with CVN requirements of the Structural General Notes.

1. Shielded Metal-Arc Welding (SMAW): Welding electrodes for manual SMAW shall have a maximum H4 series level of diffusible hydrogen and conform to the Specification for Carbon Steel Electrodes; AWS A5.1, or the Specification for Low-Alloy Steel Electrodes; AWS A5.5.

2. Gas Metal-Arc Welding (GMAW): Welding electrodes for semiautomatic GMAW shall have a maximum H4 series level of diffusible hydrogen and conform to the Specification for Carbon Steel Electrodes and Rods; AWS A5.18, or the Specification for Low-Alloy Steel Electrodes and Rods; AWS A5.28
3. Flux Core-Arc Welding-Gas Shielding (FCAW-G): Welding electrodes for semiautomatic FCAW-G shall have a maximum H8 series level of diffusible hydrogen and conform to the Specification for Low-Alloy Steel Electrodes; AWS A5.29
4. Flux Core-Arc Welding-Self Shielding (FCAW-S): Welding electrodes for semiautomatic FCAW-S shall have a maximum H16 series level of diffusible hydrogen and conform to the Specification for Carbon Steel Electrodes; AWS A5.20
5. Submerged-Arc Welding (SAW): Bare electrodes and granular flux used in submerged-arc welding shall conform to F70 or F80 AWS flux classifications of the specification for Gare Mild Steel Electrodes and Fluxes for submerged-arc Welding, AWS A5.17.
6. Intermixing of welding processes shall not be permitted unless clearly indicated in Contractor's WPS submission. Contractor shall coordinate and submit for record all shop/field welding procedures, which overlap different welding process fusion zones
7. Alternate non-prequalified welding processes shall be considered based on Contractor qualifying test result submissions of Welding Procedure Specifications (WPS) and Procedure Qualification Records (PQR)
8. Where Charpy V-Notch values are required on the base metal, an electrode meeting the Charpy V-Notch requirements listed in the Structural General Notes shall be provided.

H. Headed Studs (shear connectors) shall be per Structural General Notes.

I. Deformed Bar Anchors shall be as specified in Structural General Notes.

J. Steel Castings shall conform to ASTM A27, Grade 65-35, medium strength carbon steel.

K. Grout: Refer to General Notes.

L. Post-installed Anchors shall be per Structural General Notes.

M. Slide bearing assemblies:

1. Sliding elements (upper and lower) shall be a nominal 3/32" thick glass-filled virgin polytetrafluoroethylene (PTFE). PTFE shall have:

   a) Minimum average tensile strength of 2200 psi conforming to ASTM D4894.
   b) Minimum average elongation of 200% conforming to ASTM D4894.
   c) Hardness at 78°F of 55 to 65 durometer D conforming to ASTM D2240.

2. Assembly shall have allowable bearing stress of 2000 psi (14MPa).

3. Acceptable products:

a) Type TTX by Fabreeka
b) Con-Slide type CSA by Con-Serve]

N. Elastomeric bearing pads: Pre-formed bearing pads consisting of Neoprene or synthetic rubber molded with internal steel shims. ASTM D 2240 Shore A hardness of 60 durometer.

1. American Bearing Co., Inc. "Neoprene Bearing Pads."
2. Balco, Inc. "Neoprene Bearing Pads."
3. Fluorocarbon/Oil States Bearing Pad Division. "Elastomeric Bearing Pads."
4. Tobi Engineering, Inc. "Dura-Slide Elastomeric Pads."

2.4 **[LEED REQUIREMENTS]**

PART 3 - EXECUTION

3.1 PREPARATION

A. Work by Others: Examine all work prepared by others to receive work of this Section and report any defects affecting installation to Design Professionals. Commencement of work will be construed as complete acceptance of preparatory work by others. The Contractor alone shall be responsible for checking the dimensions and coordination of the structural steel work with other trades.

B. Anchor Rods: At least 20 working days prior to the start of the structural steel erection, the Contractor shall ascertain by accurate survey the existing location, alignment, and elevation of the anchor rods embedded in the concrete by others. The Contractor shall immediately notify the Design Professionals of any discrepancies observed between the Contract Documents and the as-built conditions. Steel erection shall not start until corrective measures, if required, have been performed.

3.2 FABRICATION

A. Fabricate and assemble structural steel in the shop to the greatest extent possible.

B. Tolerances:

1. Conform to the tolerances of the AISC "Code of Standard Practice," compensate for the difference between the temperature at time of fabrication and the mean temperature in service.
2. Elevator shafts used for temporary hoists shall conform to the detailed requirements of the hoist manufacturer.

C. Holes: Holes shall be provided in members to permit connections to the work of other trades or contracts, and for passage through the member of work of other

trades. All holes shall be accurately drilled, cut, or punched at right angles to the surface of the metal in accordance with AISC Specifications. Thermally cut or water jet cut holes made with CNC equipment and that meet the requirements per both AISC and RCSC specifications are permitted. Thermally cut or water jet cut holes shall meet the surface roughness requirements of ASME B46.1. Burning or drifting unfair holes will not be permitted. Holes that must be enlarged shall be reamed. Drift pins will be allowed only to bring together the several parts for connection. Holes in base plates are permitted to be drilled or thermally cut. Thermally cut holes in base plates shall meet the requirements of the AISC specification section M2.2. Holes shall be clean-cut without torn or ragged edges. Outside burrs resulting from drilling operations shall be removed with a suitable tool.

D. Camber: Provide camber as indicated on the Contract Documents. Where no camber is indicated, provide natural camber up.

E. Cutting: Manual oxyfuel or plasma cutting processes in the shop may be used only if automatic or semi-automatic methods are not possible. If manual shop cutting is required, it shall be done only with a mechanically guided torch, except that an unguided torch may be used where the cut is more than 1/2 inch (12mm) from the finished dimension and final removal is completed by means such as chipping or grinding to produce a gouge-free surface of quality equal to that of the base metal. At restrained joints and as indicated elsewhere, weld access holes shall be ground smooth to a bright metal finish.

F. Cutting of Heavy Sections: Where Heavy Sections are to be joined by partial or complete joint penetration welds in tension or require slots, copes, or blocking for connections, preheating shall be required for all thermal cutting operations except at holes and slots to receive bolts. Preheat shall be sufficient to prevent cracking but in no case less than 150 degrees F (65°C). Weld access holes, weld termination holes, blocks, and copes shall be ground to a bright metal finish and a smooth radius after cutting and tested for cracks by the magnetic particle method. All cut edges shall be free of sharp notches and gouges.

G. Anchor Rods: Rigid steel templates and anchor rods shall be furnished, labeled and shipped in sets indicating sizes and locations of columns, together with instructions for setting of anchor rods. Plate washers per Typical Details shall be provided.

H. Bolting: Bolts shall be driven accurately into the holes without damaging the threads. Bolt heads shall be protected from damage during driving. Bolt heads and nuts shall rest squarely against the metal. Where bolts are to be used on beveled surfaces having slopes greater than 1 in 20 with a plane normal to the bolt axis, beveled washers shall be provided to give full bearing under the head or nut.

I. Bolts indicated as “finger tight” on the Contract Documents shall be prevented from backing off by using lock nuts, thread compound or deformed threads.

J. Installation of High Strength Bolts:

1. Except where "snug tight" installation is specifically permitted on design Drawings, all high strength bolts shall be installed with full pretension using Turn-of-Nut Pretensioning, Twist-Off Type Tension Control Bolt Pretensioning or Direct-Tension-Indicator (DTI) Pretensioning in accordance with the "Specification for Structural Joints Using ASTM A325 or A490 Bolts".
2. Comply with special washer requirements of the RCSC, such as those related to slotted and oversize holes, and tapered flanges. DTI "washers" shall not be substituted for such required washers.
3. All high strength bolt assemblies (including Tension Control bolts and DTI's) used in pretensioned connections shall be verified in accordance with the Pre-Installation Verification section of the RCSC.
4. Clean and re-lubricate bolts and nuts that become dry or rusty before use, except Tension Control bolts must be re-lubricated by manufacturer.

K. Welding of Structural Steel:

1. Pre-Weld Inspection: The surface to be welded and the filler material to be used shall be subject to inspection before welding is performed.
2. Welds indicated on the Contract Documents or the approved shop or erection drawings shall be created by electric arc welding processes that comply in all respects with the codes and specifications herein noted covering the design, fabrication, and inspection of welded structures and the qualifications of welders and supervisors. Control the heat input, weld length, weld sequence and cooling process to prevent distortion of the completed assembly.
3. Each welder's work shall be traceable.
4. Special Requirements: For High Restraint welds and welds at Heavy Sections, follow approved welding procedures for weld process, sequence, pre-heating and cooling. Use stress relieving techniques where shown in the approved procedure developed by the Contractor's Welding Consultant.

    a) Special Procedures: Prior to the start of production welding, the contractor shall demonstrate to the Testing Agency that preheat can be maintained without relying on heat from the arc. For field welding, the contractor shall provide a shelter to protect each joint from inclement weather (rain, snow, etc.), from start until completion of the joint.
    b) Preheat and Postheat: Preheat shall be sufficient to prevent cracking, but in no case less than required by AWS D1.1. The Contractor shall prepare a written welding sequence and distortion control plan to be included in the welding procedures submittal. Assembly sequence of adjoining parts shall balance applied induced heat from preheat and welding processes to minimize distortion and shrinkage. Complex assemblies shall include special considerations to minimize significant shrinkage stress restraint in accordance with AWS D1.1, Annex H provisions. Under conditions of severe external shrinkage restraint, preheat temperature limitations for making welds shall be in accordance with AWS D1.1, Annex H, Table H2. Under conditions of severe

external restraint, reduction of induced heat and cooling rate shall be monitored under the provisions of the Hydrogen Control/HAZ Hardness Control methods of AWS D1.1, Annex H. The preheat shall be maintained throughout the thickness of the material for a distance equal to twice the material thickness on both sides of the joint at a minimum. Where different thicknesses of steel are being joined, the greater thickness shall govern. Preheat shall be measured on the face opposite the side of the heat application. Preheat shall be applied uniformly in a manner that does not harm the surface of the material nor cause surface temperatures to exceed 1100 degrees F (600°C). Should stress relief heat treatment be required, the contractor shall submit a written procedure.

c) Prior to heat treatment on a production weld, prepare and treat a test sample per the Contractor's written procedure for tensile and Charpy V-notch tests in accordance with ASTM requirements.

5. Welded Joint Details:

a) Welding Backing: The use of weld backing shall be in accordance with AWS D1.1. Weld backing shall be removed where required by the Contract Documents or for the WPS by AWS D1.1.

b) Weld Tabs:

i. Use of Weld Tabs: Welds shall be terminated at the end of a joint in a manner that will ensure sound welds in accordance with AWS D1.1. Whenever necessary, this shall be done by use of weld tabs.

ii. Heavy Section Joint Weld Tab Removal and Finish: All welded tension splices in Heavy Sections shall have the weld tabs removed and ground smooth.

c) Weld Access Holes:

i. Weld access holes shall meet the dimensional, surface finish, and testing requirements of AISC 360 Chapter J1.6 and AWS D1.1, except as otherwise required by the Contract Documents.

ii. Weld access holes are defined for this project as any hole created in order to access a weld joint, facilitate the welding process, or relieve stresses due to weld shrinkage in a web, flange, or any other element of a steel shape.

d) Welding for moment connections shall be sequenced so as to minimize residual stress in the joint.

e) Weld Termination Holes:

i. Weld termination holes are defined for this project as any hole created in order to allow for weld termination or to relieve stresses due to weld shrinkage as part of the welding process.

ii. Re-entrant corners and/or internal radii of weld termination holes shall have a minimum radius of ½" or the thickness of the material divided by two, whichever is greater.

6. Deficient Welds: Welds found deficient in dimensions but not in quality may be enlarged by additional welding. Any weld found deficient in quality shall be removed by grinding or melting and the weld shall be remade.
7. Surface Roughness: Surfaces of weld access holes and weld termination holes in Heavy Sections shall be ground to a bright metal finish and inspected by Magnetic Particle Testing (MT) per the requirements of this specification.

L. Bearing:

1. Bearing ends of columns shall be milled or sawn square perpendicular to axis of the column, or at slope indicated in the Contract Documents.
2. Finish bearing areas of base plates per AISC M2.8.

M. Stiffeners: Fitted stiffeners shall be ground to fit closely against flanges.

N. Cleaning and Preparation of Steel Surfaces:

1. Clean all steel work in accordance with the Society for Protective Coatings (SSPC) Method specified herein that corresponds to its location and exposure. Steel work to be painted shall be painted within the same day that it is cleaned.

a) Interior, Not Exposed to View (above suspended ceilings, under sprayed-on fireproofing, steel to be encased in concrete): SSPC-SP-2, Hand Tool Cleaning.
b) Interior, Exposed in the Finished Building: SSPC-SP-6, Commercial Blast Cleaning, unless noted otherwise on the Drawings.
c) Exterior (exposed to weather or in unconditioned space): SSPC-SP-6, Commercial Blast Cleaning, unless noted otherwise on the Drawings.
d) Members to be Hot Dipped Galvanized: SSPC-SP3, Power Tool Cleaning, before galvanizing.

O. Shop Coating:

1. Where painting is specified, paint all steel work in accordance with the Society for Protective Coatings (SSPC) Method specified herein that corresponds to its location and exposure and in accordance with manufacturer's written instructions. Paint steel work the same day that it is cleaned.

a) Interior, Not Exposed to View (above suspended ceilings, under sprayed-on fireproofing, steel to be encased in concrete): No Paint.
b) Interior, Exposed in the Finished Building: SSPC – Paint 25

c) Exterior (exposed to weather or in unconditioned space): SSPC – Paint 20

2. Protect finished bearing surfaces with a rust-inhibiting coating which is to be removed immediately prior to erection.
3. Do not paint:

   a) Surfaces within six (6) inches (150mm) of field welds
   b) Surfaces to be encased in concrete or to receive cementitious fireproofing
   c) Contact surfaces of high-strength bolted Slip Critical connections (unless surface prep and paint has been specifically prequalified by the contractor or approved for use in this location by the SER)
   d) Surfaces required for testing and preheat, until all testing and preheat has been performed
   e) Finished bearing surfaces (use removable rust-inhibiting coating)
   f) Top flange of the beam where steel deck or headed studs are to be attached

4. Paint shall be applied thoroughly and evenly to dry surfaces only when surface temperatures are above dew-point, in strict accordance with manufacturer's instructions.
5. Surfaces of exterior members which are inaccessible after assembly or erection shall receive their second coat of the approved paint, in a different shade, in the shop.
6. Hot-dip galvanize the following steel members:

   a) All angles, steel plates and shims supporting exterior masonry or exposed to the weather, including shelf, arch and relieving angles
   b) All connections between the above angles and steel plates and the supporting structural member, including clip angles and hardware
   c) Any other steel members indicated as “Galvanized” on the Contract Documents.
   d) All miscellaneous metal, angles, clips, etc. on exterior masonry walls.

3.3 ERECTION

A. Tolerances: Erect all work plumb, square and true to lines and levels in strict accordance with the structural requirements of the building within tolerances of the AISC Code of Standard Practice, unless otherwise indicated on the Contract Documents. Compensate for the difference between the temperature at time of erection and the mean temperature in service.

B. Bracing: Brace the frame during erection in accordance with the Contractor’s erection procedure.

C. Errors: Immediately notify the Design Professionals of any errors in shop fabrication, deformations resulting from handling and transportation, and improper erection that affects the assembly and fitting of parts. Prepare details

for corrective work and obtain approval of the method of correction. Approved corrections shall be made expeditiously at the sole expense of the Contractor.

D. Column Base Plates: Support and align on steel shims or setting bolts. After the supported members have been plumbed and properly positioned, tighten anchor rod nuts in preparation for grouting. Cut off wedges and shims flush with edges of plates and leave in place. The use of leveling plates will not be permitted without prior written approval by the SER. Contractor proposing the use of levelling plates shall provide documentation of plumbing procedure and remediation procedure for gaps between leveling plate and column base plate for SER review.

E. Grouting: Refer to General Notes. Grout base plates immediately after the first tier of columns are plumbed. Do not proceed with steel erection above the first tier until base plates are grouted.

F. Bolting and Welding of Structural Steel: See Section on "Fabrication".

G. Bearing Surface: Clean bearing surfaces and surfaces that will be in permanent contact before the members are assembled.

H. Splices: Splices will be permitted only where indicated on the Contract Drawings or the reviewed shop drawings. Fasten splices of compression members only after surfaces are cleaned and abutting surfaces have been brought completely into contact. Fill any remaining gaps with steel shims driven into place and cut flush. Tack weld shims to each other and to members. Use runoff tabs at bevel weld splices. Cut off runoff tabs and ground smooth after weld completion.

I. Driftpins: Driftpins may be used only to bring together the several parts, and shall not be used in such a manner as to distort or damage the metal. Correct poor matching of holes by drilling to the next larger size and using a larger size bolt. Plug welding and redrilling will not be permitted, unless a specific instance arises and is approved by the SER.

J. Erection bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surfaces. On non-exposed welded construction, remove erection bolts.

K. Hammering: Hammering which may damage or distort the members will not be permitted.

L. Do not use cutting torches in the field without the specific approval of the SER for each application. Where cutting torch use is permitted, all the requirements of the Section on "Fabrication" shall apply.

M. Additional Material and Labor: If the Contractor furnishes additional material and labor for the purpose of erection or if the erection method requires that material be added to certain members, the required modifications shall be at the sole expense of the Contractor.

N. Alignment: Following erection, accurately align, level, and adjust all members prior to final fastening. Conform to AISC standard tolerances unless otherwise noted in the Contract Documents.

O. Touch-Up and Field Applied Paint: After erection, clean all damaged areas in the shop coat, exposed surfaces of bolts, bolt heads, nuts and washers and all field welds and unpainted areas adjacent to field welds according to manufacturers recommendations and paint with the same paint used for the shop coat. Match the touch up and field applied paint color to the as-built paint color. After touch up, at exterior (exposed to the weather or in unconditioned space) steel members apply a full coat of the specified paint in a different shade than the shop applied coat.

P. After erection, clean all damaged galvanized areas, welds and areas adjacent to welds and paint with the specified galvanizing repair paint.

Q. Clean all steel members of mud and debris and construction residue prior to erection.

R. Headed Studs and Deformed Bar Anchors:

1. End weld headed studs and deformed bar anchors with an automatic process in accordance with section 7 of AWS D1.1.
2. Areas to which studs are to be attached must be free of foreign material, such as rust, oil, grease, paint etc. When mill scale is sufficiently thick to cause difficulty in obtaining proper welds, remove by grinding or sand blasting.
3. Remove ceramic ferrules from studs and work after welding.
4. Replace any studs that crack or break. Only straighten studs that would foul other work or have less than 1 inch (25mm) cover in bent position.

S. Slide Bearings: Slide bearing plates shall be permanently affixed to member and support, respectively, by welding or bolting, as indicated. Member faces shall be aligned and leveled so as to maintain full and level contact between surfaces before completing installation. Use tapered shims where required for leveling.

3.4 CORRECTIVE MEASURES

A. Conflicts: The Contractor shall be solely responsible for errors of detailing, fabrication, and erection of structural steel and steel deck.

B. Compensation for Additional Services: Should additional work by Design Professionals such as design, documentation, meetings and/or site visits be required which are necessitated by failure of the Contractor to perform the work in accordance with the Contract Documents either developing corrective actions or reviewing corrective actions developed by others, the Contractor is responsible for paying for additional work performed by the Design Professionals at their standard firm-wide billing rates plus out-of-pocket expenses incurred at cost + 10%. Additional costs for testing and inspection by the Owner shall also be compensated by the Contractor.

[Balance of page blank; see form on next page]

Structural Substitution Request Form – to be completed by Contractor

Project:		Substitution Request #
Date:		
Requesting Contractor:		Pages Attached (including this form)

1. Description of Requested Substitution:

2. Related Drawings and Specification Sections:

3. Rationale or Benefit Anticipated:

4. Effect on Construction Schedule[1] (check one): ☐ NONE ☐ See Attached

5. Effect on Owner's Cost[2] attach data (check one): ☐ CREDIT TO OWNER ☐ EXTRA

6. Effect on Construction Documents[3] (design work anticipated): ☐ NONE ☐ See Attached

7. Requesting Contractor Agrees to Pay for Design Changes (check): ☐ YES ☐ NO ☐ NOT APPLICABLE

8. Effect on Other Trades[4]:

9. Effect of Substitution on Manufacturer's Warranty (check): ☐ NONE ☐ See Attachment

Signature[5]: Date:

Company:

General Contractor Signature[5]: Date:

Notes:

1. Contractor is responsible for means and methods and any problems that may arise from making the requested substitution.
2. This is **NOT A CHANGE ORDER FORM**. A separate form is required to adjust costs and/or schedules.
3. Contractor is responsible for any design impacts that may arise from this substitution, including redesign efforts.
4. Contractor is responsible for effects on other trades from this substitution;
   General Contractor must review and agree effects on other trades are fairly represented in items 4-9.
5. Signature by a person having authority to legally bind his/her company to the above terms. Otherwise this request is void
6. All items in form must be completed for substitution request to be considered.

Request Review Responses (completed by Architect and/or Engineer(s)):

ACCEPTED	ACCEPTED AS NOTED	REJECTED	INSUFFICIENT DATA TO SUPPORT REQUEST	ENGINEER / ARCH / MEP SIGNATURE	DATE

Engineer/Architect Comments:

END OF SECTION

SECTION 053000

STEEL DECK

PART 1 - GENERAL

1.1 GENERAL

Work of this Section shall conform to the requirements of Drawings and general provisions of the Contract, including General Conditions, Supplementary General Conditions and Division 1 Specification sections.

1.2 SCOPE

The work covered by this Section shall include all labor, material, equipment, permits, engineering and other services necessary for the design and installation of composite and non-composite structural steel floor deck systems, steel roof deck systems and related work with all attachments, flashings, metal closures, concrete stops, accessories and fittings as required for a complete installation in accordance with the Drawings and as specified herein.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Division 1
Quality Control	Division 1
Quality Assurance: Structural Testing and Inspection	Section 014500
Concrete	Section 033000
Structural Steel	Section 051200
Miscellaneous Metals	Division 5
Fireproofing	Division 7
Painting	Division 9

1.4 CODES AND STANDARDS

A. Building Code: Steel deck work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.

B. Standards:

1. All steel floor and roof deck manufacturers shall be listed in the Underwriter's Laboratories "Fire Resistance Index of Companies".
2. American Iron and Steel Institute (AISI) “Specification for the Design of Cold-Formed Steel Structural Members”.
3. American Welding Society AWS D1.3 , “Structural Welding Code – Sheet Steel.”
4. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein.

5. Steel Deck Institute (SDI) “Design Manual for Composite Decks, Form Decks and Roof Decks”.

C. Definitions:

1. See Section 051200.

1.5 STEEL DECK MANUFACTURER AND CONTRACTOR QUALIFICATIONS

A. The Manufacturer and the Steel Deck Erector (“Erector”) shall each demonstrate a minimum of ten (10) years of experience with the specified steel deck systems.

B. The Erector shall use prequalified welding processes in accordance with the AWS Structural Welding Code and shall provide certification that those welders to be employed in the Work are currently qualified for those processes and have satisfactorily passed the applicable AWS qualification tests.

C. Contractor’s Engineer shall be qualified to perform the type of work required by the project. The Engineer shall be a Professional Engineer licensed in the state where the project is located. The Contractor’s Engineer shall have 10 years of experience in responsible charge of work of this nature, on steel deck installations similar to this Project in material, design, and extent, with a record of successful in-service performance. Proposed Contractor’s Engineer shall be subject to approval of Design Professionals and Owner. The Engineer shall be a Professional Engineer licensed in the state where the project is located.

1.6 SUBMITTALS

A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested.

(1) Submittal Schedule
(2) Calculations, Shop Drawings and Erection Drawings
(3) Manufacturer’s Certification
(4) Manufacturer’s Installation Instructions
(5) Welder Certifications
(6) Research Reports or Evaluation Reports
(7) **[LEED Submittals]**

1. **Submittal Schedule**: The Steel Deck Contractor shall submit for action a schedule of drawing and calculation submissions at least twenty (20) working days prior to commencing submission of drawings and calculations. The schedule will indicate the number of drawings and calculations proposed to be submitted each week. Any modifications to the schedule shall be submitted for approval at least twenty (20) working days prior to modification is proposed to take place.
2. **Calculations, Shop Drawings and Erection Drawings** (including Field Work Drawings): Submit for record manufacturers standard load tables and calculations for items designed by the Contractor’s Engineer

including substitution requests. Submit for approval shop drawings and erection drawings for all steel deck indicated on the Contract Documents.

a) Materials shall not be fabricated or delivered to the site before the shop drawings have been approved or approved as noted by the Design Professionals and returned to the Contractor.
b) Submit for record, prior to or with shop drawings, calculations for items designed by the Contractor's Engineer. Calculations shall address all design gravity, uplift, and in-plane diaphragm loads indicated. Each calculation package shall be sealed and signed by the Contractor's Engineer.
c) Shop Drawings shall clearly indicate:

    i. Deck types (profiles), steel gauges, and deck finishes.
    ii. Deck layout, including panel locations, number of deck spans per panel, structural support locations and joint locations.
    iii. Deck dimensions and sections keyed to layout plans, including side and end details and bearing requirements.
    iv. Deck fastener types (welds, screws, pins, proprietary systems) and layout patterns at panel sides, ends and interior supports.
    v. Deck manufacturer, profiles, properties, vertical load capacity and in-plane diaphragm shear capacity for all as-detailed conditions.
    vi. Details and locations of accessories including hardware, framing reinforcement anchorage, sump pans, cant strips, ridge plates, valley plates and closure plates.
    vii. Fabrication necessary to incorporate steel deck into the job.
    viii. Correlation with other requirements, openings and flashings.
    ix. Fully dimensioned layout of field-installed headed studs (shear connectors).
    x. Contractor-coordinated openings for mechanical, electrical, plumbing, fire protection and other trades.

d) A letter shall be submitted along with the shop drawings. It shall bear the registration number seal, signature and address of the Professional Engineer who prepared or supervised the calculation and reviewed the shop drawing submittal and shall include the following: "The steel deck calculations have been developed for this project and are designed by me, or by qualified personnel under my direct supervision, to resist the loads and reactions indicated on the Contract Documents. I have reviewed the steel deck layout drawings and they comply with assumptions used to develop the steel deck calculations."
e) The Contractor shall have reviewed and approved the shop drawings prior to submission to the Design Professionals for their review, representing that the Contractor has verified all quantities, dimensions, specified performance criteria, installation

requirements, materials, catalog number and similar data with respect thereto and reviewed or coordinated each drawing and sample with the work of other trades and with the requirements of the project and the Contract Documents.

3. **Manufacturer's Certification**: Submit for record a letter of certification from the deck manufacturer stating that the design, the detailing and fabrication of the steel deck to be installed under this Section are in accordance with the SDI Design Manual for Composite Decks, Form Decks and Roof Decks.
4. **Manufacturer's Installation Instructions**: Submit for record Manufacturer's literature providing recommended installation instructions.
5. **Welder Certifications**: Submit for record welder certificates signed by the Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.
6. **Research or Evaluation Reports**: Submit for record research reports or evaluation reports of the model code organization acceptable to authorities having jurisdiction that evidence steel deck's compliance with the building code in effect for the Project.
7. **[LEED Submittals:]**

B. Submittal Process: See Section 051200.

C. SER Submittal Review: See Section 051200.

D. Substitution Request: See Section 051200.

E. Request for Information (RFI): See Section 051200.

1.7 COORDINATION AND TEMPORARY SUPPORT

A. Consult and cooperate with Contractors for other trades whose work affects or is affected by work under this Section in order that all phases of the work are properly coordinated to avoid delays, errors, omissions, or damage to any part of the work.

B. Steel Deck Contractor shall inform General Contractor of any special support requirements such as shoring of deck for wet concrete loads.

C. General Contractor shall coordinate with Steel Deck Contractor regarding any construction loads on deck before concreting, and on completed deck in excess of the design loads shown. Such conditions may include both gravity and lateral loads.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not bend or mar decking.

B. Store off ground with one end elevated for drainage.

C. Cover decking with waterproof material, ventilated to avoid condensation.

D. Do not store deck bundles on framing unless material is securely tied down and the framing has been analyzed to ensure that such storage will not cause an overload.

1.9 STRUCTURAL STEEL PRE-ERECTION CONFERENCE

A. See Section 051200.

1.10 QUALITY ASSURANCE BY OWNER'S TESTING AGENCY

A. See Section 014500.

1.11 QUALITY CONTROL BY CONTRACTOR

A. See Section 051200.

1.12 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS

A. See Section 051200.

1.13 PERMITS AND WARRANTY

A. See Section 051200.

PART 2 - PRODUCTS

2.1 GENERAL

The work specified herein is based on the products of Vulcraft in order to establish design quality and function in the installed work. Products of other manufacturers shall be subject to the approval of the Design Professionals. All steel deck units shall be of the same depth and profile as shown on the Drawings and the product of one manufacturer.

2.2 DESIGN

A. Section properties of the steel deck units shall be calculated in accordance with the AISI "Specification for the Design of Cold-Formed Steel Structural Members". The minimum positive and negative section moduli so obtained shall be used in calculations involving positive and negative moments, respectively, in determining the required gauges of steel deck units.

B. Where indicated on Drawings or Structural General Notes, the Contractor's Engineer shall design the steel deck using the load criteria shown on the Drawings and the design criteria specified herein.

C. The Contractor's Engineer shall be responsible for determining the suitability of single, double and multiple span lengths of decking for analysis under service and construction conditions.

D. Design of steel deck not receiving concrete fill:

1. Resist design loads using bare steel deck properties. Consider both construction loads and specified loads.
2. Use three span continuous layouts wherever possible.

E. Design of steel deck to receive concrete fill:

1. Design to work compositely with the concrete fill, unless otherwise specifically noted in the Contract Documents as ‘form deck.’
2. Assume deck acts with hardened concrete in a simple-span mode unless otherwise specifically noted on the Contract Documents.
3. Resist superimposed dead and live loads indicated on Drawings, but not less than 150 psf (7.5kPa) superimposed load on composite slab.
4. Resist construction loads using bare steel deck properties.
5. Assume unshored construction unless shoring is specifically coordinated with the General Contractor prior to design.
6. Use three span continuous layouts wherever possible.

F. At spans where trenches cross steel deck, design the interrupted deck ends as noncomposite cantilevers capable of supporting a superimposed dead and live load of 150 psf (7.5kPa) excluding concrete fill, unless greater load capacity is required by the Contract Documents. Increased deck gauge may be necessary to satisfy this loading condition.

G. Steel deck shall be approved by ICC or IAPMO for lateral shear resistance.

2.3 MATERIALS

A. Composite Steel Floor Deck

1. Galvanized Steel Deck: shall be formed from steel sheets conforming to ASTM A653, Structural Quality Grade 33 (minimum) with minimum yield strength of 33 ksi (230MPa). Before forming, the steel sheet shall be zinc coated conforming to ASTM A924, G60.
2. Phosphatized/Painted Steel Deck: shall be formed from steel sheets conforming to ASTM A1008 SS Grade 33 (minimum) with minimum yield strength of 33ksi (230MPa). Prior to painting, the steel shall be chemically cleaned and pre-treated. Following pre-treatment, the bottom side of deck shall be painted with high-heat, baked-on thermal setting primer.

B. Steel Roof Deck, Form Deck: shall be formed from steel sheets conforming to ASTM A653, Structural Quality Grade 33 (minimum) with minimum yield strength of 33 ksi (230MPa). Before forming, the steel sheet shall be zinc coated conforming to ASTM A924-G60.

C. Floor decking shall be formed with integral locking lugs or embossments to provide a mechanical lock between the steel floor and the concrete slab sufficient to resist at least twice the design shear force. Minimum depth of embossments or locking lugs shall be .050"(1.3mm).

D. All steel decking shall be roll formed for uniformity in dimension and strength.

E. Floor and roof decking shall be classified by Underwriters' Laboratories, Inc. Each unit or bundle shall be labeled and marked as required by UL, indicating manufacturer, testing, and inspection.

2.4 ACCESSORIES

A. General: Provide accessory materials for steel deck that comply with requirements indicated and recommendations of the steel deck manufacturer.

B. Side Lap Fasteners: Manufacturer's standard, corrosion-resistant, hexagonal washer head; self-drilling, carbon steel screws, No. 10 minimum diameter.

C. Pour Stops and Girder Fillers: Steel sheet, of same material as deck panels, and of thickness and profile indicated, but not less than the deck gauge.

D. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material and thickness as deck panels, unless otherwise indicated.

E. Hanger Tabs: Manufacturer's standard UL rated piercing steel sheet hanger attachment devices for floor deck panels.

F. Recessed Sump Pans: Manufacturer's standard size, single piece steel sheet 0.071-inch (1.8mm) thick minimum, of same material as deck panels, with 1-1/2-inch (40mm) minimum deep level recessed pans and 3-inch (75mm) wide flanges. Cut holes for drains in the field.

G. Flat Receiver Pan: Manufacturer's standard size, single-piece steel sheet, 0.071" (1.8mm) thick minimum units, of same material as deck panels.

H. Miscellaneous Roof Deck Accessories: Steel sheet ridge and valley plates, finish strips, and reinforcing channels, of same material and thickness as roof deck unless otherwise indicated.

I. Headed Studs (shear connectors) shall be per Structural General Notes.

J. Steel Sheet Accessories: ASTM A 653, galvanized to G60 coating class conforming to ASTM A924.

K. Galvanizing Repair Paint: SSPC Paint 20 or MIL-P-21035, with dry film containing a minimum of 94% zinc dust by weight.

L. Flexible Rib Closure Strips: Manufacturer's standard vulcanized, closed-cell, synthetic rubber.

M. Sound-Absorbing Insulation: As required by the Contract Documents, provide manufacturer's standard premolded roll or strip glass fiber or mineral fiber.

2.5 SIDE JOINT HANGER SYSTEM FOR USE IN COMPOSITE STEEL FLOOR DECK ONLY

A. Provide hanger tabs along the side joints of units at 1'-0" (300mm) centers.

B. Side joint hanger tabs shall have a minimum allowable static load capacity of at least 100 lbs (45kg) and shall accommodate a flat bar hanger (no rod hangers).

C. All hangers, their installation, and tab activation shall be by trades requiring the tabs.

D. No plastered ceilings shall be hung from side joint hanger tabs.

E. No mechanical, electrical, plumbing or fire protection loads shall be hung from deck side joint hanger tabs.

2.6 MISCELLANEOUS MATERIALS

A. Arc-Welding Electrodes: AWS A5.1 E60XX or E70XX Series, as required for the conditions of use.

B. Touch Up Paint: use galvanized repair paint specified above.

C. Closure Tape as required to maintain cells clear of concrete at abutting panel ends.

2.7 **[LEED REQUIREMENTS]**

PART 3 - EXECUTION

3.1 PREPARATION

A. Work by Others: Examine all work prepared by others to receive work of this Section, especially plan and elevation locations of supporting frames and walls. Report any defects affecting installation to Design Professionals. The Contractor alone shall be responsible for checking the dimensions and coordination of the steel deck work with other trades.

B. Do not place deck units on supports with debris or unapproved coatings that could affect full, level bearing and proper connections.

C. Do not place deck units on concrete supporting structures until concrete has cured and is dry.

D. Coordinate the location of decking bundles with a structural steel erector to prevent overloading of structural members.

3.2 ERECTION – PLACEMENT

A. Erect steel deck in accordance with the decking manufacturer’s recommendations and the requirements of the Drawings and these Specifications.

B. Place steel deck on the supporting framework and adjust to final position with ends accurately aligned and bearing on supporting members before making permanent connections. Do not stretch or contract sidelap interlocks.

C. Place deck units flat, square, without warping or excessive deflections, in straight alignment for entire length of run of cells and with close alignment between the cells at ends of abutting units.

D. Abutting ends of deck panels shall occur over supports. End bearing shall be a minimum of 2 inches (50mm), or greater if required (web crippling) by deck manufacturer.

E. Where deck panels nest, laps shall be a minimum of 2" (50mm) and shall occur over supports. Nesting is permitted only where profiles are designed to nest and are fabricated with offset ends.

F. Install slab edge closures and pour stops at the theoretical position with maximum tolerance of + 3/8" (10mm). Closures and pour stops shall have adequate adjustments to maintain this tolerance while accommodating the structural steel frame tolerances.

3.3 ERECTION - CONNECTIONS

A. Connect steel deck to the steel framework at ends of units and at intermediate supports as shown on the Contract Documents and approved shop drawings.

B. Deck to support welds shall be puddle welds of diameter and spacing shown on Contract Documents and/or approved shop drawings.

C. Use welding washers for puddle welding at deck thinner than 22 gauge (0.85mm) and where recommended by the manufacturer

D. Where headed studs occur, if fused to deck for full weld perimeter each headed stud may be considered to replace one puddle weld

E. Fasten side laps and perimeter edges of panels between supports by button punching, side seam welding or screws, or as noted on Construction Drawings.

3.4 ERECTION – OPENINGS AND CLOSURES

A. Contractor to coordinate location of all openings with other trades (see Submittals).

B. Cut and install sleeves and holes through decking for openings indicated on the Architectural, Structural, and/or Mechanical-Electrical-Plumbing-Fire Protection Drawings. Cost shall be paid by the trade requiring such sleeves and holes. Sleeves will be furnished by the various trades requiring them. Provide and install reinforcement as required around sleeves. Where possible, leave deck intact and use block outs to hold back concrete at openings. Cut deck after concrete cures.

C. Provide miscellaneous headers and other steel reinforcing and supports welded to decking and structural steel as required at penetrations, around columns, etc. per typical details and manufacturer’s recommendations.

D. Field cutting parallel to flutes shall be done in the low flutes, taking care to leave sufficient horizontal material to permit satisfactory welding of deck to supporting steel.

E. Openings required for work of other trades and not indicated on Architectural, Structural, Mechanical / Electrical / Plumbing / Fire Protection / Telecom Drawings shall be permitted only upon approval of the Design Professionals as to size and location.

F. Furnish and install tight-fitting closures at locations including but not limited to

1. Open ends of flutes and sides of decking (neoprene or sheet steel)
2. Open ends of all flutes at columns, walls and openings shown on Contract Drawings
3. Panel ends where panels change direction or abut (sheet steel or closure tape)
4. Between deck units and columns (sheet steel)
5. Between columns and exterior cladding (sheet steel)
6. Welding hole cover, with friction fastening, to close excess holes when required (sheet steel).

3.5 WELDING

A. Welding of steel deck shall follow the technique outlined by the steel deck manufacturer.

B. Welding of headed studs shall conform to all AWS requirements, including workmanship, quality control, and inspection, which shall be performed by the Contractor and observed by the Testing Agency.

3.6 ROOF SUMP PANS

Place over openings provided in roof decking and weld to top decking surface. Space welds not more than 12 inches (300mm) o.c. with at least one weld at each corner. Cut opening in roof sump bottom to accommodate drain size shown, coordinate with Plumbing Drawings.

3.7 CONCRETE PLACEMENT

A. Concrete with admixtures containing chloride salts or other deleterious materials shall not be used with steel deck.

B. Steel deck used to support concrete buggy runways shall be adequately protected against wheel damage. Decking and any runways or shoring shall be evaluated and designed by Contractor’s Engineer.

3.8 TOUCH-UP

A. After installation touch-up welds on galvanized decking with specified galvanized repair paint to a dry film thickness of 2 mils, at all locations that will not receive concrete fill.

B. Touch-Up Painting: Where exposed to view, wire brush, clean, and paint scarred areas, welds, and rust spots on both surfaces of installed deck panels.

1. Touch up painted surfaces with same type of shop paint used on adjacent surfaces.
2. Where shop-painted surfaces are exposed in-service, apply touch-up paint to blend into adjacent surfaces.

3.9 CORRECTIVE MEASURES

A. Where the Contractor requests that the Design Professionals develop the corrective actions or review corrective actions developed by others, the Design Professional shall be compensated as outlined in Part 3 – CORRECTIVE MEASURES section of Specification 051200.

END OF SECTION

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies materials and services required for installation of cold-formed steel, including tracks and required accessories as shown and specified. This Section includes the following:

1. Exterior load-bearing steel stud walls.
2. Interior load-bearing steel stud walls.
3. Exterior non-load-bearing steel stud curtain wall.
4. Steel joists.
5. Steel trusses.

1.2 RELATED WORK:

A. Structural steel framing: Section 05 12 00, STRUCTURAL STEEL FRAMING.

B. Open web steel joists: Section 05 21 00, STEEL JOIST FRAMING.

C. Non-load-bearing metal stud framing assemblies: Section 09 22 16, NON-STRUCTURAL METAL FRAMING.

D. Gypsum board assemblies: Section 09 29 00, GYPSUM BOARD.

1.3 DESIGN REQUIREMENTS:

A. Design steel in accordance with American Iron and Steel Institute Publication "Specification for the Design of Cold-Formed Steel Structural Members", except as otherwise shown or specified.

B. Structural Performance: Engineer, fabricate and erect cold-formed metal framing with the minimum physical and structural properties indicated.

C. Structural Performance: Engineer, fabricate, and erect cold-formed metal framing to withstand design loads within limits and under conditions required.

1. Design Loads: As indicated.
2. Design framing systems to withstand design loads without deflections greater than the following:
   a. Exterior Load-Bearing Walls: Lateral deflection of 1/240 and 1/360 of the wall height.
   b. Interior Load-Bearing Walls: Lateral deflection of 1/240 and 1/360 of the wall height.
   c. Exterior Non-load-Bearing Curtain wall: Lateral deflection of // 1/240 and 1/360 of the wall height.
   d. Floor Joists: Vertical deflection of 1/240 and 1/360 of the span.
   e. Roof Trusses: Vertical deflection of 1/240 and 1/360 of the span.

3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change (range) of 67 degrees C (120 degrees F).
4. Design framing system to accommodate deflection of primary building structure and construction tolerances, and to maintain clearances at openings.
5. Design exterior non-load-bearing curtain wall framing to accommodate lateral deflection without regard to contribution of sheathing materials.
6. Engineering Responsibility: Engage a fabricator who assumes undivided responsibility for engineering cold-formed metal framing by employing a qualified professional engineer to prepare design calculations, shop drawings, and other structural data.

1.4 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Shop Drawings: Shop and erection drawings showing steel unit layout, connections to supporting members, and information necessary to complete installation as shown and specified.

C. Manufacturer's Literature and Data: Showing steel component sections and specifying structural characteristics.

D. For cold-formed metal framing indicated to comply with certain design loadings, include structural analysis data sealed and signed by the qualified professional engineer who was responsible for its preparation.

1.5 APPLICABLE PUBLICATIONS:

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

B. American Iron and Steel Institute (AISI):

Specification and Commentary for the Design of Cold-Formed Steel Structural Members (1996)

C. American Society of Testing and Materials (ASTM):

A36/A36M-08 ..... Standard Specifications for Carbon Structural Steel

A123/A123M-09 ..... Standard Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

A153/A153M-09 ..... Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

A307-10 ..... Standard Specifications for Carbon Steel Bolts and Studs

A653/A653M-10 ..... Standard Specifications for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

C1107/C1107M-08 ..... Standard Specifications for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)

E488-96(R2003) .....Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

E1190-95(R2007) .....Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members

D. American Welding Society (AWS):

D1.3/D1.3M-08 .....Structural Welding Code-Sheet Steel

E. Military Specifications (Mil. Spec.):

MIL-P-21035B.....Paint, High Zinc Dust Content, Galvanizing Repair

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Sheet Steel for joists, studs and accessories 16 gage and heavier: ASTM A653, structural steel, zinc coated G90 , with a yield of 340 MPa (50 ksi) minimum.

B. Sheet Steel for joists, studs and accessories 18 gage and lighter: ASTM A653, structural steel, zinc coated G90 , with a yield of 230 MPa (33 ksi) minimum.

C. Galvanizing Repair Paint: MIL-P-21035B.

D. Nonmetallic, Non-shrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, Portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107, with fluid consistency and a 30 minute working time.

2.2 WALL FRAMING:

SPEC WRITER NOTE: Retain this article when steel studs are required. Select the steel thickness as required. Sequence corresponds to 20 gage, 18 gage, 16 gage, 14 gage, and 12 gage thicknesses.

A. Steel Studs: Manufacturer’s standard C-shaped steel studs of web depth indicated, with lipped flanges, and complying with the following:

1. Design Uncoated-Steel Thickness:

   0.91 mm (0.0358 inch)

   1.20 mm (0.0474 inch)

   1.52 mm (0.0598 inch)

   2.66 mm (0.1046 inch)

2. Flange Width:

   35 mm (1-3/8 inches)

(1-5/8 inches)

(2 inches)

(2-1/2 inches)

3. Web: Punched

B. Steel Track: Manufacturer's standard U-shaped steel track, unpunched, of web depths indicated, with straight flanges, and complying with the following:

1. Design Uncoated-Steel Thickness: Matching steel studs.

2. Flange Width: Manufacturer's standard deep flange where indicated, standard flange elsewhere.

2.3 JOIST FRAMING:

A. Steel Joists: Manufacturer's standard C-shaped steel joists, unpunched, of web depths indicated, with lipped flanges, and complying with the following:

1. Design Uncoated-Steel Thickness: 0.91 mm (0.0358 inch).

1.20 mm (0.0474 inch). and 1.52 mm (0.0598 inch). And 1.90 mm 0.0747 inch).

2. Flange Width: // 41 mm (1 5/8 inches) minimum. 2 inches). And 63 mm (2 1/2 inches)

B. Steel Joist Track: Manufacturer's standard U-shaped steel joist track, unpunched, of web depths indicated, with straight flanges, and complying with the following:

1. Design Uncoated-Steel Thickness: Matching steel joists.

2. Flange Width: (1 5/8-inches) minimum. 51 mm (2 inches). 63 mm (2 1/2-inches).

2.4 FRAMING ACCESSORIES:

A. Fabricate steel framing accessories of the same material and finish used for framing members, with a minimum yield strength of 230 MPa (33 ksi).

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.

2. Bracing, bridging, and solid blocking.

3. Web stiffeners.

4. Gusset plates.

5. Deflection track and vertical slide clips.

6. Stud kickers and girts.

7. Joist hangers and end closures.

8. Reinforcement plates.

2.5 ANCHORS, CLIPS, AND FASTENERS:

A. Steel Shapes and Clips: ASTM A36, zinc coated by the hot-dip process according to ASTM A123.

B. Cast-in-Place Anchor Bolts and Studs: ASTM A307, Grade A, zinc coated by the hot-dip process according to ASTM A153.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times the design load, as determined by testing per ASTM E488 conducted by a qualified independent testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times the design load, as determined by testing per ASTM E1190 conducted by a qualified independent testing agency.

E. Mechanical Fasteners: Corrosion-resistant coated, self-drilling, self-threading steel drill screws. Low-profile head beneath sheathing, manufacturer's standard elsewhere.

2.6 REQUIREMENTS:

A. Welding in accordance with AWS D1.3

B. Furnish members and accessories by one manufacturer only.

PART 3 - EXECUTION

3.1 FABRICATION:

A. Framing components may be preassembled into panels. Panels shall be square with components attached.

B. Cut framing components squarely or as required for attachment. Cut framing members by sawing or shearing; do not torch cut.

C. Hold members in place until fastened.

D. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.

1. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

2. Locate mechanical fasteners and install according to cold-formed metal framing manufacturer's instructions with screw penetrating joined members by not less than 3 exposed screw threads.

E. Where required, provide specified insulation in double header members and double jamb studs which will not be accessible after erection.

3.2 ERECTION:

A. Handle and lift prefabricated panels in a manner as to not distort any member.

B. Securely anchor tracks to supports as shown.

C. At butt joints, securely anchor two pieces of track to same supporting member or butt-weld or splice together.

D. Plumb, align, and securely attach studs to flanges or webs of both upper and lower tracks.

E. All axially loaded members shall be aligned vertically to allow for full transfer of the loads down to the foundation. Vertical alignment shall be maintained at floor/wall intersections.

F. Install jack studs above and below openings and as required to furnish support. Securely attach jack studs to supporting members.

G. Install headers in all openings that are larger than the stud spacing in that wall.

H. Attach bridging for studs in a manner to prevent stud rotation. Space bridging rows as shown.

I. Studs in one piece for their entire length, splices will not be permitted.

J. Provide a load distribution member at top track where joist is not located directly over bearing stud.

K. Provide joist bridging and web stiffeners at reaction points where shown.

L. Provide end blocking where joist ends are not restrained from rotation.

M. Provide an additional joist under parallel partitions, unless otherwise shown, when partition length exceeds one-half joist span and when floor and roof openings interrupt one or more spanning members.

N. Provide temporary bracing and leave in place until framing is permanently stabilized.

O. Do not bridge building expansion joints with cold-formed metal framing. Independently frame both sides of joints.

P. Fasten reinforcement plate over web penetrations that exceed size of manufacturer's standard punched openings.

3.3 TOLERANCES:

A. Vertical alignment (plumbness) of studs shall be within 1/960th of the span.

B. Horizontal alignment (levelness) of walls shall be within 1/960th of their respective lengths.

C. Spacing of studs shall not be more than 3 mm (1/8 inch) +/- from the designed spacing providing that the cumulative error does not exceed the requirements of the finishing materials.

D. Prefabricated panels shall be not more than 3 mm (1/8 inch) +/- out of square within the length of that panel.

3.4 FIELD REPAIR:

Touch-up damaged galvanizing with galvanizing repair paint.

END OF SECTION 054000

SECTION 055025 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel framing and supports for ceiling-hung toilet compartments.
2. Steel framing and supports for overhead doors and grilles.
3. Steel framing and supports for countertops.
4. Steel tube reinforcement for low partitions.
5. Steel framing and supports for mechanical and electrical equipment.
6. Steel framing and supports for applications where framing and supports are not specified in other Sections.
7. Elevator machine beams, hoist beams.
8. Steel shapes for supporting elevator door sills.
9. Metal ladders.
10. Elevator pit sump covers.
11. Miscellaneous steel trim including loading-dock edge angles.
12. Metal bollards.
13. Downspout guards.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

C. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Section 042213 "Structural Reinforced Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
3. Section 051200 "Structural Steel Framing."

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts,

anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Paint products.
2. Grout.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Steel framing and supports for ceiling-hung toilet compartments.
2. Steel framing and supports for overhead doors and grilles.
3. Steel framing and supports for countertops.
4. Steel tube reinforcement for low partitions.
5. Steel framing and supports for mechanical and electrical equipment.
6. Steel framing and supports for applications where framing and supports are not specified in other Sections.
7. Elevator machine beams, hoist beams.
8. Steel shapes for supporting elevator door sills.
9. Metal ladders.
10. Elevator pit sump covers.
11. Miscellaneous steel trim including loading-dock edge angles.
12. Metal bollards.
13. Downspout guards.
14. Loose steel lintels.

C. Delegated-Design Submittal:

1. For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. For elevator machine beams, hoist beams including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders and elevator machine beams, hoist beams.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.

D. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.

E. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.

F. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

G. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.

H. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.

I. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.
2. Provide stainless-steel fasteners for fastening stainless steel.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3 (ASTM A 325M, Type 3); with hex nuts, ASTM A 563, Grade C3 (ASTM A 563M, Class 8S3); and, where indicated, flat washers.

D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593 (ASTM F 738M); with hex nuts, ASTM F 594 (ASTM F 836M); and, where indicated, flat washers; Alloy Group (1) A1.

E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

F. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

G. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group (1) A1 stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099000 “Painting."

B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

D. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Furnish inserts for units installed after concrete is placed.

C. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 METAL LADDERS

A. General:

1. Comply with ANSI A14.3, except for elevator pit ladders.
2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Ladders:

1. Space siderails 16 inches (406 mm) apart unless otherwise indicated.
2. Siderails: Continuous, 3/8-by-2-1/2-inch (9.5-by-64-mm) steel flat bars, with eased edges.
3. Rungs: 3/4-inch- (19-mm-) diameter steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets.
6. Prime exterior ladders, including brackets and fasteners, with primer specified in Section 099000 “Painting."

2.8 ELEVATOR PIT SUMP COVERS

A. Fabricate from 1/8-inch (3.2-mm) plate with four 1-inch- (25-mm-) diameter holes for water drainage and for lifting.

B. Provide steel angle supports as indicated.

2.9 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Prime exterior miscellaneous steel trim with primer specified in Section 099000 “Painting."

2.10 METAL BOLLARDS

A. Fabricate metal bollards from 1/4-inch (6.4-mm) wall-thickness rectangular steel tubing.

B. Prime bollards with primer specified in Section 099000 “Painting."

2.11 DOWNSPOUT GUARDS

A. Fabricate downspout guards from 3/8-inch- (9.5-mm-) thick by 12-inch- (300-mm-) wide steel plate, bent to fit flat against the wall or column at both ends and to fit around pipe with 2-inch (50-mm) clearance between pipe and pipe guard. Drill each end for two 3/4-inch (19-mm) anchor bolts.

B. Prime downspout guards with primer specified in Section 099000 “Painting."

2.12 ABRASIVE METAL NOSINGS

A. Cast-Metal Units: Cast aluminum, with an integral-abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.

B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

C. Apply bituminous paint to concealed surfaces of cast-metal units.

2.13 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8 inches (200 mm) unless otherwise indicated.

C. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.14 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.15 STEEL AND IRON FINISHES

A. Shop prime iron and steel items unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with primers specified in Section 099000 “Painting" are indicated.

B. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Items Indicated to Receive Primers Specified in Section 099000 “Painting": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

C. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.16 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 612.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for ceiling hung toilet partitions, and overhead doors, and overhead grilles securely to, and rigidly brace from, building structure.

C. Support steel girders on solid grouted masonry, concrete or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

3.3 INSTALLING METAL BOLLARDS

A. Anchor bollards in concrete in formed or core-drilled holes not less than 8 inches (200 mm) deep and 3/4 inch (19 mm) larger than OD of bollard. Fill annular space around bollard solidly with nonshrink grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch (3 mm) toward bollard.

B. Fill bollards solidly with concrete, mounding top surface to shed water.

1. Do not fill removable bollards with concrete.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099000 "Painting."

END OF SECTION 055025

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SECTION 055050 – METAL GATE FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel gate frames.

B. Related Requirements:

1. Drawings and details for installing anchor bolts, and other items built into unit masonry and concrete.
2. Section 099600 “High Performance Coatings” for finishes.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Gate hardware.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Steel framing and supports for steel edge channels for gate, and concealed diagonal support.
2. Steel tube and caps.
3. Steel bolt lock escutcheon for handle, lock, cane bolt and casters.

C. Delegated-Design Submittal: For gate, hinges and anchoring/support, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design gate system.

1. Design to ASCE 7-10 and Florida Building Code 2014, 5th Edition.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 GATES

A. General: Provide welded gate design indicated on Drawings.

1. Support Posts: 4 inch (102 mm) square minimum, unless noted otherwise on Drawings.
2. Gate Frames: 1 inch (25.4 mm) square minimum, unless noted otherwise on Drawings.
3. Gate Infill Members: 3/4 inch (19 mm) square minimum, unless noted otherwise on Drawings.

2.3 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.

D. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.

E. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing. Channel Framing: Formed metal channels complying with AISC.
1. Size of Channels: As indicated.
2. Material: Cold-rolled steel, ASTM A 1008/A 1008M, commercial steel, Type B; 0.0966-inch (2.5-mm) minimum thickness; unfinished hot-dip galvanized after fabrication.

2.4 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-

plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening stainless steel.

B. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.5 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099600 "High Performance Coatings".

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.6 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

1. Weld corners and seams continuously to comply with the following: Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

E. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

F. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

G. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

H. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

I. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm)

o.c., unless otherwise indicated.

2.7 GATE FRAMES

A. Fabricate gate frames from steel shapes, plates, and bars of size and to dimensions indicated, fully welded together, with steel channel as indicated. Plug-weld built-up members and continuously weld exposed joints. Secure removable stops to frame with countersunk machine screws, uniformly spaced at not more than 10 inches (250 mm) o.c. Reinforce frames and drill and tap as necessary to accept finish hardware.

1. Provide with integrally welded steel strap anchors for securing door frames into adjoining concrete or masonry.

B. Extend bottom of frames as indicated with steel angle clips welded to frames for anchoring frame to wall with expansion shields and bolts.

C. Prime steel frames.

2.8 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.9 STEEL AND IRON FINISHES

A. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning".

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

END OF SECTION 055050

SECTION 055100 - METAL STAIRS

1.GENERAL

1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

2. SUMMARY

A. Section Includes:

1. Preassembled steel stairs with concrete-filled treads.

B. Related Sections:

1. Division 03 Section "Cast-in-Place Concrete" for concrete fill for stair treads and platforms.
2. Division 05 Section "Metal Fabrications."
3. Division 05 Section "Pipe and Tube Railings" for pipe and tube railings.

3. PERFORMANCE REQUIREMENTS

A. Delegated Design: Design metal stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Uniform Load: 100 lbf/sq. ft.
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch, whichever is less.

C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
b. Infill load and other loads need not be assumed to act concurrently.

D. Seismic Performance: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor is 1.5.

4. SUBMITTALS

A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

B. Samples for Initial Selection: For products involving selection of color, texture, or design.

C. Samples for Verification: For the following products, in manufacturer's standard sizes:

1. Precast concrete treads.
2. Epoxy-resin-filled stair treads.
3. Stair treads with nonslip-aggregate surface finish.
4. Metal floor plate treads.
5. Grating treads.
6. Abrasive nosings.

D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

5. QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

2.PRODUCTS

1. METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.

D. Rolled-Steel Floor Plate: ASTM A 786/A 36M, rolled form plate complying with ASTM/A 36 36M or ASTM A 283/A 283M, Grade C or D.

2. FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts,[**railings,**] clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.
3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.

B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 2 welds: completely sanded joint, some undercutting and pinholes okay.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

3. STEEL-FRAMED STAIRS

A. Stair Framing:

1. Fabricate stringers of steel plates or channels.

2. Construct platforms of steel plate or channel headers and miscellaneous framing members as needed to comply with performance requirements indicated.
3. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
4. Where stairs are enclosed by gypsum board or shaft-wall assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts where they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.
5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

B. Metal-Pan Stairs: Form risers, sub-tread pans, and sub-platforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 0.067 inch.
1. At Contractor's option, provide stair assemblies with metal-pan sub-treads filled with reinforced concrete during fabrication.
2. Provide epoxy-resin-filled treads, reinforced with glass fibers, with slip-resistant, abrasive surface.

4. FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

C. Finish metal stairs after assembly.

3.EXECUTION

1. INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

F. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

G. Place and finish concrete fill for treads and platforms to comply with Division 03 Section "Cast-in-Place Concrete."

1. Install abrasive nosings with anchors fully embedded in concrete. Center nosings on tread width.

H. Install precast concrete treads with adhesive supplied by manufacturer.

2. ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 painting Sections and Division 09 Section "High-Performance Coatings."

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055100

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipe and tube railings.

B. Related Requirements:

1. Section 033000 "Cast-In-Place Concrete" or Structural Drawings for substrate.
2. Section 042213 “Structural Reinforced Unit Masonry” or Structural Drawings for substrate.
3. Section 099600 “High Performance Coatings” for finishes.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.4 ACTION SUBMITTALS

A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

B. Samples: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters, including finish.
2. Fittings and brackets.
3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.

    a. Show method of connecting and finishing members at intersections.

C. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

B. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code – Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code – Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C, material surfaces).

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

C. Source Limitations: Obtain each type of railing from single source from single manufacturer.

2.3 STEEL AND IRON

A. Tubing: ASTM A 500 (cold formed).

B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

C. Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.4 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

B. Extruded Bars and Tubing: ASTM B 221 (ASTM B 221M), Alloy 6063-T5/T52.

C. Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.

2.5 FASTENERS

A. General: Provide the following:

1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 for zinc coating.
2. Aluminum Railings: Type 304 stainless-steel fasteners.
3. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.

2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.6 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Shop Primers: Provide primers that comply with Section 099600 “High Performance Coatings”.

C. Intermediate Coats and Topcoats: Provide products that comply with Section 099600 “High Performance Coatings”.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.7 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Form Changes in Direction as Follows:

1. by inserting prefabricated flush-elbow fittings.

I. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

J. Close exposed ends of railing members with prefabricated end fittings.

K. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

L. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

M. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

N. For railing posts set in concrete, provide steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.

2.8 STEEL AND IRON FINISHES

A. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC- SP 6/NACE No. 3, "Commercial Blast Cleaning.

B. Shop prime uncoated railings with primer specified in Section 099600 “High Performance Coatings”.

C. High-Performance Coating: Apply manufacturer recommended intermediate and fluoropolymer topcoats to prime-coated surfaces as specified in Section 099600 “High Performance Coatings”. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.9 ALUMINUM FINISHES

A. Preparation for finish coating in accordance with manufacturers recommendations.

B. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).

C. Evacuate entrapped water in hollow sections of railing members that are exposed to exterior or to moisture from condensation or other sources, in order to prevent water from entering the concrete slab. If acceptable to the Architect, provide another means to evacuate the entrapped water, i.e., a weephole and epoxy fill system (“drill-and-fill”).

D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

E. Adjust railings before anchoring to ensure matching alignment at abutting joints.

F. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.4 ANCHORING POSTS

A. Anchor posts in concrete by forming or core drilling holes not less than 5 inches (127 mm) deep and 3/4 inch (19 mm) greater than outside diameter of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with non-metallic, non-shrink grout, mixed and placed to comply with anchoring material manufacturer's directions.

B. Leave anchorage joint exposed with 1/8-inch (3-mm) buildup, sloped away from post.

3.5 ATTACHING RAILINGS

A. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

B. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.

3.6 ADJUSTING AND CLEANING

A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099600 “High Performance Coatings”.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 055213

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SECTION 061000 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Rooftop equipment bases and support curbs.
2. Wood blocking, cants, and nailers.
3. Wood furring.
4. Wood sleepers.
5. Plywood backing panels.

B. Related Requirements:

1. Section 313116 "Termite Control" for site application of borate treatment to wood framing.

1.3 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater size but less than 5 inches nominal (114 mm actual) size in least dimension.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant- treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal (38-mm actual) thickness or less, 19 percent for more than 2-inch nominal (38-mm actual) thickness unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Treatment shall not promote corrosion of metal fasteners.

2. Exterior Type: Treated materials shall comply with requirements specified above for fire- retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

E. Application: Treat items indicated on Drawings, and the following:

1. Framing for raised platforms.
2. Concealed blocking.
3. Roof framing and blocking.
4. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
5. Plywood backing panels.

2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.

B. Dimension Lumber Items: Standard, Stud, or No. 3 grade lumber of the following species:

1. Mixed southern pine or southern pine; SPIB.

C. Concealed Boards: 19 percent maximum moisture content of the following species and grades:

1. Mixed southern pine or southern pine, No. 2 grade; SPIB.

D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.

2.7 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Furring to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

E. Do not splice structural members between supports unless otherwise indicated.

F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.

G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches (2438 mm) o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches (2438 mm) o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal (38-mm actual) thickness.
3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. (9.3 sq. m) and to solidly fill space below partitions.
4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet (6 m) o.c.

H. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

I. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

J. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

K. Securely attach carpentry work to substrate by anchoring and fastening as indicated.

3.2 WOOD BLOCKING AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.3 PROTECTION

A. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

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SECTION 061600 - SHEATHING

1.GENERAL

1. RELATED DOCUMENTS

   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

2. SUMMARY

   A. Section Includes:

      1. Wall sheathing.
      2. Building Wrap.

3. ACTION SUBMITTALS

   A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

4. INFORMATIONAL SUBMITTALS

   A. Evaluation Reports: For following products:
      1. Building Wrap.

5. DELIVERY, STORAGE, AND HANDLING

   A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

2.PRODUCTS

A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.

   1. Products: Subject to compliance with requirements, **available products that may be incorporated into the Work include, but are not limited to, the following**:

      a. CertainTeed Corporation; GlasRoc.
      b. G-P Gypsum Corporation; Dens-Glass Gold.
      c. Temple-Inland Inc.; GreenGlass
      d. United States Gypsum Co.; Securock.

   2. Type and Thickness: **Type X,** 5/8 inch thick.

2. FASTENERS

A. General: Provide fasteners of size and type indicated.

1. For wall sheathing panels, provide fasteners with corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B117.

3. SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing: Elastomeric silicone joint sealant recommended by sheathing manufacturer.

B. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended by sheathing manufacturer for sealing joints and penetrations in sheathing.

3.EXECUTION

1. INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."

2. GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.
1. Fasten gypsum sheathing to cold-formed metal framing with screws.
2. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
3. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
4. Do not bridge building expansion joints.

3. WEATHER-RESISTANT SHEATING-PAPER INSTALLATION

A. General: Cover sheathing with weather-resistant sheathing paper as follows:
1. Cut back barrier ½ inch on each side of the break in supporting members at expansion or control-joint locations.
2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap, unless otherwise indicated.

B. Fluid-applied membrane air and water resistive barrier for exterior assmeblies.
1. Seal seams, edges, fasteners, and penetrations with tape.
2. Extend into jambs of openings and seal corners with tape.

4. SHEATHING JOINT-AND-PENETRATION TREATMENT

A. Seal sheathing joints according to sheathing manufacturer's written instructions.:
   1. Apply glass fiber sheathing tape to glass-mat gypsum sheathing board joints, and apply and trowel silicone emulsion sealant to embed tape in sealant. Apply sealant to exposed fasteners. Seal other penetrations and openings.
   2. Apply sheathing tape to joints between foam-plastic sheathing panels and at items penetrating sheathing. Apply at upstanding flashing to overlap both flashing and sheathing.

END OF SECTION 061600

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

1.GENERAL

1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

2. SUMMARY

A. This Section includes the following:
   1. Plastic-laminate cabinets.
   2. Plastic-laminate countertops.
   3. Solid-surfacing-material countertops.

B. Related Sections include the following:

   1. Division 06 Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
   2. Division 06 Section "Finish Carpentry" for interior carpentry exposed to view that is not specified in this Section.

3. SUBMITTALS

A. Samples for Verification:
   1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish, with 1 sample applied to core material and specified edge material applied to 1 edge.

   2. Exposed cabinet hardware and accessories, one unit for each type and finish.

4. QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program. Shop is a licensee of WI's Certified Compliance Program.

B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.

5. DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

6. PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

C. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

2.PRODUCTS

1. MATERIALS

A. Wood Products: Comply with the following:
1. Hardboard: AHA A135.4.
2. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
3. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
4. Softwood Plywood: DOC PS 1, Medium Density Overlay.

B. Thermoset Decorative Panels (Melamine): Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

C. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
1. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:

a. Abet Laminati, Inc.
b. Arborite; Division of ITW Canada, Inc.
c. Formica Corporation.
d. Lamin-Art, Inc.
e. Nevamar Company, LLC; Decorative Products Div.
f. Panolam Industries International Incorporated.
g. Westinghouse Electric Corp.; Specialty Products Div.
h. Wilsonart International; Div. of Premark International, Inc.

2. FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this Article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified.

1. Do not use treated materials that do not comply with requirements of referenced woodworking standard or that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.

B. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.

C. Fire-Retardant Fiberboard: Medium-density fiberboard panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84.

3. CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)."

B. Butt Hinges: 2-1/2-inch (70-mm), 5-knuckle steel hinges made from 0.095-inch- (2.4-mm-) thick metal, and as follows:

1. Semi-concealed Hinges for Flush Doors: BHMA A156.9, B01361.
2. Semi-concealed Hinges for Overlay Doors: BHMA A156.9, B01521.

C. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening[, self-closing.

D. Back-Mounted Pulls: BHMA A156.9, B02011.

E. Wire Pulls: Back mounted, solid metal, 5 inches (127 mm) long, 2-1/2 inches (63.5 mm) deep, and 5/16 inch (8 mm) in diameter.

F. Catches: Magnetic catches, BHMA A156.9

G. Adjustable Shelf Standards and Supports: shelf brackets, B04112.

H. Shelf Rests: BHMA A156.9, B04013; metal, two-pin type with shelf hold-down clip.

I. Drawer Slides: BHMA A156.9, B05091.

1. Standard Duty (Grade 1, Grade 2, and Grade 3): Side mounted[and extending under bottom edge of drawer]; [full-extension] [partial-extension] type; [zinc-plated steel] [epoxy-coated steel] with polymer rollers.
2. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; [full-extension] [full-overtravel-extension] type; zinc-plated steel ball-bearing slides.
3. Box Drawer Slides: [Grade 1] [Grade 1HD-100]; for drawers not more than 6 inches (150 mm) high and 24 inches (600 mm) wide.
4. File Drawer Slides: [Grade 1HD-100] [Grade 1HD-200]; for drawers more than 6 inches (150 mm) high or 24 inches (600 mm) wide.
5. Pencil Drawer Slides: [Grade 2] [Grade 1]; for drawers not more than 3 inches (75 mm) high and 24 inches (600 mm) wide.
6. Keyboard Slides: [Grade 1] [Grade 1HD-100]; for computer keyboard shelves.
7. Trash Bin Slides: [Grade 1HD-100] [Grade 1HD-200]; for trash bins not more than 20 inches (500 mm) high and 16 inches (400 mm) wide.

J. Aluminum Slides for Sliding Glass Doors: BHMA A156.9, B07063.

K. Door Locks: BHMA A156.11, E07121.

L. Drawer Locks: BHMA A156.11, E07041.

M. Grommets for Cable Passage through Countertops: 2-inch (51-mm) OD, black molded-plastic grommets and matching plastic caps with slot for wire passage.

1. Product: Subject to compliance with requirements, provide "[**OG**] [**SG**] series" by Doug Mockett & Company, Inc.

N. Paper Slots: [12 inches (305 mm)] [17 inches (432 mm)] long by 1-3/4 inches (45 mm) wide by 1 inch (25 mm) deep; black, molded-plastic, paper-slot liner with 1/4-inch (6.4-mm) lip.

1. Product: Subject to compliance with requirements, provide "Model CP-2 or CP-1 by Doug Mockett & Company, Inc.

O. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Dark, Oxidized, Satin Bronze, Oil Rubbed: BHMA 613 for bronze base; BHMA 640 for steel base; match Architect's sample.
2. Bright Brass, Clear Coated: BHMA 605 for brass base; BHMA 632 for steel base.
3. Satin Brass, Blackened, Bright Relieved, Clear Coated: BHMA 610 for brass base; BHMA 636 for steel base.
4. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
5. Bright Chromium Plated: BHMA 625 for brass or bronze base; BHMA 651 for steel base.
6. Satin Stainless Steel: BHMA 630.

P. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

4. MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

5. FABRICATION, GENERAL

6. PLASTIC-LAMINATE CABINETS

A. Grade: Premium.

B. AWI Type of Cabinet Construction: As indicated.

C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:

1. Horizontal Surfaces Other Than Tops: Grade HGS.
2. Post-formed Surfaces: Grade HGP.
3. Vertical Surfaces: Grade HGS.
4. Edges: Grade HGS

D. Materials for Semi-exposed Surfaces:

1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.

a. Edges, Grade HGS.

2. Drawer Sides and Backs: Thermoset decorative panels.
3. Drawer Bottoms: Thermoset decorative panels.

E. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.

F. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. Match Architect's sample.

7. PLASTIC-LAMINATE COUNTERTOPS

A. Grade: Premium.

B. High-Pressure Decorative Laminate Grade: HGS or HGP.

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. Match Architect's sample.

D. Edge Treatment: Same as laminate cladding on horizontal surfaces.

E. Core Material at Sinks: Particleboard made with exterior glue.

8. SOLID-SURFACING-MATERIAL COUNTERTOPS

A. Grade: Premium.

B. Solid-Surfacing-Material Thickness: 1/2 inch.

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:

1. Match Architect's sample.

D. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

1. Fabricate tops with shop-applied edges of materials and configuration indicated.
2. Fabricate tops with shop-applied backsplashes.
3. Delete two paragraphs below if no sinks.

E. Install integral sink bowls in countertops in shop.

F. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

9. SHOP FINISHING

A. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

1. Back-priming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces.

3.EXECUTION

1. PREPARATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and back-priming.

2. INSTALLATION

A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.

B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.

C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails[or finishing screws] for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

F. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Scarf running joints and stagger in adjacent and related members.

1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.

G. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Maintain veneer sequence matching of cabinets with transparent finish.
3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

H. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

3. ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023

SECTION 071416 - COLD FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single-component polyurethane waterproofing.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.

B. Warranty: Sample of special warranty.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver liquid materials to Project site in original containers with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, shelf life, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer.

C. Remove and replace liquid materials that cannot be applied within their stated shelf life.

D. Protect stored materials from direct sunlight.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F (3 deg C) above dew point.

1. Do not apply waterproofing in snow, rain, fog or mist, or when such weather conditions are imminent during application and curing period.

B. Maintain adequate ventilation during application and curing of waterproofing materials.

PART 2 - PRODUCTS

2.1 SINGLE-COMPONENT POLYURETHANE WATERPROOFING

A. Single-Component, Polyurethane Waterproofing: Comply with manufacturer's written physical requirements.

1. Products: Subject to compliance with requirements, provide the following:
   a. BASF HLM 5000.

2.2 PROTECTION COURSE

A. Protection Course: Unfaced, extruded-polystyrene board insulation; ASTM C 578, Type X, 1/2 inch (13 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.

1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean and prepare substrate according to manufacturer's written recommendations. Provide clean, dust-free, and dry substrate for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage or overspray affecting other construction.

C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

D. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, acid residues, and other penetrating contaminants or film-forming coatings from concrete.

1. Abrasive blast clean concrete surfaces uniformly to expose top surface of fine aggregate according to ASTM D 4259 with a self-contained, recirculating, blast-cleaning apparatus. Remove material to provide a sound surface free of laitance, glaze, efflorescence, curing compounds, concrete hardeners, or form-release agents. Remove remaining loose material and clean surfaces according to ASTM D 4258.

E. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.

3.3 PREPARATION AT TERMINATIONS AND PENETRATIONS

A. Prepare vertical and horizontal surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, and sleeves according to ASTM C 898 and manufacturer's written instructions.

B. Prime substrate unless otherwise instructed by waterproofing manufacturer.

C. Apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.

1. Provide sealant cants around penetrations and at inside corners of deck-to-wall butt joints when recommended by waterproofing manufacturer.

3.4 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 898 and waterproofing manufacturer's written instructions. Remove dust and dirt from joints and cracks, complying with ASTM D 4258, before coating surfaces.

1. Comply with ASTM C 1193 for joint-sealant installation.
2. Apply bond breaker between sealant and preparation strip.
3. Prime substrate and apply a single thickness of preparation strip extending a minimum of 3 inches (75 mm) along each side of joint. Apply waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat.

B. Install sheet flashing and bond to deck and wall substrates where indicated or required according to waterproofing manufacturer's written instructions.

1. Extend sheet flashings onto perpendicular surfaces and other work penetrating substrate according to ASTM C 898.

3.5 WATERPROOFING APPLICATION

A. Apply waterproofing according to ASTM C 898 and manufacturer's written instructions.

B. Start installing waterproofing in presence of manufacturer's technical representative.

C. Apply primer over prepared substrate.

D. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.

1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases, with an average dry film thickness of 60 mils (1.5 mm) and a minimum dry film thickness of 50 mils (1.3 mm) at any point.
2. Apply waterproofing to prepared wall terminations and vertical surfaces.
3. Verify wet film thickness of waterproofing every 100 sq. ft. (9.3 sq. m).

E. Install protection course with butted joints over nominally cured membrane before starting subsequent construction operations.

3.6 CURING, PROTECTION, AND CLEANING

A. Cure waterproofing according to manufacturer's written recommendations, taking care to prevent contamination and damage during application stages and curing.

1. Do not permit foot or vehicular traffic on unprotected membrane.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Protect installed board insulation from damage due to ultraviolet light, harmful weather exposures, physical abuse, and other causes. Immediately after installation, provide temporary coverings where insulation will be subject to abuse and cannot be concealed and protected by permanent construction.

D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 071416

SECTION 071800 - TRAFFIC COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes traffic coatings for the following applications:

1. Interior and exterior, pedestrian traffic.
2. Vehicular traffic

1.2 SUBMITTALS

A. Product Data: For each product indicated.

B. Shop Drawings: Show extent of each traffic coating. Include details for treating substrate joints and cracks, flashings, deck penetrations, and other termination conditions.

C. Samples for Initial Selection: For each type of finish indicated.

D. Samples for Verification: For each type of traffic coating required, prepared on rigid backing and of same thickness and material indicated for the Work.

E. Qualification data.

F. Material test reports.

G. Material certificates.

H. Maintenance data.

I. Warranty.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of traffic coatings required for this Project.

B. Source Limitations:

1. Obtain traffic coatings from a single manufacturer.
2. Obtain primary traffic coating materials, including primers, from traffic coating manufacturer. Obtain secondary materials including aggregates, sheet flashings, joint sealants, and substrate repair materials of type and from source recommended in writing by primary material manufacturer.

C. Fire-Test-Response Characteristics: Provide traffic coating materials with the fire-test-response characteristics as determined by testing identical products per test method below for deck type and slopes indicated by an independent testing and inspecting agency that is acceptable to authorities having jurisdiction.

1. Class A roof covering per ASTM C 957-91 or UL 790.

D. Mockups: Apply mockups to set quality standards for materials and execution.

1. Architect will select one representative surface for each traffic coating and each substrate to receive traffic coatings. Apply each coating to at least 100 sq. ft. of each substrate to demonstrate surface preparation, joint and crack treatment, thickness, texture, color, and standard of workmanship.
2. Remove and reapply mockups until they are approved by Architect.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which traffic coating manufacturer agrees to repair or replace traffic coatings that deteriorates during the specified warranty period. Warranty does not include deterioration or failure of traffic coating due to unusual weather phenomena, failure of prepared and treated substrate, formation of new substrate cracks exceeding 1/16 inch (1.6 mm) in width, fire, vandalism, or abuse by snowplow, maintenance equipment, and truck traffic.

1. Deterioration of traffic coatings includes the following:

   a. Adhesive or cohesive failures.
   b. Abrasion or tearing failures.
   c. Surface crazing or spalling.
   d. Intrusion of water, oils, gasoline, grease, salt, deicer chemicals, or acids into deck substrate.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Traffic Coatings: Complying with ASTM C 957.

B. VOC Content: Provide traffic coatings for use inside the weatherproofing system, with VOC content of 150 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Material Compatibility: Provide primers; base, intermediate, and topcoats; and miscellaneous materials that are compatible with one another and with substrate under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

2.2 TRAFFIC COATING (TC-1)

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

B. Products: Subject to compliance with requirements, provide one of the following:
1. Key Resin Company; Resinous flooring
2. Kinsman Corporation/Nox-Crete Products Group; High Traffic coating
3. Pacific Polymers International, Inc.;
4. Pecora Corporation; Stonhard; Deck traffic coating systems
5. POLY-CARB, Inc.; Traffic coatings
6. Tamms Industries, Inc.; Tammsdeck system
7. Tremco Incorporated, Sealant/Waterproofing Division; Traffic Coating
8. Urethane Polymers International, Inc.; URADEK system
9. Mapei Mapefloor

C. Primer: Manufacturer's standard factory-formulated primer recommended for substrate and conditions indicated.

1. Material: Epoxy

D. Preparatory and Base Coats: Single- or multi-component, aromatic liquid urethane elastomeric.

E. Intermediate Coat: Single-or multi-component, aliphatic liquid urethane elastomer; Liquid epoxy.

F. Topcoat: Single- or multi-component, aromatic liquid urethane elastomer with UV inhibitors, Liquid epoxy.

1. Color: As selected by Architect from manufacturer's full range

2.3 MISCELLANEOUS MATERIALS

A. Joint Sealants: As specified in Division 07 Section "Joint Sealants."

B. Adhesive: Contact adhesive recommended in writing by traffic coating manufacturer.

C. Reinforcing Strip: Fiberglass mesh recommended in writing by traffic coating manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements and for other conditions affecting performance of traffic coatings.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance.
2. Verify compatibility with and suitability of substrates.
3. Begin coating application only after minimum concrete curing and drying period recommended by traffic coating manufacturer has passed, after unsatisfactory conditions have been corrected, and after surfaces are dry.
4. Verify that substrates are visibly dry and free of moisture.

a. Test for moisture vapor transmission by plastic sheet method according to ASTM D 4263.

5. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Clean and prepare substrates according to ASTM C 1127 and manufacturer's written recommendations to produce clean, dust-free, dry substrate for traffic coating application.

B. Mask adjoining surfaces not receiving traffic coatings, deck drains, and other deck substrate penetrations to prevent spillage, leaking, and migration of coatings.

C. Concrete Substrates: Mechanically abrade concrete surfaces to a uniform profile according to ASTM D 4259. Do not acid etch.

1. Remove grease, oil, paints, and other penetrating contaminants from concrete.
2. Remove concrete fins, ridges, and other projections.

3. Remove laitance, glaze, efflorescence, curing compounds, concrete hardeners, form-release agents, and other incompatible materials that might affect coating adhesion.
4. Remove remaining loose material to provide a sound surface, and clean surfaces according to ASTM D 4258.

3.3 TERMINATIONS AND PENETRATIONS

A. Prepare vertical and horizontal surfaces at terminations and penetrations through traffic coatings and at expansion joints, drains, and sleeves according to ASTM C 1127 and manufacturer's written recommendations.

B. Provide sealant cants at penetrations and at reinforced and nonreinforced, deck-to-wall butt joints.

C. Terminate edges of deck-to-deck expansion joints with preparatory base-coat strip.

D. Install sheet flashings at deck-to-wall expansion and dynamic joints, and bond to deck and wall substrates according to manufacturer's written recommendations.

3.4 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrates according to ASTM C 1127 and manufacturer's written recommendations. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.

1. Comply with recommendations in ASTM C 1193 for joint-sealant installation.

3.5 TRAFFIC COATING APPLICATION

A. Apply traffic coating material according to ASTM C 1127 and manufacturer's written recommendations.

1. Verify that wet film thickness of each component coat complies with requirements every 100 sq. ft.

B. Apply traffic coatings to prepared wall terminations and vertical surfaces to height indicated, and omit aggregate on vertical surfaces.

C. Cure traffic coatings according to manufacturer's written recommendations. Prevent contamination and damage during application and curing stages.

3.6 PROTECTING AND CLEANING

A. Protect traffic coatings from damage and wear during remainder of construction period.

B. Clean spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 071800

SECTION 072726 – FLUID APPLIED MEMBRANE AIR BARRIER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes water-resistant, self-adhering sheet air and vapor barriers used in exterior wall assemblies.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section “LEED Requirements” for additional information concerning LEED and the environmental goals for the project.
2. Division 1 Section "Construction Waste Management" for handling of product rejects, scrap, waste materials, and packing materials.
3. Division 3 Section “Cast-In-Place Concrete.”
4. Division 6 Section “Sheathing” for gypsum sheathing substrate for air barrier installation.
5. Division 7 Section “Metal Wall Panels” for gypsum sheathing, air barrier materials, and building insulation installed as part of the building enclosure assembly.
6. Division 7 Section “Sheet Metal Flashing and Trim.”
7. Division 7 Section “Joint Sealants.”

1.3 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

C. Air-Barrier Assembly: The collection of air-barrier materials and accessory materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous air barrier and as a liquidwater drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Commonwealth of Massachusetts Building Code Requirements: The intent of this specification is to require compliance with 780 CMR 13, Section 1304.3 Air Leakage.

1304.3.1 AIR BARRIERS

The building envelope shall be designed and constructed with a continuous air barrier to control air leakage into, or out of the conditioned space. An air barrier shall also be provided for interior partitions between conditioned space and space designed to maintain temperature or humidity levels which differ from those in the conditioned space by more than 50% of the difference between the conditioned space and design ambient conditions. The air barrier shall have the following characteristics:

1. It must be continuous, with all joints made airtight.
2. It shall have an air permeability not to exceed requirements specified in this Section.
3. It shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on the envelope without damage or displacement, and shall transfer the load to the structure. It shall not displace adjacent materials under full load.
4. It shall be durable or maintainable.
5. The air barrier shall be joined in an airtight and flexible manner to the air barrier material of adjacent systems, allowing for the relative movement of systems due to thermal and moisture variations and creep. Connection shall be made between:

    a. Foundation and walls.
    b. Walls and windows or doors.
    c. Different wall systems.
    d. Wall and roof.
    e. Wall and roof over unconditioned space.
    f. Walls, floor and roof across construction, control and expansion joints.
    g. Walls, floors and roof to utility, pipe and duct penetrations.

6. All penetrations of the air barrier and paths of air infiltration/exfiltration shall be made airtight.

1.5 REFERENCES

A. The following standards and publications are applicable to the extent referenced in the text. The most recent version of these standards is implied unless otherwise stated.

B. American Society for Testing and Materials (ASTM)

1. C920 Specifications for Elastomeric Joint Sealants
2. C1193 Guide for Use of Joint Sealants
3. D412 Standard Test Methods for Rubber Properties in Tension
4. D570 Test Method for Water Absorption of Plastics
5. D1004 Test Method for Initial Tear Resistance of Plastic Film and Sheeting
6. D1876 Test Method for Peel Resistance of Adhesives
7. D1938 Test Method for Tear Propagation Resistance of Plastic Film and Sheeting
8. D1970 Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
9. D4258 Practice for Surface Cleaning Concrete for Coating
10. D4263 Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
11. E96 Test Methods for Water Vapor Transmission of Materials
12. E154 Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
13. E162 Test Method for Surface Flammability of Materials Using a Radiant Heat Source
14. E1186 Practice for Air Leakage Site Detection in Building Envelopes and Air Retarder Systems
15. E2178-01 Standard Test Method for Air Permeance of Building Materials

16. E2357 Standard Test Method for Determining Air Leakage of Air Barrier Asemblies

1.6 SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products. B. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
2. Include details of interfaces with other materials that form part of air barrier.

C. Samples: Submit representative samples of the following for approval:

1. Sheet Membrane.
2. Transition Membrane.
3. Through-Wall Flashing. D. LEED Submittals:

1. Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content.

E. Quality Assurance Submittals:

1. Qualification Data: For Installer.
2. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with air barrier.
3. Product Test Reports: Submit documentation from an approved independent testing laboratory certifying the air leakage and vapor permeance rates of the air barrier membranes, including primary membrane and transition sheets, exceed the requirements of the Massachusetts Energy Code and in accordance with ASTM E 2178.

F. Warranty: Submit a sample warranty identifying the terms and conditions stated in Article 1.10.

1.7 QUALITY ASSURANCE

A. Manufacturer: Air barrier systems shall be manufactured and marketed by a firm with a minimum of 20 years experience in the production and sales of waterproofing and air barriers. Manufacturers proposed for use, but not named in these specifications shall submit evidence of ability to meet all requirements specified, and include a list of projects of similar design and complexity completed within the past five years.

B. Source Limitations: Obtain primary air-barrier material and through wall flashing through one source from a single manufacturer. Should project require a vapor permeable and a vapor impermeable air barrier on same project, obtain vapor-permeable and vapor impermeable air barrier and through wall flashing from one source from a single manufacturer.

C. Applicator Qualifications: A firm experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

D. Mockups: Before beginning installation of air barrier, provide air barrier work for exterior wall assembly mockups, incorporating backup wall construction, external cladding, window, door frame and sill, insulation, and flashing to demonstrate surface preparation, crack and joint treatment, and sealing of gaps, terminations, and penetrations of air barrier membrane.

1. Coordinate construction of mockup to permit inspection by testing agency of air barrier before external insulation and cladding is installed.
2. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.

E. Mock-Up Tests for Air and Water Infiltration: Test mock-up for air and water infiltration in accordance with ASTM E 1186 (air leakage location), ASTM E 783 (air leakage quantification), and ASTM E 1105 (water penetration). Use smoke tracer to locate sources of air leakage. If deficiencies are found, reconstruct mock-up and retest until satisfactory results are obtained. Deficiencies include air leakage beyond values specified, uncontrolled water leakage, unsatisfactory workmanship.

1. Perform the air leakage tests and water penetration test of mock-up prior to installation of cladding and trim but after installation of all fasteners for cladding and trim and after installation of other penetrating elements.

E. Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Preinstallation conference shall include the Contractor, installer, Architect, and system manufacturer's field representative. Agenda for meeting shall include but not be limited to the following:

1. Review of submittals.
2. Review of surface preparation, minimum curing period and installation procedures.
3. Review of special details and flashings.
4. Sequence of construction, responsibilities and schedule for subsequent operations.
5. Review of mock-up requirements.
6. Review of inspection, testing, protection and repair procedures.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and products in labeled packages. Store and handle in strict compliance with manufacturer’s instructions, recommendations and material safety data sheets. Protect from damage from sunlight, weather, excessive temperatures and construction operations. Remove damaged material from the site and dispose of in accordance with applicable regulations.

B. Do not double-stack pallets of fluid applied membrane components on the job site. Provide cover on top and all sides, allowing for adequate ventilation.

C. Protect fluid-applied membrane components from freezing and extreme heat.

D. Sequence deliveries to avoid delays, but minimize on-site storage.

1.9 PROJECT CONDITIONS

A. Temperature: Install air and vapor barrier within range of ambient and substrate temperatures recommended by air and vapor barrier manufacturer. Do not apply air and vapor barrier to a damp or wet substrate.

B. Field Conditions: Do not install air and vapor barrier in snow, rain, fog, or mist. Do not install air and vapor barrier when the temperature of substrate surfaces and surrounding air temperatures are below those recommended by the manufacturer.

1.10 WARRANTY

A. Material Warranty: Manufacturer's standard form in which manufacturer agrees to replace sheet membrane air barrier materials, that fail within specified warranty period when installed and used in strict conformance with written manufacturer's instructions.

1. Failures include, but are not limited to, the following:

a. Failure to maintain specified air permeance rating when tested per ASTM E2178, within specified warranty period.
b. Failure to maintain specified vapor permeance rating when tested in accordance with ATM E96.

2. Warranty Period: Five years from date of Substantial Completion.

B. Installation Warranty: Provide installer's Two (2) year warranty from date of Substantial Completion, including all components of the air and vapor barrier assembly, against failures including loss of air tight seal, loss of watertight seal, loss of adhesion, loss of cohesion, failure to cure properly.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

B. VOC Content: 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and complying with VOC content limits of authorities having jurisdiction.

C. Low-Emitting Materials: Air barriers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 SELF-ADHERING SHEET AIR AND VAPOR BARRIER (Option 1)

A. Sheet Air and Vapor Barrier: Self-adhering membrane composed of flexible facing material coated completely and uniformly on one side with adhesive material, formed into uniform, flexible sheets, interleaved with disposable release liner that is removed prior to application. Use regular or low-temperature formulation depending on site conditions, within temperature ranges specified by manufacturer. Provide related accessories including primer, seam tape, mastic, fluid and sealant recommended by manufacturer.

1. Basis-of-Design Product: Subject to compliance with requirements, provide "Blueskin® SA," manufactured by Henry Company, or comparable product by the following manufacturers:

a. Grace, W. R. & Co., - Conn.
b. Meadows, W. R.
c. Tremco Incorporated, an RPM Company.
d. Carlisle Coatings and Waterproofing, Inc.

2. Physical and Performance Properties:

a. Air leakage: <0.0001 CFM/ft² @1.6 lbs/ft^2 to ASTM E 2178 and ASTM E 283 and have no increased air leakage when subjected to a sustained wind load of 10.5 lbs/ft^2 for 1 hour and gust wind load pressure of 62.8 lbs/ft^2 for 10 seconds when tested at 1.6 lbs/ft^2 to ASTM E331.

b. Membrane Thickness: 0.0394" (40 mils).
c. Vapor Permeance: 0.05 perms to ASTM E96.
d. Tested to ASTM E2357 for air leakage of air barrier assemblies.
e. Low temperature flexibility: -22 degrees F to CGSB 37-GP-56M.
f. Elongation: 200% to ASTM D412-modifed.
g. Meets CAN/CGSB-51-33 Type I Water Vapor Permeance requirements.
h. Surface Burning Characteristics: Class A, when tested in accordance with ASTM E84: Flame Spread Rating of 0 and Smoke Development Classification of 105.

B. Window Sill Pan Flashing: Self-adhering membrane for window sill pan flashings shall be Blueskin SA or LT manufactured by Henry; an SBS modified bitumen, self-adhering sheet membrane which is integrally laminated to a blue polyethylene film.

C. Transition Flashing: Self-adhering membrane for all window jambs, headers, door openings, inside and outside corners, and other transitions shall be pre-cut BlueskinVP™ manufactured by Henry; a self-adhering reinforced modified polyolefin tri-laminate (White) sheet air barrier membrane for wall construction, specifically designed to be water resistant and vapor permeable.

D. Through Wall Flashing: Through-wall flashing membrane (Self-Adhering) shall be Blueskin TWF manufactured by Henry; an SBS modified bitumen, self-adhering (Yellow) sheet membrane complete with a cross-laminated polyethylene film.

E. Insulation Adhesive: "Air-Bloc 21 Insulation Adhesive" manufactured by Henry; a synthetic, trowel applied, rubber based adhesive, having the following physical properties:

1. Compatibility: With air barrier membrane, substrate and insulation.
2. Air leakage: 0.0026 CFM/ft2 @ 2.1 lbs/ft2 to ASTM E283.
3. Water vapor permeance: 0.03 perms to ASTM E96.
4. Long term flexibility: CGSB 71-GP-24M.

2.3 FLUID APPLIED AIR AND VAPOR BARRIER (Option 2)

A. Fluid Applied Air and Vapor Barrier: Fluid applied membrane composed of a one component elastomeric membrane, trowel or spray applied. Use regular or low-temperature formulation depending on site conditions, within temperature ranges specified by manufacturer. Provide related accessories including primer, seam tape, mastic, fluid and sealant recommended by manufacturer.

1. Basis-of-Design Product: Subject to compliance with requirements, provide "Air-Bloc 32MR", manufactured by Henry Company, or comparable product by the following manufacturers:

a. Grace, W. R. & Co.
b. BASF
c. Meadows, W. R.
d. Tremco Incorporated, an RPM Company.
e. Carlisle Coatings and Waterproofing, Inc.

2. Physical and Performance Properties:

a. Meets the air leakage requirements of the Massachusetts Commercial Energy Code (780 CMR, Ch. 13) Energy Conservation Requirements for the Building Envelope

b. Air permeability: <0.00012 CFM/ft² @1.6 lbs/ft^2 to ASTM E 2178 and ASTM E 283 and have no increased air leakage when subjected to a sustained wind load of 10.5 lbs/ft^2 for 1 hour

and gust wind load pressure of 62.8 lbs/ft^2 for 10 seconds when tested at 1.6 lbs/ft^2 to ASTM E331.

c. Rating 0 –No fungal growth as tested to ASRM D 5339.

d. Maximum Water Vapor Permeance: 0.1 perms to ASTM E96.

e. VOC Content: No appreciable VOC (less than 100g/L)

f. Tested to ASTM E2357 for air leakage of air barrier assemblies.

g. Elastic Recovery: 90% to CAN/CGSB 37.58M86.

h. Meets CAN/CGSB-51-33 Type I Water Vapor Permeance requirements.

B. Window Sill Pan Flashing: Self-adhering membrane for window sill pan flashings shall be Blueskin SA or LT manufactured by Henry; an SBS modified bitumen, self-adhering sheet membrane which is integrally laminated to a blue polyethylene film.

C. Transition Flashing: Self-adhering membrane for all window jambs, headers, door openings, inside and outside corners, and other transitions shall be pre-cut BlueskinVP™ manufactured by Henry; a self-adhering reinforced modified polyolefin tri-laminate (White) sheet air barrier membrane for wall construction, specifically designed to be water resistant and vapor permeable.

D. Through Wall Flashing: Through-wall flashing membrane (Self-Adhering) shall be Blueskin TWF manufactured by Henry; an SBS modified bitumen, self-adhering (Yellow) sheet membrane complete with a cross-laminated polyethylene film.

E. Insulation Adhesive: "Air-Bloc 21 Insulation Adhesive" manufactured by Henry; a synthetic, trowel applied, rubber based adhesive, having the following physical properties:

1. Compatibility: With air barrier membrane, substrate and insulation.
2. Air leakage: 0.0026 CFM/ft2 @ 2.1 lbs/ft2 to ASTM E283.
3. Water vapor permeance: 0.03 perms to ASTM E96.
4. Long term flexibility: CGSB 71-GP-24M.

~~2.3~~2.4 AUXILIARY MATERIALS FOR AIR AND VAPOR BARRIER

A. General: Auxiliary materials recommended by air barrier manufacturer for intended use and compatible with air barrier membrane. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Liquid Membrane for Details and Terminations: Provide Bituthene Liquid Membrane as manufactured by Grace Construction Products

C. Wall Primer (for Use with Through wall Flashing and Tapes Applied to Substrate): Primer for primary self-adhering water resistive air barrier membrane, self-adhering transition membrane and SBS modified bitumen membranes at all temperatures shall be Blueskin Spray-Prep or Blueskin Adhesive manufactured by Henry, a synthetic rubber based adhesive aerosol, quick setting.

E. Joint Reinforcing Strip: Air barrier manufacturer's approved tape.

F. Transition Membrane: 0.8 mm (32 mils) of self-adhesive rubberized asphalt integrally bonded to 0.2 mm (8 mil) of cross-laminated, high-density polyethylene film to provide a min. 1.0 mm (40 mil) thick membrane. Membrane shall be interleaved with disposable silicone-coated release paper until installed, conforming with the following:

1. Water Vapor Transmission: ASTM E96, Method B: 2.9 ng/m2sPa (0.05 perms) max.

2. Water Absorption: ASTM D570: max. 0.1% by weight 3. Puncture Resistance: ASTM E154: 356 N (80 lbs.) min.
4. Tear Resistance

   a. Initiation ASTM D1004: min. 58 N (13.0 lbs.) M.D.
   b. Propagation ASTM D1938: min. 40 N (9.0 lbs.) M.D.

5. Lap Adhesion at -4ºC (25ºF): ASTM D1876: 880 N/m (5.0 lbs./in.) of width
6. Low Temperature Flexibility ASTM D1970: Unaffected to -43ºC (-45ºF)
7. Tensile Strength: ASTM D412, Die C Modified: min. 5.5 MPa (800 psi)
8. Elongation, Ultimate Failure of Rubberized Asphalt: ASTM D412, Die C: min. 200%.
9. Product: Perm-A-Barrier Wall Flashing manufactured by Grace Construction Products.

G. Substrate Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

1. Product: Bituthene Liquid Membrane, manufactured by Grace Construction Products.

H. Sprayed Polyurethane Foam Sealant: 1- or 2-component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 lb/cu. ft (24 to 32 kg/cu. m) density; flame spread index of 25 or less according to ASTM E162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.

I. Joint Sealant: ASTM C920, single-component, neutral-curing silicone; Class 100/50 (lowmodulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that concrete has cured and aged for minimum time period recommended by airbarrier manufacturer.
3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
4. Verify sealants used in sheathing are compatible with membrane proposed for use. Perform field peel-adhesion test on materials to which sealants are adhered.

B. Proceed with installation only after unsatisfactory conditions have been corrected. Notify Architect in writing of anticipated problems using air and vapor barrier over substrate prior to proceeding.

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.

1. Install modified bituminous strips and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch.

G. Bridge and cover isolation joints, expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with overlapping modified bituminous strips.

H. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

I. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 INSTALLATION

A. General: Install modified bituminous sheets and accessory materials according to air-barrier manufacturer's written instructions and according to recommendations in ASTM D 6135.

1. When ambient and substrate temperatures range between 25 and 40 deg F, install selfadhering, modified bituminous air-barrier sheet produced for low-temperature application. Do not install low-temperature sheet if ambient or substrate temperature is higher than 60 deg F.

B. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.

1. Install modified bituminous strips centered over vertical inside corners. Install 3/4-inch fillets of termination mastic on horizontal inside corners.

C. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations with termination mastic and according to ASTM D 6135.

D. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier sheet on same day. Reprime areas exposed for more than 24 hours.

1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

E. Apply and firmly adhere modified bituminous sheets horizontally over area to receive air barrier. Accurately align sheets and maintain uniform 2-1/2-inch- minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure airtight installation.

1. Apply sheets in a shingled manner to shed water without interception by any exposed sheet edges.
2. Roll sheets firmly to enhance adhesion to substrate.

F. Apply continuous modified bituminous sheets over modified bituminous strips bridging substrate cracks, construction, and contraction joints.

G. Seal top of through-wall flashings to air-barrier sheet with an additional 6-inch- wide, modified bituminous strip.

H. Seal exposed edges of sheet at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

I. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.

1. Coordinate air-barrier installation with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install modified bituminous strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.

J. Connect and seal exterior wall air-barrier membrane continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

K. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply modified bituminous transition strip so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.

1. Modified Bituminous Transition Strip: Roll firmly to enhance adhesion.
2. Elastomeric Flashing Sheet: Apply adhesive to wall, frame, and flashing sheet. Install flashing sheet and termination bars, fastened at 6 inches o.c. Apply lap sealant over exposed edges and on cavity side of flashing sheet.
3. Preformed Silicone-Sealant Extrusion: Set in full bed of silicone sealant applied to walls, frame, and membrane.

L. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of air-barrier membrane with foam sealant.

M. At end of each working day, seal top edge of air-barrier material to substrate with termination mastic.

N. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

O. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air-barrier sheet extending 6 inches beyond repaired areas in all directions.

P. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.

Q. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Contractor to engage testing agency to perform field tests on the mock-up for air and water infiltration in accordance with ASTM E 1186 (air leakage location), ASTM E 783 (air leakage quantification), and ASTM E 1105 (water penetration) as indicated in this Section. Owner may engage a qualified testing agency to perform additional tests and inspections.

B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Continuous structural support of air-barrier system has been provided.
3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed.
7. Laps in sheet materials have complied with the minimum requirements and have been shingled in the correct direction (or mastic applied on exposed edges), with no fishmouths.
8. Termination mastic has been applied on cut edges.
9. Air barrier has been firmly adhered to substrate.
10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

C. Tests: As determined by Owner's testing agency from among the following tests:
1. Qualitative Air-Leakage Testing: Air-barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186.
2. Quantitative Air-Leakage Testing: Air-barrier assemblies will be tested for air leakage according to ASTM E 783.
3. Adhesion Testing: Air-barrier assemblies will be tested for minimum air-barrier adhesion of 16 lbf/sq. in. according to ASTM D 4541 for each 600 sq. ft. of installed air barrier or part thereof.

D. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above. E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

3.5 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than 30 days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.
2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed Work, using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 072726

074660 – FIBER CEMENT SIDING

PART 1 GENERAL

1.1 Section Includes

A. Siding panels.
B. Soffit panels.
C. Accessories and trim.

1.2 Related Sections

A. Section 06100 - Rough Carpentry: Framing and Sheathing.
B. Section 07900 - Joint Sealers.
C. Section 09900 - Paints and Coatings: Field painting.

1.3 References

A. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants; 1998.
B. ASTM C 1185 - Standard Test Methods for Sampling and Testing Non Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards; 1999.
C. ASTM C 1186 - Standard Specification for Flat Non-Asbestos Fiber Cement Sheets; 1999.
D. ASTM E 72 - Standard Test Methods of Conducting Strength Tests of Panels for Building Construction; 1998.
E. ASTM E 84 -- Standard Test Method for Surface Burning Characteristics of Building Materials; 1999.
F. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials; 1995.
G. ASTM E 136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 1999.
H. ASTM E 228 - Standard Test Method for Linear Thermal Expansion of Solid Materials With a Vitreous Silica Dilatometer; 1995.
I. ASTM G 26 - Standard Practice for Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials; 1996.
J. ASTM E 330-97 – Structural Performance of exterior windows, curtain walls and doors by uniform static air pressure difference.

1.4 Submittals

A. Make submittals under provisions of Section 01300.
B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods, including nailing patterns.
4. Applicable model code authority evaluation report (ICC, CCMC, etc.)
~~C. LEED Submittals: Provide documentation of how the requirements of Credit will be met:~~
~~1. List of proposed materials with recycled content. Indicate post-consumer recycled content and pre-consumer recycled content for each product having recycled content.~~
~~2. Product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content.~~
~~3. List of proposed materials with rapidly renewing content. Indicate rapidly renewing content percentage for each product having rapidly renewing content.~~
D. Siding manufacturer's requirements for vapor retarders, primer, paint, etc., to be installed by others.
E. Maintenance and periodic inspection recommendations.
~~F. Manufacturer's Certificates: Certify products meet or exceed specified requirements~~.

1.5 Quality Assurance

A. Installer Qualifications: Provide installer with not less than three years of experience with products similar to those specified.

1.6 Delivery, Storage, And Handling

A. Store products off the ground, on a flat surface, and under a roof or separate waterproof covering.

1.7 WARRANTY

A. Provide Allura 50 year limited siding warranty.

B. Allura ColorMax Finish – provide 15 year limited paint warranty
C. Register manufacturer's warranty, made out in Owner's name, with copy to Owner.

PART 2 PRODUCTS

2.1 Manufacturer
A. Allura of Plycem, 15055 Woodham Drive Houston, Texas 77073
main: (844) 4 ALLURA or (844) 425-5872 email: info@elementia.com www.alluraUSA.com
B. Substitutions:
1. James Hardie.
2. Or equal (pending Architect acceptance)
C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 Panels
A. Fiber Cement Board Panels - General: Allura Fiber Cement Board Panels consist of cement, recycled content and cellulose fiber formed under high pressure into boards with integral surface texture; complying with ASTM C 1186 Type A Grade II; machined edges; for nail attachment.
1. Surface Burning Characteristics: Flame spread index of 0, smoke developed index of 5, maximum; when tested in accordance with ASTM E 84 (Class I/A).
2. Flammability: Noncombustible, when tested in accordance with ASTM E 136.
3. Flexural Strength: At least 1450 psi (10 MPa) when in equilibrium condition, and at least 1015 psi (7 MPa) when in wet condition, tested in accordance with ASTM C 1185.
4. Coefficient of Thermal Expansion: Less than 1 x 10^-5/inch/inch/degree F (0.5 x 10^-5/degree C), when tested in accordance with ASTM E 228.
5. Freeze Thaw Resistance: At least 80 percent flexural strength retained, when tested in accordance with ASTM C 1185.
6. UV Resistance: No cracking, checking, or erosion, when tested for 2000 hours in accordance with ASTM G 26.
7. Water Tightness: No water droplets on underside, when tested in accordance with ASTM C 1185.

~~B. Horizontal Siding: Allura Lap Siding.~~
~~1. Thickness: 5/16 inch (7.9 mm), plus or minus .04 inch (1 mm).~~
~~2. Length: 12 feet (3657 mm), plus 0, minus 1/8 inch (3 mm).~~
~~3. Style: Smooth lap siding.~~
~~a. Width: 6-1/4 inches (159 mm) wide.~~
~~4. Sealant/Primer: Our Primary Sealant/Primer.~~
~~5. Field Finish Paint: 100 percent acrylic latex as specified in Section 099113.~~
~~6. Factory Finish: Factory applied ColorMax Finishing System by Allura with 100 percent acrylic solid color as follows:~~
~~a. Standard Finish/Color (per Architect)~~
~~7. Style: Cedar lap siding.~~
~~a. Width: 6-1/4 inches (159 mm) wide.~~
~~8. Sealant/Primer: Our primary Sealant/Primer.~~
~~9. Field Finish Paint: 100 percent acrylic latex as specified in Section 09900.~~
~~10. Factory Finish: Factory applied ColorMax Finishing System by Allura with 100 percent acrylic solid color as follows:~~
~~a. Standard Finish/Color (per Architect)~~
~~11. Factory Stain Finish: Factory applied Allura Fiber Cement Siding Premium Stain color as follows:~~
~~a. Standard Finish/Color (per Architect)~~

~~C. Simulated Shingle Siding: Allura Shakes.~~
~~1. Thickness: 5/16 inch (7.9 mm), plus or minus .04 inch (1 mm).~~
~~2. Style: Perfection shingle, grooved, 7 inches (178 mm) exposure, 8-1/4 inches (210 mm) wide by 12 feet (3657 mm), plus 0, minus 1/8 inch (3 mm).~~
~~3. Style: Random square straight edge, cut between shingles, 5 inches (127 mm) exposure, 12 inches (305 mm) wide by 48 inches (1219 mm) long.~~
~~4. Style: Random square straight edge, cut between shingles, 7 inches (178 mm) exposure, 16 inches (406 mm) wide by 48 inches (1219 mm) long.~~

~~5. Style: Random square staggered edge, cut between shingles, 7 inches (178 mm) exposure, 16 inches (406 mm) wide by 48 inches (1219 mm) long.~~
~~6. Style: Half-rounds full cut between shingles, 7 inches (178 mm) exposure, 16 inches (406 mm) wide by 48 inches (1219 mm) long.~~
~~7. Style: Octagons full cut between shingles, 7 inches (178 mm) exposure, 16 inches (406 mm) wide by 48 inches (1219 mm) long.~~
~~8. Sealant/Primer: Our primary Sealant/Primer.~~
~~9. Field Finish Paint: 100 percent acrylic latex as specified in Section 09900.~~
~~10. Factory Finish: Factory applied ColorMax Finishing System by Allura with 100 percent acrylic solid color as follows:~~
~~a. Standard Finish/Color (per Architect)~~
~~11. Factory Stain Finish: Factory applied Allura Fiber Cement Siding Premium Stain color as follows:~~
~~a. Standard Finish/Color (per Architect)~~
~~12. Simulated Shingle Siding: Allura Shakes.~~
~~13. Thickness: ¼ inch (6.4 mm) plus or minus .031 inch (.8mm)~~
~~14. Style: Individual Shakes, 8" reveal with 18" length. Package comes with all 3 widths to apply in a straight or staggered appearance:~~
~~a. Width: 6 ¼"~~
~~b. Width: 8 ¼~~
~~c. Width: 12"~~
~~15. Sealant/Primer: Our primary Sealant/Primer.~~
~~16. Field Finish Paint: 100 percent acrylic latex as specified in Section 09900.~~

D. Vertical Siding: Allura Vertical Siding.
1. Thickness: 5/16 inch (7.9 mm), plus or minus .04 inch (1 mm).
2. Size: 48 by 96 inches (1220 by 2440 mm).
3. Size: 48 by 108 inches (1220 by 2743 mm).
4. Size: 48 by 120 inches (1220 by 3048 mm).
5. Style: Smooth panel.
6. Style: Stucco texture panel.
7. Style: Cedar panel, no grooves.
8. Style: Cedar panel, 3/8 inch (9.5 mm) wide grooves at 8 inches (200 mm) on center.
9. Sealant/Primer: Our primary Sealant/Primer.
10. Field Finish Paint: 100 percent acrylic latex as specified in Section 09900.
11. Factory Finish: Factory applied ColorMax Finishing System by Allura with 100 percent acrylic solid color as follows:
a. Standard Finish/Color (per Architect)

E. Soffit: Allura Soffit, ventilated and non-ventilated.
1. Thickness: 1/4 inch (6.35 mm), plus or minus 1/32 inch (0.8 mm).
2. Length: 12 feet (3657 mm), plus 0, minus 1/8 inch (3 mm).
3. Style: Smooth texture
a. Width: 12 inches (305 mm) wide.
b. Width: 16 inches (406 mm) wide.
c. Width: 24 inches (610 mm) wide.
4. Style: Cedar texture
a. Width: 12 inches (305 mm) wide.
b. Width: 16 inches (406 mm) wide.
c. Width: 24 inches (610 mm) wide.
5. Ventilated soffit.
6. Non-ventilated soffit.
7. Combination of Ventilated and Non-ventilated as indicated on the Drawings.
8. Sealant/Primer: Our primary Sealant/Primer.
9. Field Finish Paint: 100 percent acrylic latex as specified in Section 099113.
10. Factory Finish: Factory applied ColorMax Finishing System by Allura with 100 percent acrylic solid color as follows:
a. Standard Finish/Color (per Architect)

F. Soffit/Porch Panel: Allura FiberCement Soffit/Porch Panel.
1. Thickness: 1/4 inch (6 mm), (6.35 mm, plus or minus 0.8 mm).

2. Width: 48 inches (1220 mm).
3. Length: 8 feet (2440 mm), plus 0, minus 1/8 inch (3.17 mm).
4. Style: Smooth texture
5. Style: Cedar texture
6. Sealant/Primer: Sealant/Primer.
7. Field Finish Paint: 100 percent acrylic latex as specified in Section 099113.

2.3 Accessories

A. Trim: Allura Trim/Fascia Board

1. Size:
   a. Thickness 7/16 inch (11 mm) plus or minus (1 mm).
   b. Width:
      1) 3-1/2 inch (89 mm).
      2) 5-1/2 inch (140 mm).
      3) 7-1/4 inch (185 mm).
      07466 / 7
      4) 9-1/4 inch (235 mm).
      5) 11-1/4 inch (286 mm).
   c. Length: 12 feet (3.657 m) plus or minus 1/8 inch (3.17 mm).
2. Sealant/Primer: Our primary Sealant/Primer.

B. Provide the following trim:

1. ~~Starter strip for lap siding.~~
2. Outside corners, butted to siding.
3. Outside corners, overlapping siding.
4. Fascia board.

C. Sealant: Paintable, 100 percent acrylic latex caulk complying with ASTM C 920.
D. Sheet Metal Flashing: Minimum 26 gauge hot-dipped galvanized steel sheet, or coated aluminum.
E. Nails: Length as required to penetrate minimum 1-1/4 inch (32mm) into solid backing; hot-dipped galvanized or stainless steel.
F. Building Paper: Kraft or bituminous paper; not polyethylene or foil.
G. Field Finish Paint: 100 percent acrylic latex as specified in Section 099113.

PART 3 EXECUTION

3.1 Examination

A. Prior to commencing installation, verify governing dimensions of building and condition of substrate.
B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 Preparation

A. Examine, clean, and repair as necessary any substrate conditions that would be detrimental to proper installation.
B. Do not begin installation until unacceptable conditions have been corrected.

3.3 Installation

A. Install in accordance with manufacturer’s instructions and Drawing details.

1. Read warranty and comply with all terms necessary to maintain warranty coverage.
2. Install in accordance with conditions stated in model code evaluation report applicable to location of project.
3. Use trim details indicated on drawings.
4. Touch up all field cut edges before installing.
5. Pre-drill nail holes if necessary to prevent breakage.

B. Over Wood Studs Without Sheathing: Install building paper over studs prior to installing siding.
C. Over Wood and Wood-Composite Sheathing: Fasten siding through sheathing into studs.
D. Over Foam Sheathing: Read and comply with sheathing manufacturer’s recommendations.

1. For sheathing of 1 inch (25 mm) thickness or less, nail through sheathing into studs using correspondingly longer nails.

E. Over Masonry Walls: Install furring strips of adequate thickness to accept full length of nails and spaced at 16 inches (406 mm) on center.
F. Over Steel Studs: Minimum 20 gauge steel, 3 5/8” (92 mm) C-studs. Use 1-5/8” (41 mm) long, #8-18 x 3/8” HD self-tapping, corrosion-resistant ribbed bugle head screws. Attach siding at each stud insuring that at least 3 screw threads penetrate the studs.
G. Diagonal Siding: Follow manufacturer’s instructions.
H. Allow space between both ends of siding panels that butt against trim for thermal movement; seal joint between panel and trim with exterior grade sealant.
I. Joints in Horizontal Siding: Avoid joints in lap siding except at corners; where joints are inevitable stagger joints between successive courses.
J. Joints in Vertical Siding: Install Z-flashing in horizontal joints between successive courses of vertical siding.
K. Furred Installation: Leave space at top and bottom open; top may be behind soffit; at bottom install insect screen over opening by wrapping a strip of screen over bottom ends of vertical furring strips.
L. Install sheet metal flashing above door and window casings and horizontal trim in field of siding.
M. Do not install siding less than 6 inches (150 mm) from surface of ground nor closer than 1 inch (25 mm) to roofs, patios, porches, and other surfaces where water may collect.
N. After installation, seal all joints except lap joints of lap siding. Seal around all penetrations.
Paint all exposed cut edges.
O. Finish Painting: Specified
P. Finish Painting: Within 24 months after installation, paint siding and trim with one coat finish paint.
Q. Finish Painting: Within 24 months after installation, paint siding and trim with one coat primer and two coats finish paint.

3.4 Cleaning

A. At completion of work, remove debris caused by siding installation from project site.
B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 075113 – HOT APPLIED BUILT-UP ASPHALT ROOFING (BUR)

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Built-up asphalt roofing system.

B. Cover board.

C. Roof insulation

D. Vapor retarder.

E. Substrate board.

1.2 RELATED SECTIONS

A. Division 05 Section "Steel Decking" for furnishing acoustical deck rib insulation.

B. Division 06 Section "Miscellaneous Rough Carpentry" for wood nailers, cants, curbs, and blocking.

C. Division 07 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counterflashings.

D. Division 07 Section "Manufactured Roof Expansion Joints."

E. Division 22 Section "Storm Drainage Piping Specialties" for roof drains.

1.3 REFERENCES

A. Roofing Terminology: Refer to the following publications for definitions of roofing related terms in this Section:

1. ASTM D 1079 “Terminology Relating to Roofing and Waterproofing.”
2. Glossary of NRCA's "The NRCA Roofing and Waterproofing Manual."
3. Roof Consultants Institute “Glossary of Roofing Terms.”

B. Sheet Metal Terminology and Techniques: SMACNA Architectural Sheet Metal Manual.

C. Hot Roofing Asphalt: Roofing asphalt heated to its equiviscous temperature (EVT), the temperature at which its viscosity is 125 centipoise for mop-applied roofing asphalt and 75 centipoise for mechanical spreader-applied roofing asphalt, within a range of plus or minus 25 deg F (14 deg C), measured at the mop cart or mechanical spreader immediately before application.

1.4 DESIGN CRITERIA

A. General: Installed roofing membrane system shall remain watertight; and resist specified wind uplift pressures, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Roofing materials shall be compatible with one another under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.

C. Wind Uplift Performance: Roofing system shall be identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist wind uplift pressure calculated in accordance with ASCE-7.

1. Field-of-Roof Uplift Pressure: <**Insert number**> lbf/sq. ft. (kN/sq. m).
2. Perimeter Uplift Pressure: <**Insert number**> lbf/sq. ft. (kN/sq. m).
3. Corner Uplift Pressure: <**Insert number**> lbf/sq. ft. (kN/sq. m).

D. FMG Listing: Roofing membrane, base flashings, and component materials shall comply with requirements in FMG 4450 and FMG 4470 as part of a roofing system and that are listed in FMG's “RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FMG markings.

1. Roofing system shall comply with to RoofNav #:
2. Fire/Windstorm Classification: Class 1A-**Insert number** (starting at 60 and incrementing by 15)
3. Hail Resistance: [**MH**] [**SH**].

E. LEED Credits:

1. Roofing system shall be eligible for LEED Credit SS 7.1 and/or SS 7.2.
2. Insulation and cover board materials shall contribute to LEED credit MR 4.1
3. Insulation package shall contribute to LEED EA credit.
4. Materials with minimal VOC shall contribute to LEED credit EQ 4.

F. EPA Energy Star:

1. Roofing membrane that achieves an initial reflectance of greater than 0.65 and a three year aged reflectance of greater than 0.50.

G. California Code of Regulations Title 24 (T24/CRRC-1):

1. Provide roofing system that complies with the requirements of Title 24.

1.5 SUBMITTALS

A. Product Data: Manufacturer’s data sheets for each product to be provided.

B. Detail Drawings: Provide roofing system plans, elevations, sections, details, and details of attachment to other Work, including:

1. Base flashings, cants, and membrane terminations.
2. Tapered insulation, including slopes.
3. Crickets, saddles, and tapered edge strips, including slopes.
4. Insulation fastening patterns.

C. Verification Samples: Provide for each product specified.

D. Maintenance Data: Refer to Johns Manville’s latest published documents on www.specJM.com.

E. Guarantees: Special guarantees specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive the specified manufacturer's guarantee.

B. Manufacturer Qualifications: A qualified manufacturer that has [**UL listing**] [**FMG approval**] for roofing system identical to that used for this Project.

C. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

D. Test Reports:

1. Roof drain and leader test or submit plumber's verification.
2. Core cut (if requested).
3. Roof deck fastener pullout test.

E. Moisture Survey:

1. Submit prior to installation, results of a non-destructive moisture test of roof system completed by approved third party. Utilize one of the approved methods:

a. Infrared Thermography
b. Nuclear Backscatter

F. Source Limitations: Obtain all components from the single source roofing system manufacturer guaranteeing the roofing system. All products used in the system shall be labeled by the single source roofing manufacturer issuing the guarantee.

G. Provide evidence of CERTA training for any installer of torch-applied modified bitumen membrane. Copies of certifications are required prior to award and must be maintained on the jobsite for inspection at any time.

H. Fire-Test-Response Characteristics: Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL[, FMG,] or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.

1. Exterior Fire-Test Exposure: Class [A] [B] [C]; ASTM E 108, for application and roof slopes indicated.
2. Fire-Resistance Ratings: ASTM E 119, for fire-resistance-rated roof assemblies of which roofing system is a part.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storage.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.8 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when current and forecasted weather conditions permit roofing system to be installed in accordance with manufacturer's written instructions and guarantee requirements.

1.9 GUARANTEE

A. Provide manufacturer's system guarantee equal to Johns Manville's Peak Advantage No Dollar Limit Roofing System Guarantee.

1. Single-Source special guarantee includes roofing plies, flashings, roofing membrane accessories, roof insulation, fasteners, cover board, substrate board, vapor retarder, walkway products, [**manufacturer's expansion joints**], [**manufacturer's edge metal products**], and other single-source components of roofing system marketed by the manufacturer.

2. Guarantee Period: **[10] [15] [20]** years from date of Substantial Completion.
3. Wind Rider: Guarantee shall not exclude coverage for wind events up to [number between 55 - 120] mph.
4. Hail Rider: Guarantee shall have no exclusions for hail events up to [1 inch] [1.5 inches] [2 inches]
5. Accidental Puncture Rider: Guarantee shall provide coverage for accidental puncture for up to [8] [16] billed repair hours per year for the life of the guarantee.

B. Installer's Guarantee: Submit roofing Installer's guarantee, signed by Installer, covering Work of this Section, including all components of roofing system for the following warranty period:

1. Guarantee Period: Two Years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ROOFING MEMBRANE PLIES

A. Glass-Fiber Base-Ply Sheet: ASTM D 2178, Type [**IV**] [**VI**], asphalt-impregnated, glass-fiber felt. Basis of Design: [GlasPly IV] [GlasPly Premier] [or architect pre approved equal]

2.2 FLASHING MATERIALS

A. Backer Sheet: ASTM D 2178, Type [**IV**] [**VI**], asphalt-impregnated, glass-fiber felt. Basis of Design: [GlasPly IV] [GlasPly Premier] [or architect pre approved equal]

B. Backer Sheet: [ASTM D 6164, Grade S, Type I, polyester-reinforced] [ASTM D 6163, Grade S, Type I, glass-fiber-reinforced] [ASTM D 6162, Grade S, Type II, composite polyester- and glass-fiber-reinforced], SBS-modified asphalt sheet; smooth surfaced; suitable for application method specified. Basis of Design: [DynaLastic 180 S] [DynaBase] [DynaPly] [or architect pre approved equal]

C. Backer Sheet: ASTM D 4601, Type II, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides. Basis of Design: PermaPly 28 [or architect pre approved equal]

D. Flashing Sheet: [ASTM D 6164, Grade G, Type II, polyester-reinforced] [ASTM D 6163, Grade G, Type I, glass-fiber-reinforced] [ASTM D 6221, Grade G, Type I, composite polyester- and glass-fiber-reinforced] [ASTM D 6298, embossed aluminum foil surfaced, glass-fiber-reinforced], SBS-modified asphalt sheet; granular surfaced; suitable for application method specified. Basis of Design: [DynaLastic 250 FR] [DynaLastic 250 FR CR] [DynaWeld Cap 180 FR] [DynaWeld Cap FR] [DynaWeld Cap FR CR] [DynaFlex] [DynaFlex CR] [DynaClad] [or architect pre approved equal]

E. Flashing Sheet: Roofing system manufacturer's asphalt-impregnated and -coated composite sheet; smooth surfaced and reinforced with a composite polyester and glass-fiber core. Basis of Design: GlasTite Flexible [or architect pre approved equal]

2.3 AUXILIARY ROOFING MEMBRANE MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with built-up roofing.

B. Roofing Asphalt: ASTM D 312, Type [**III**] [**IV**] [**PermaMop**].

C. Asphalt Primer: ASTM D 41. Basis of Design: Asphalt Primer [or architect pre approved equal]

D. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required by roofing system manufacturer for application. Basis of Design: Bestile Industrial Roof Cement or architect pre approved equal]

E. Cold-Applied Adhesive: ASTM D3019, Type III, Grade 2. asphalt-based, asbestos-free, cold-applied adhesive specially formulated for compatibility and use with membrane applications. Basis of Design: MBR Cold Application Adhesive [or architect pre approved equal]

F. Cold-Applied Adhesive: Roofing system manufacturer's asphalt-based, two-component, asbestos-free, cold-applied adhesive specially formulated for compatibility and use with membrane applications. Basis of Design: MBR Bonding Adhesive [or architect pre approved equal]

G. Cold-Applied Adhesive: Roofing system manufacturer's specially formulated one-part, elastomeric cold application adhesive. Basis of Design: JM BUR Adhesive [or architect pre approved equal]

H. Cold-Applied Flashing Adhesive: Roofing system manufacturer's asphalt-based, two-component, asbestos-free, trowel-grade, cold-applied adhesive specially formulated for compatibility and use with flashing applications. Basis of Design: MBR Flashing Cement [or architect pre approved equal]

I. Mastic Sealant: As required by Johns Manville.

J. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roofing membrane components to substrate, tested by manufacturer for required pullout strength, and provided by the roofing system manufacturer. Basis of Design: [UltraFast Fasteners and Plates] [All Purpose Fasteners and Plates] [or architect pre approved equal]

K. Aggregate Surfacing: ASTM D 1863, No. 6 or No. 67, clean, dry, opaque, [**water-worn gravel or crushed stone, free of sharp edges**] [**crushed slag, free of sharp edges**].

L. Miscellaneous Accessories: Provide miscellaneous accessories recommended by roofing system manufacturer.

2.4 AUXILIARY ROOFING SYSTEM COMPONENTS

A. Expansion Joints: Provide factory fabricated weatherproof, exterior covers for expansion joint openings consisting of flexible rubber membrane, supported by a closed cell foam to form flexible bellows, with two metal flanges, adhesively and mechanically combined to the bellows by a bifurcation process. Provide product manufactured and marketed by single-source membrane supplier that is included in the No Dollar Limit guarantee. Basis of Design: [Expand-O-Flash] [Expand-O-Gard] [or architect pre approved equal]

B. Coping System: Manufacturer’s factory fabricated coping consisting of a base piece and a snap-on cap. Provide product manufactured and marketed by single-source membrane supplier that is included in the No Dollar Limit guarantee. Basis of Design: Presto-Lock Coping [or architect pre approved equal]

C. Fascia System: Manufacturer's factory fabricated fascia consisting of a base piece and a snap-on cover. Provide product manufactured and marketed by single-source membrane supplier that is included in the No Dollar Limit guarantee. Basis of Design: [Presto Lock Fascia] [Presto-Tite Fascia] [or architect pre approved equal]

D. Metal Flashing Sheet: Metal flashing sheet is specified in Division 07 Section "Sheet Metal Flashing and Trim."

2.5 WALKWAYS

A. Walkway Pads: Mineral-granule-surfaced, reinforced modified asphalt composition, slip-resisting pads, manufactured as a traffic pad for foot traffic provided by roofing system manufacturer, with a pad size of 32 inch x 32 inch. Basis of Design: [Johns Manville DynaTred] [Johns Manville DynaTred Plus] [or architect pre approved equal]

2.6 COVER BOARD

A. Perlite Board: ASTM C 728; composed of expanded perlite, cellulosic fibers, binders and waterproofing agents with top surface seal-coated. Basis of Design: : [RetroPlus Roof Board] [3/4" Fesco Board] [1" Fesco Board] [1/2" Retro-Fit Board] [1/2" DuraBoard] [3/4" DuraBoard] [1" DuraBoard] [or architect pre approved equal]

2.7 ROOF INSULATION

A. General: Provide preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.

B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Basis of Design: ENRGY 3 [or architect pre approved equal]

1. Provide insulation package with R Value greater than [**19**] [**insert R Value**] [**minimum required by applicable code**].
2. Provide insulation package with minimum thickness [**insert thickness**].

2.8 TAPERED INSULATION

A. Tapered Insulation: ASTM C 1289, provide factory-tapered insulation boards fabricated to slope of [1/4 inch per 12 inches (1:48)] <**Insert slope**>, unless otherwise indicated. Basis of Design: Tapered ENRGY 3 [or architect pre approved equal]

2.9 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.

B. Provide factory preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated. Basis of Design: [Tapered Pre-Cut Cricket] [Tapered Pre-Cut Miter] [Tapered Fesco Edge Strip] [or architect pre approved equal]

C. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and furnished by roofing system manufacturer. Basis of Design: [UltraFast Fasteners and Plates] [UltraFast Pre-Assembled Fasteners] [UltraFast AccuTrac Fastener and Plate System] [or architect pre approved equal]

D. Cold Fluid-Applied Adhesive: Manufacturer's No VOC, two-component cold fluid-applied adhesive formulated to adhere roof insulation to substrate. Basis of Design: MBR Bonding Adhesive [or architect pre approved equal]

E. Urethane Adhesive: Manufacturer's two component urethane adhesive formulated to adhere insulation to substrate. Basis of Design: [JM Two-Part Urethane Insulation Adhesive] [JM Green Two-Part Urethane Insulation Adhesive] [or architect pre approved equal]

F. Insulation Cant Strips: ASTM C 728, perlite insulation board. Basis of Design: FesCant Plus [or architect pre approved equal]

G. Wood Nailer Strips: Comply with requirements in Division 06 Section **"**Miscellaneous Rough Carpentry**."**

2.10 VAPOR RETARDER

A. Glass-Fiber Felts: ASTM D 2178, Type IV, asphalt-impregnated, glass-fiber felt. Basis of Design: [GlasPly IV] [or architect pre approved equal]

B. Torch Applied SBS Vapor Retarder : [ASTM D 6163, Grade S, Type I, glass-fiber-reinforced] [ASTM D 6164, Grade S, Type I, polyester-reinforced], SBS-modified asphalt sheet; smooth surfaced; suitable for application method specified. Basis of Design: [DynaWeld Base] [DynaWeld 180 S] [or architect pre approved equal]

2.11 SUBSTRATE BOARD

A. Substrate Board: ASTM C 728, perlite board, [3/4 inch (19 mm)] [1 inch (25 mm)] thick, seal coated. Basis of Design: Fesco Board [or architect pre approved equal]

B. Substrate Board: ASTM C 1177, glass-mat, water-resistant gypsum substrate, [5/8 inch (16 mm) thick. Basis of Design: JM Securock Glass Mat Roof Board [or architect pre approved equal]

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements affecting performance of roofing system.

1. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.

2. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 05 Section "Steel Decking."

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and remove from substrate sharp projections, dust, debris, moisture, and other substances detrimental to roofing installation in accordance with roofing system manufacturer's written instructions.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 RE-ROOF PREPARATION

A. Remove all roofing membrane, surfacing, coverboards, insulation, fasteners, asphalt, pitch, adhesives, etc.

1. Remove an area no larger than can be re-roofed in one day.

B. Tear out all base flashings, counterflashings, pitch pans, pipe flashings, vents and like components necessary for application of new membrane.

C. Remove abandoned equipment curbs, skylights, smoke hatches, and penetrations.

1. Install decking to match existing as directed by Owner's Representative.

D. Raise (disconnect by licensed craftsmen, if necessary) all HVAC units and other equipment supported by curbs to conform with the following:

1. Modify curbs as required to provide a minimum 8" base flashing height measured from the surface of the new membrane to the top of the flashing membrane.
2. Nail top of flashing and install new metal counterflashing prior to re-installation of unit.
3. Perimeter nailers must be elevated to match elevation of new roof insulation.

E. Immediately remove all debris from roof surface. Demolished roof system may not be stored on the roof surface.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 RECOVER PREPARATION

A. Prepare existing roof according to roofing system manufacturer's written instructions, applicable recommendations of the roofing manufacturer, and requirements in this Section.

B. Tear out all base flashings, counterflashings, pitch pans, pipe flashings, vents and like components necessary for application of new membrane.

C. Disable existing roof membrane by cutting a minimum 5 foot x 5 foot grid pattern.

D. “Skin” existing membrane at substrate.

E. Remove existing membrane at fasteners.

F. Remove and replace wet, deteriorated or damaged roof insulation and decking as identified in moisture survey.

G. Remove abandoned equipment curbs, skylights, smoke hatches, and penetrations. Install decking to match existing as directed by Owner's Representative.

H. Raise, (disconnect by licensed craftsmen, if necessary) all HVAC units and other equipment supported by curbs to conform with the following:

1. Modify curbs as required to provide a minimum 8" base flashing height measured from the surface of the new membrane to the top of the flashing membrane.

2. Nail top of flashing and install new metal counterflashing prior to re-installation of unit.
3. Perimeter nailers must be elevated to match elevation of new roof insulation.

I. Immediately remove all debris from roof surface. Demolished roof system may not be stored on the roof surface.

J. Prime existing cap sheet to prepare for recover application.

K. Proceed with installation only after unsatisfactory conditions have been corrected.

3.5 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

1. Fasten substrate board to top flanges of steel deck according to recommendations in FMG's "Approval Guide" for specified Windstorm Resistance Classification.
2. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturer's written instructions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.6 VAPOR-RETARDER INSTALLATION

A. Install 2 glass-fiber felt plies lapping each sheet 19 inches (483 mm) over preceding sheet. Embed each sheet in a solid mopping of hot roofing asphalt. Glaze-coat completed surface with hot roofing asphalt. Apply hot roofing asphalt at a rate of 20 lb/100 sq. ft. (1 kg/sq. m), plus or minus 25 percent.

B. Install modified bituminous vapor retarder sheet according to roofing manufacturer's written instructions, starting at low point of roofing system. Extend roofing membrane sheets over and terminate beyond cants, installing as follows:

1. Torch apply vapor retarder to substrate according to roofing system manufacturer’s instruction.
2. Adhere vapor retarder in a full mopping of hot asphalt to substrate according to roofing system manufacturer’s instruction.
3. Self adhere vapor retarder to substrate according to roofing system manufacturer’s instruction.
4. Unroll roofing membrane sheets and allow them to relax for minimum time period required by manufacturer.

C. Laps: Accurately align roofing membrane sheets, without stretching, and maintain uniform side and end laps. Stagger end laps. Completely bond and seal laps, leaving no voids.

1. Repair tears and voids in laps and lapped seams not completely sealed.

D. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into membrane roofing system.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.7 INSULATION INSTALLATION

A. Coordinate installation of roof system components so insulation and cover board is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system manufacturer's written instructions for installation of roof insulation and cover board.

C. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing membrane system with vertical surfaces or angle changes greater than 45 degrees per manufacturer's instruction.

D. Install tapered insulation under area of roofing to conform to slopes indicated.

E. Install insulation boards with long joints in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with like material.

F. Install one or more layers of insulation under area of roofing to achieve required thickness. Where overall thickness is X.X inches (XX mm) or greater, install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.

G. Trim surface of insulation boards where necessary at roof drains so completed surface is flush and does not restrict flow of water.

H. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.

I. Mechanically Fastened with Subsequent Layers Adhered Insulation: Secure first layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type to deck type.

1. Fasten first layer according to requirements in FMG's "Approval Guide" for specified Windstorm Resistance Classification.
2. Fasten first layer to resist uplift pressure at corners, perimeter, and field of roof.
3. Install subsequent layers in a solid mopping of hot roofing asphalt according to roofing system manufacturer's instruction.
4. Install subsequent layers in a cold fluid-applied adhesive according to roofing system manufacturer's instruction.

J. Proceed with installation only after unsatisfactory conditions have been corrected.

3.8 COVER BOARD INSTALLATION

A. Coordinate installing membrane roofing system components so cover board is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with membrane roofing system manufacturer's written instructions for installing roof cover board.

C. Install cover board with long joints of cover board in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with cover board.

1. Cut and fit cover board within 1/4 inch (6 mm) of nailers, projections, and penetrations.

D. Trim surface of cover board where necessary at roof drains so completed surface is flush and does not restrict flow of water.

1. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.

E. Adhered Cover Board: Adhere cover board to substrate as follows:

1. Install in a solid mopping of hot roofing asphalt according to roofing system manufacturer's instruction.
2. Install using a cold fluid-applied adhesive according to roofing system manufacturer's instruction.
3. Install in a two-part urethane adhesive according to roofing system manufacturer's instruction.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.9 ROOFING MEMBRANE INSTALLATION, GENERAL

A. Install roofing system specification 4GIG in accordance with roofing system manufacturer's written instructions, applicable recommendations of the roofing manufacturer and requirements in this Section.

B. Start installation of roofing membrane in presence of roofing system manufacturer's technical personnel.

C. Where roof slope exceeds 1/2 inch per 12 inches (1:24, contact the membrane manufacturer for installation instructions regarding installation direction and backnailing

D. Cooperate with testing and inspecting agencies engaged or required to perform services for installing roofing system.

E. Coordinate installing roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is imminent.

1. Provide tie-offs at end of each day's work to cover exposed roofing membrane sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt with joints and edges sealed.
2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.
3. Remove and discard temporary seals before beginning work on adjoining roofing.

F. Asphalt Heating: Heat roofing asphalt and apply within plus or minus 25 deg F (14 deg C) of equiviscous temperature unless otherwise required by roofing system manufacturer. Do not raise roofing asphalt temperature above equiviscous temperature range more than one hour before time of application. Do not exceed roofing asphalt manufacturer's recommended temperature limits during roofing asphalt heating. Do not heat roofing asphalt within 25 deg F (14 deg C) of flash point. Discard roofing asphalt maintained at a temperature exceeding finished blowing temperature for more than 4 hours.

G. Substrate-Joint Penetrations: Prevent roofing asphalt from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

H. Proceed with installation only after unsatisfactory conditions have been corrected.

3.10 ROOFING MEMBRANE INSTALLATION

A. Install four ply sheets starting at low point of roofing system. Align ply sheets without stretching. Shingle side laps of ply sheets uniformly to achieve required number of plies throughout thickness of roofing membrane. Shingle in direction to shed water. Extend ply sheets over and terminate beyond cants.

1. Install each ply sheet in a solid mopping of hot roofing asphalt applied at rate required by roofing system manufacturer, to form a uniform membrane without ply sheets touching.
2. Install cap sheet in a cold fluid-applied adhesive according to roofing system manufacturer’s instruction.

B. Aggregate Surfacing: Promptly after installing and testing roofing membrane, base flashing, and stripping, flood-coat roof surface with 60 lb/100 sq. ft. (3 kg/sq. m) of hot roofing asphalt. While flood coat is hot and fluid, cast the following average weight of aggregate in a uniform course:

1. Aggregate Weight: [400 lb/100 sq. ft. (20 kg/sq. m)] [300 lb/100 sq. ft. (15 kg/sq. m)].

2. If aggregate surfacing is delayed, promptly apply glaze coat of hot roofing asphalt at a rate of 10 lb/100 sq. ft. (0.5 kg/sq. m).

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.11 FLASHING AND STRIPPING INSTALLATION

A. Install base flashing over cant strips and other sloping and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrates according to roofing system manufacturer's written instructions and as follows:

1. Prime substrates with asphalt primer if required by roofing system manufacturer.

2. Backer Sheet Application: Mechanically fasten backer sheet to walls or parapets. Adhere backer sheet over roofing membrane at cants in a solid mopping of hot roofing asphalt.
3. Backer Sheet Application: Install backer sheet and adhere to substrate in a solid mopping of hot roofing asphalt.
4. Backer Sheet Application: Install backer sheet and adhere to substrate in approved adhesive applied at rate required by roofing system manufacturer.
5. Flashing Sheet Application: Adhere flashing sheet to substrate in a solid mopping of hot roofing asphalt applied at EVT. Apply hot roofing asphalt to back of flashing sheet if recommended by roofing system manufacturer.
6. Flashing Sheet Application: Adhere flashing sheet to substrate in approved adhesive applied at rate required by roofing system manufacturer.
7. Flashing Sheet Application: Adhere flashing sheet to substrate in approved asphalt roofing cement; apply cement at rate required by roofing system manufacturer.
8. Flashing Sheet Application: Torch apply flashing sheet to substrate as required by roofing system manufacturer.

B. Extend base flashing up walls or parapets a minimum of 8 inches (200 mm) above roofing membrane and 4 inches (100 mm) onto field of roofing membrane.

C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing at a rate given by roofing system manufacturer.

1. Seal top termination of base flashing with a strip of glass-fiber fabric set in cold applied flashing adhesive.

D. Roof Drains: Set [30-by-30-inch (760-by-760-mm)] <**Insert size**> 4 lb lead flashing sheet in a bed of MBR Flashing Cement on completed roofing membrane. Cover metal flashing with roofing membrane cap-sheet stripping and extend a minimum of 4 inches (100 mm) beyond edge of metal flashing onto field of roofing membrane. Clamp roofing membrane, metal flashing, and stripping into roof-drain clamping ring.

E. Roof Drains: Flash drain using PermaFlash system. Clamp roofing membrane, flashing, and stripping into roof-drain clamping ring.

1. Install stripping according to roofing system manufacturer's written instructions.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.12 WALKWAY INSTALLATION

A. Walkway Pads: Install walkway pads using units of size indicated or, if not indicated, of manufacturer's standard size according to walkway pad manufacturer's written instructions.

1. Sweep away loose aggregate surfacing and set walkway pads in additional flood coat of hot roofing asphalt.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.13 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform roof tests and inspections and to prepare test reports.

B. Final Roof Inspection: Arrange for roofing system manufacturer's Registered Roof Observer (RRO) to inspect roofing installation on completion and submit report to Architect.

C. Repair or remove and replace components of roofing system where test results or inspections indicate that they do not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.14 PROTECTION AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period.

B. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075113

SECTION 076200 - SHEET METAL FLASHING AND TRIM

GENERAL

1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

2. SUMMARY

A. Section Includes:

1. Manufactured Products:

a. Manufactured through-wall flashing and counterflashing.
b. Manufactured reglets and counterflashing.

3. PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Fabricate and install roof edge flashing and copings capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:

1. Wind Zone 1: For velocity pressures of 10 to 20 lbf/sq. ft. (0.48 to 0.96 kPa): 40-lbf/sq. ft. (1.92-kPa) perimeter uplift force, 60-lbf/sq. ft. (2.87-kPa) corner uplift force, and 20-lbf/sq. ft. (0.96-kPa) outward force.
2. Wind Zone 1: For velocity pressures of 21 to 30 lbf/sq. ft. (1.00 to 1.44 kPa): 60-lbf/sq. ft. (2.87-kPa) perimeter uplift force, 90-lbf/sq. ft. (4.31-kPa) corner uplift force, and 30-lbf/sq. ft. (1.44-kPa) outward force.
3. Wind Zone 2: For velocity pressures of 31 to 45 lbf/sq. ft. (1.48 to 2.15 kPa): 90-lbf/sq. ft. (4.31-kPa) perimeter uplift force, 120-lbf/sq. ft. (5.74-kPa) corner uplift force, and 45-lbf/sq. ft. (2.15-kPa) outward force.
4. Wind Zone 3: For velocity pressures of 46 to 104 lbf/sq. ft. (2.20 to 4.98 kPa): 208-lbf/sq. ft. (9.96-kPa) perimeter uplift force, 312-lbf/sq. ft. (14.94-kPa) corner uplift force, and 104-lbf/sq. ft. (4.98-kPa) outward force.

C. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

4. SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:

1. Identification of material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
4. Details of termination points and assemblies, including fixed points.
5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
7. Details of special conditions.
8. Details of connections to adjoining work.
9. Detail formed flashing and trim at a scale of not less than 1-1/2 inches per 12 inches (1:10)

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Sheet Metal Flashing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches (300 mm) long and in required profile. Include fasteners and other exposed accessories.
3. Accessories and Miscellaneous Materials: Full-size Sample.
4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

D. Qualification Data: For qualified fabricator.

E. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.

F. Warranty: Sample of special warranty.

5. QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

C. Copper Sheet Metal Standard: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical scupper, approximately 10 feet long, including supporting construction cleats, seams, attachments, underlayment, and accessories.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

6. DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

7. WARRANTY

A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

1. PRODUCTS

1. MANUFACTURED SHEET METAL FLASHING AND TRIM

A. Through-Wall Ribbed Sheet Metal Flashing: Manufacture through-wall sheet metal flashing for embedment in masonry with ribs at 3-inch intervals along length of flashing to provide an integral mortar bond. Manufacture through-wall flashing with snaplock receiver on exterior face to receive counterflashing.

2. FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.

E. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

G. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" for application, but not less than thickness of metal being secured.

H. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

I. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.

J. Do not use graphite pencils to mark metal surfaces.

3. ROOF DRAINAGE SHEET METAL FABRICATIONS

A. Downspouts: Fabricate round downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.
1. Aluminum: 0.032 inch (0.81 mm) thick.

B. Parapet Scuppers: Fabricate scuppers of dimensions required with closure flange trim to exterior, 6-inch-wide wall flanges to interior, and base extending 6 inches beyond cant or tapered strip into field of roof.
1. Aluminum: 0.032 inch (0.81 mm) thick.

C. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape indicated complete with outlet tubes, exterior flange trim, and built-in overflows. Fabricate from the following materials:
1. Aluminum: 0.032 inch (0.81 mm) thick.

D. Splash Pans: Fabricate from the following materials:
1. Aluminum: 0.040 inch (1.02 mm) thick.

E. Copings: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight.
1. Fabricate from the following materials:
a. Aluminum: 0.050 inch (1.27 mm) thick.

F. Roof and Roof to Wall Transition Roof to Roof Edge Flashing Transition Roof to Roof Edge Flashing and Fascia Cap Transition Expansion-Joint Cover: Fabricate from the following materials:
1. Aluminum: 0.050 inch (1.27 mm) thick.

G. Base Flashing: Fabricate from the following materials:
1. Aluminum: 0.040 inch (1.02 mm) thick.

H. Counterflashing: Fabricate from the following materials:
1. Aluminum: 0.032 inch (0.81 mm) thick.

I. Flashing Receivers: Fabricate from the following materials:
1. Aluminum: 0.032 inch (0.81 mm) thick.

4. WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings. Form with 2-inch- (50-mm-) high, end dams where flashing is discontinuous. Fabricate from the following materials:

1. Stainless Steel: 0.016 inch (0.40 mm) thick.

2. EXECUTION

1. EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

2. UNDERLAYMENT INSTALLATION

A. General: Install underlayment as indicated on Drawings.

B. Polyethylene Sheet: Install polyethylene sheet with adhesive for anchorage to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped and taped joints of not less than 2 inches (50 mm).

C. Felt Underlayment: Install felt underlayment with adhesive for temporary anchorage to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

D. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.

3. INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

3. Space cleats not more than 12 inches (300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
5. Install sealant tape where indicated.
6. Torch cutting of sheet metal flashing and trim is not permitted.
7. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.

1. Coat back side of uncoated aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.

D. Fastener Sizes: Use fasteners of sizes that will penetrate wood sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws Seal joints as shown and as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

4. ROOF DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

B. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints.

1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches (1500 mm) o.c. in between.
2. Provide elbows at base of downspout to direct water away from building.
3. Connect downspouts to underground drainage system indicated.

C. Parapet Scuppers: Install scuppers where indicated through parapet. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.

1. Anchor scupper closure trim flange to exterior wall and seal with elastomeric sealant] to scupper.
2. Loosely lock front edge of scupper with conductor head.
3. Seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.

D. Conductor Heads: Anchor securely to wall with elevation of conductor head rim 1 inch (25 mm) below scupper discharge.

E. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints a minimum of 4 inches (100 mm) in direction of water flow.

5. ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch (75-mm) Insert spacing centers.

C. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at [24-inch (600-mm)

D. Copings: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.

1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch (600-mm) centers.
2. Anchor interior leg of coping with screw fasteners and washers at 24-inch (600-mm) centers.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with sealant. Secure in a waterproof manner by means of snap-in installation and sealant or lead wedges and sealant.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomericsealant and clamp flashing to pipes that penetrate roof.

6. WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Through-Wall Flashing: Installation of through-wall flashing is specified in Division 04 Section "Unit Masonry."

C. Reglets: Installation of reglets is specified in Division 03 Section Division 04 Section "Unit Masonry."

D. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings.

7. MISCELLANEOUS FLASHING INSTALLATION

A. Overhead-Piping Safety Pans: Suspend pans independent from structure above as indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

B. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

8. ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

9. CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 079200 - JOINT SEALANTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes joint sealants for the following locations:

1. Exterior joints in vertical surfaces and non-traffic horizontal surfaces as indicated below:

   a. Control and expansion joints in unit masonry.
   b. Control and expansion joints in Portland cement plaster.
   c. Perimeter joints between materials listed above and frames of doors.
   d. Control and expansion joints in ceiling and overhead surfaces.
   e. Other joints as indicated.

2. Exterior joints in horizontal traffic surfaces as indicated below:

   a. Control, expansion, and isolation joints in cast-in-place concrete slabs.
   b. Other joints as indicated.

3. Interior joints in vertical surfaces and horizontal non traffic surfaces as indicated below:

   a. Control and expansion joints on exposed interior surfaces of exterior walls where indicated.
   b. Perimeter joints of exterior openings where indicated.
   c. Vertical control joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
   d. Perimeter joints between interior wall surfaces and frames of interior doors.
   e. Other joints as indicated.

4. Interior joints in horizontal traffic surfaces as indicated below:

   a. Control, construction, and isolation joints in cast-in-place concrete slabs where indicated.
   b. Other joints as indicated.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 07 Section “Sheet Metal Flashing and Trim” for sealants used in sheet metal work.
2. Division 09 Section “Gypsum Board Assemblies” for acoustical sealant related to sound partitions.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that have been produced and installed to establish and to maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.

1.4 SUBMITTALS

A. Product data from manufacturers for each joint sealant product required.

B. Samples for initial selection purposes in form of manufacturer's standard bead samples, consisting of strips of actual products showing full range of colors available, for each product exposed to view.

C. Certificates from manufacturers of joint sealants attesting that their products comply with specification requirements and are suitable for the use indicated.

D. Field-adhesion-test reports.

E. Provide and maintain a file of manufacturer’s instructions for each of the products used.

F. Sample warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed joint sealant applications similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of successful in-service performance.

B. Single Source Responsibility for Joint Sealant Materials: Obtain joint sealant materials from a single manufacturer for each different product required.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Conditions: Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer.
2. When joint substrates are wet.

B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.

C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.8 SEQUENCING AND SCHEDULING

A. Sequence installation of joint sealants in existing interior concrete pavement to occur prior to application of clear concrete sealing compound where indicated or scheduled on drawings.

PART 2 – PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, joint filler, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. Colors: Provide color of exposed joint sealants to comply with the following:

1. Provide selections made by Architect from manufacturer's full range of standard colors for products of type indicated.

C. Interior sealants comply with the limits of VOC content when calculated according to 40 CFR 59 Subpart D. Verify compliance with these requirements for all interior products shown in this section. All non-compliant products submitted will be rejected.

2.2 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing elastomeric sealants that comply with ASTM C 920, including those requirements referencing ASTM C 920 classifications for Type, Grade, Class, and Uses.

B. Products: Subject to compliance with requirements, provide one of the products specified.

C. Single Part Pourable Urethane Sealant for use in horizontal joints in floor slabs, sidewalks, and concrete pavement. Provide one of the following:

1. “Vulkem 45"; Tremco Incorporated.
2. “NR-201 Urexpan”; Pecora Corp.
3. “Sikaflex-1c SL”; Sika Corp.
4. “Sonolastic SL1"; Sonneborn Building Products.

D. Single Part Nonsag Urethane Sealant for use in sealing hollow metal door frames aluminum framing, windows and storefronts to adjoining wall surfaces, roof flashing and edge metal installations, and general purpose exterior sealing except where silicone is specified:

1. “Vulkem 921”; Tremco Incorporated.
2. “Dynatrol 1”; Pecora Corp.
3. “Sika Flex-1a”; Sika Corp.
4. “Sonolastic NP 1”; Sonneborn Building Products.

E. Medium-Modulus Neutral-Curing Silicone Sealant for perimeter sealing of interior aluminum windows and storefronts (accommodates joint movement of ±50 percent).

1. 791: Dow Corning.

a. Apply to masonry and concrete with Dow Corning 1200 Primer.

2. Sikasil WS-295: Sika Corporation.

a. Apply primer to substrate where required for adhesion, Sikasil 2100 primer.

F. Medium-Modulus Neutral-Curing Silicone Sealant for metal panels.

1. 795: Dow Corning (accommodates joint movement of ±50 percent).

a. Apply to metal wall panels.
b. Apply to stone cladding. Test adhesion and prime as required by manufacturer.

G. Expansion and Control Joint Sealant to be a one component, neutral cure, exterior grade silicone sealant and meet the following requirements, for adhered stone.

1. Basis of Design (BOD) LATICRETE MVIS Silicone Sealant

a.	Tensile Strength (ASTM C794):	280 psi (1.9 MPa)
b.	Hardness (ASTM D751; Shore A):	25 (colored sealant) / 15 (clear sealant)
c.	Weather Resistance (QUV Weather-ometer):	10000 hours (no change

2.3 LATEX JOINT SEALANTS

A. Acrylic-Emulsion Sealant: Manufacturer's standard, one part, nonsag, mildew-resistant, acrylic-emulsion sealant complying with ASTM C 834, formulated to be paintable and recommended for exposed applications on interior locations involving joint movement of not more than plus or minus 5 percent. Provide at intersections of interior door and window frames and adjoining wall surfaces.

1. "AC-20"; Pecora Corp.
3. "Sonolac"; Sonneborn Building Products.

2.4 ACOUSTICAL JOINT SEALANT

A. Acoustical sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following:

1. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
2. Install at perimeter joints around all electrical boxes in acoustically-rated walls and all drywall ceilings throughout Building, at Bunk Rooms, and elsewhere as indicated on drawings.

B. Manufacturer – Provide one of the following:

1. AC-20FTR Acoustical and Insulation Sealant; Pecora Corporation
2. Sheetrock Acoustical Sealant; USG Corp.

2.5 MILDEW – RESISTANT SILICONE SEALANT

A. One-part mildew-resistant interior sealant designed to seal nonporous interior building surfaces at kitchen and kitchen support areas including any tubs, sinks, lavatories, and urinals at perimeter intersection with finished walls.

B. Manufacturer: Provide one of the following:

1. Dow Corning 786 Mildew-Resistant Silicone Sealant.
2. Sanitary SCS1700 Sealant; G.E. Silicones

2.6 JOINT SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding strips of flexible plastic foam of either material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

1. Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, nonoutgassing in unruptured state.
2. Proprietary, reticulated, closed-cell polymeric foam, nonoutgassing, with a density of 2.5 pcf (40 kg/cu. m) and tensile strength of 35 psi (240 kPa) per ASTM D 1623, and with water absorption less than 0.02 g/cc per ASTM C 1083.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.7 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming in any way joint substrates and adjacent nonporous surfaces, and formulated to promote optimum adhesion of sealants with joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean concrete, masonry, unglazed surfaces of ceramic tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil- free compressed air.
3. Remove laitance and form release agents from concrete.
4. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealant manufacturer based on preconstruction joint sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's recommendations. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint sealant manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:

1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

   a. Do not leave gaps between ends of joint fillers.
   b. Do not stretch, twist, puncture, or tear joint fillers.
   c. Remove absorbent joint fillers that have become wet prior to sealant application and replace with dry material.

2. Install bond breaker tape between sealants where backer rods are not used between sealants and joint fillers or back of joints.

D. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.

E. Tooling of Non sag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

1. Provide concave joint configuration per Figure 8A in ASTM C 1193, unless otherwise indicated.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so that and installations with repaired areas are indistinguishable from original work.

END OF SECTION 079200

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SECTION 079500 - EXPANSION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior expansion control systems.
2. Exterior wall expansion control systems.
3. Parking and open-air structure expansion control systems.

B. Related Requirements:

1. Division 07 Section "Manufactured Roof Expansion Joints" for factory-fabricated roof expansion control.
2. Division 07 Section "Fire-Resistive Joint Systems" for liquid-applied joint sealants in fire-resistive building joints.
3. Division 07 Section "Joint Sealants" for liquid-applied joint sealants and for elastomeric sealants without metal frames.

1.3 ACTION SUBMITTALS

A. Shop Drawings: For each expansion control system specified. Include plans, elevations, sections, details, splices, blockout requirement, attachments to other work, and line diagrams showing entire route of each expansion control system. Where expansion control systems change planes, provide isometric or clearly detailed drawing depicting how components interconnect.

B. Samples: For each exposed expansion control system and for each color and texture specified, full width by 6 inches (150 mm) long in size.

C. Samples for Initial Selection: For each type of expansion control system indicated.

1. Include manufacturer's color charts showing the full range of colors and finishes available for each exposed metal and elastomeric seal material.

D. Samples for Verification: For each type of expansion control system indicated, full width by 6 inches (150 mm) long in size.

E. Product Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:

1. Manufacturer and model number for each expansion control system.
2. Expansion control system location cross-referenced to Drawings.
3. Nominal joint width.
4. Movement capability.
5. Classification as thermal or seismic.
6. Materials, colors, and finishes.
7. Product options.

8. Fire-resistance ratings.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each fire barrier provided as part of an expansion control system, for tests performed by a qualified testing agency.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. General: Provide expansion control systems of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.

1. Furnish units in longest practicable lengths to minimize field splicing. Install with hairline mitered corners where expansion control systems change direction or abut other materials.
2. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion control systems.

B. Coordination: Coordinate installation of exterior wall[**and soffit**] expansion control systems with roof expansion control systems to ensure that wall transitions are watertight. Roof expansion joint assemblies are specified in Division 07 Sections.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: Where indicated, provide expansion control systems with fire barriers identical to those of systems tested for fire resistance per UL 2079 or ASTM E 1966 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Hose Stream Test: Wall-to-wall and wall-to-ceiling systems shall be subjected to hose stream testing.

B. Seismic Performance: Expansion control systems shall withstand the effects of earthquake motions determined according to [**ASCE/SEI 7**] <**Insert requirement**>.

1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified[**and the system will be fully operational after the seismic event**]."
2. Component Importance Factor is [**1.5**] [**1.0**].

2.3 INTERIOR EXPANSION CONTROL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or a comparable product by one of the following:

1. Architectural Art Mfg., Inc.; Division of Pittcon Industries.
2. Balco, Inc.
3. Construction Specialties, Inc.
4. JointMaster/InPro Corporation.
5. Michael Rizza Company, LLC.

6. MM Systems Corporation.
7. Nystrom, Inc.
8. Watson Bowman Acme Corp.; a BASF Construction Chemicals business.
9. <**Insert manufacturer's name**>.

C. Source Limitations: Obtain expansion control systems from single source from single manufacturer.

D. Floor-to-Floor <**Insert drawing designation**>:

1. Basis-of-Design Product: [**Indicated on Drawings**] <**Insert manufacturer's name; product name or designation**>.
2. Design Criteria:

   a. Nominal Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
   b. Minimum Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
   c. Maximum Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
   d. Movement Capability: [**As indicated on Drawings**] [**As scheduled**] [**-25 percent/+75 percent**] <**Insert percentage**>.
   e. Type of Movement: [**As indicated on Drawings**] [**As scheduled**] [**Thermal**] [**Seismic**].
   f. Load Capacity:

      1) Uniform Load: [**150 lb/sq. ft. (732 kg/sq. m)**] <**Insert load**>.
      2) Concentrated Load: [**2000 lb (907 kg)**] <**Insert load**>.
      3) Maximum Deflection: [**0.5 inch (13 mm)**] <**Insert deflection**>.

   g. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than [**that indicated**] [**that of adjacent construction**] [**1 hour**] [**1-1/2 hours**] [**2 hours**] [**3 hours**] [**4 hours**] <**Insert rating**>.

3. Type: [**Cover plate**] [**Center plate**] [**Glide plate**] [**Hidden sightline**] [**Pan**] [**Elastomeric seal, recessed**] [**Elastomeric seal, surface mounted**] [**Dual elastomeric seal**].

   a. Cover-Plate Design: [**Plain**] [**Serrated**] [**Abrasive filled**] [**Recessed to accept field-applied finish materials**].

      1) Cover-Plate Recess Depth: [**As required to accommodate adjacent flooring**] [**1/8 inch (3 mm)**] [**3/8 inch (10 mm)**] <**Insert depth**>.

   b. Metal: Aluminum.

      1) Finish: [**Mill**] [**Clear anodic, Class I**] [**Clear anodic, Class II**] [**Color anodic, Class I**] [**Color anodic, Class II**] [**Manufacturer's standard**] <**Insert finish**>.

   c. Metal: Stainless steel.

      1) Finish: [**No. 2B**] [**No. 4**] [**Manufacturer's standard**] <**Insert finish**>.

   d. Metal: [**Bronze**] [**Brass**].

      1) Finish: [**Mill**] [**Manufacturer's standard**] <**Insert finish**>.

   e. Seal Material: [**Santoprene**] [**Manufacturer's standard**] <**Insert material**>.

      1) Color: [**Black**] [**Brown**] [**Beige**] [**Tan**] [**Gray**] [**White**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

E. Floor-to-Wall <**Insert drawing designation**>:

1. Basis-of-Design Product: [**Indicated on Drawings**] <**Insert manufacturer's name; product name or designation**>.
2. Design Criteria:

   a. Nominal Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
   b. Minimum Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
   c. Maximum Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
   d. Movement Capability: [**As indicated on Drawings**] [**As scheduled**] [**-25 percent/+75 percent**] <**Insert percentage**>.
   e. Type of Movement: [**As indicated on Drawings**] [**As scheduled**] [**Thermal**] [**Seismic**].
   f. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than [**that indicated**] [**that of adjacent construction**] [**1 hour**] [**1-1/2 hours**] [**2 hours**] [**3 hours**] [**4 hours**] <**Insert rating**>.

3. Type: [**Cover plate**] [**Center plate**] [**Glide plate**] [**Hidden sightline**] [**Pan**] [**Elastomeric seal, recessed**] [**Elastomeric seal, surface mounted**] [**Dual elastomeric seal**].

   a. Cover-Plate Design: [**Plain**] [**Serrated**] [**Abrasive filled**] [**Recessed to accept field-applied finish materials**].

      1) Cover-Plate Recess Depth: [**As required to accommodate adjacent flooring**] [**1/8 inch (3 mm)**] [**3/8 inch (10 mm)**] <**Insert depth**>.

   b. Metal: Aluminum.

      1) Finish: [**Mill**] [**Clear anodic, Class I**] [**Clear anodic, Class II**] [**Color anodic, Class I**] [**Color anodic, Class II**] [**Manufacturer's standard**] <**Insert finish**>.

   c. Metal: Stainless steel.

      1) Finish: [**No. 2B**] [**No. 4**] [**Manufacturer's standard**] <**Insert finish**>.

   d. Metal: [**Bronze**] [**Brass**].

      1) Finish: [**Mill**] [**Manufacturer's standard**] <**Insert finish**>.

   e. Seal Material: [**Santoprene**] [**Manufacturer's standard**] <**Insert material**>.

      1) Color: [**Black**] [**Brown**] [**Beige**] [**Tan**] [**Gray**] [**White**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

F. Wall-to-Wall <**Insert drawing designation**>:

1. Basis-of-Design Product: [**Indicated on Drawings**] <**Insert manufacturer's name; product name or designation**>.
2. Design Criteria:

   a. Nominal Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
   b. Minimum Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
   c. Maximum Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
   d. Movement Capability: [**As indicated on Drawings**] [**As scheduled**] [**-25 percent/+75 percent**] <**Insert percentage**>.
   e. Type of Movement: [**As indicated on Drawings**] [**As scheduled**] [**Thermal**] [**Seismic**].
   f. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than [**that indicated**] [**that of adjacent construction**] [**1 hour**] [**1-1/2 hours**] [**2 hours**] [**3 hours**] [**4 hours**] <**Insert rating**>.

3. Type: [**Cover plate**] [**Glide plate**] [**Snap-on cover**] [**Clip-in cover**] [**Elastomeric seal**] [**Dual elastomeric seal**] [**Accordion**] [**Flat seal**].

a. Metal: Aluminum.

1) Finish: [**Mill**] [**Clear anodic, Class I**] [**Clear anodic, Class II**] [**Color anodic, Class I**] [**Color anodic, Class II**] [**Manufacturer's standard**] <**Insert finish**>.

b. Metal: Stainless steel.

1) Finish: [**No. 2B**] [**No. 4**] [**Manufacturer's standard**] <**Insert finish**>.

c. Metal: [**Bronze**] [**Brass**].

1) Finish: [**Mill**] [**Manufacturer's standard**] <**Insert finish**>.

d. Seal Material: [**Santoprene**] [**PVC**] [**Manufacturer's standard**] <**Insert material**>.

1) Color: [**Black**] [**Brown**] [**Beige**] [**Tan**] [**Gray**] [**White**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

G. Wall Corner <**Insert drawing designation**>:

1. Basis-of-Design Product: [**Indicated on Drawings**] <**Insert manufacturer's name; product name or designation**>.
2. Design Criteria:

a. Nominal Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
b. Minimum Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
c. Maximum Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
d. Movement Capability: [**As indicated on Drawings**] [**As scheduled**] [**-25 percent/+75 percent**] <**Insert percentage**>.
e. Type of Movement: [**As indicated on Drawings**] [**As scheduled**] [**Thermal**] [**Seismic**].
f. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than [**that indicated**] [**that of adjacent construction**] [**1 hour**] [**1-1/2 hours**] [**2 hours**] [**3 hours**] [**4 hours**] <**Insert rating**>.

3. Type: [**Cover plate**] [**Glide plate**] [**Snap-on cover**] [**Clip-in cover**] [**Elastomeric seal**] [**Dual elastomeric seal**] [**Accordion**] [**Flat seal**].

a. Metal: Aluminum.

1) Finish: [**Mill**] [**Clear anodic, Class I**] [**Clear anodic, Class II**] [**Color anodic, Class I**] [**Color anodic, Class II**] [**Manufacturer's standard**] <**Insert finish**>.

b. Metal: Stainless steel.

1) Finish: [**No. 2B**] [**No. 4**] [**Manufacturer's standard**] <**Insert finish**>.

c. Metal: [**Bronze**] [**Brass**].

1) Finish: [**Mill**] [**Manufacturer's standard**] <**Insert finish**>.

d. Seal Material: [**Santoprene**] [**PVC**] [**Manufacturer's standard**] <**Insert material**>.

1) Color: [**Black**] [**Brown**] [**Beige**] [**Tan**] [**Gray**] [**White**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

H. Wall-to-Ceiling <**Insert drawing designation**>:

1. Basis-of-Design Product: [**Indicated on Drawings**] <**Insert manufacturer's name; product name or designation**>.

2. Design Criteria:

   a. Nominal Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
   b. Minimum Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
   c. Maximum Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
   d. Movement Capability: [**As indicated on Drawings**] [**As scheduled**] [**-25 percent/+75 percent**] <**Insert percentage**>.
   e. Type of Movement: [**As indicated on Drawings**] [**As scheduled**] [**Thermal**] [**Seismic**].
   f. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than [**that indicated**] [**that of adjacent construction**] [**1 hour**] [**1-1/2 hours**] [**2 hours**] [**3 hours**] [**4 hours**] <**Insert rating**>.

3. Type: [**Cover plate**] [**Glide plate**] [**Snap-on cover**] [**Clip-in cover**] [**Elastomeric seal**] [**Dual elastomeric seal**] [**Accordion**] [**Flat seal**].

   a. Metal: Aluminum.

      1) Finish: [**Mill**] [**Clear anodic, Class I**] [**Clear anodic, Class II**] [**Color anodic, Class I**] [**Color anodic, Class II**] [**Manufacturer's standard**] <**Insert finish**>.

   b. Metal: Stainless steel.

      1) Finish: [**No. 2B**] [**No. 4**] [**Manufacturer's standard**] <**Insert finish**>.

   c. Metal: [**Bronze**] [**Brass**].

      1) Finish: [**Mill**] [**Manufacturer's standard**] <**Insert finish**>.

   d. Seal Material: [**Santoprene**] [**PVC**] [**Manufacturer's standard**] <**Insert material**>.

      1) Color: [**Black**] [**Brown**] [**Beige**] [**Tan**] [**Gray**] [**White**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

I. Ceiling-to-Ceiling <**Insert Drawing Designation**>:

1. Basis-of-Design Product: [**Indicated on Drawings**] <**Insert manufacturer's name; product name or designation**>.
2. Design Criteria:

   a. Nominal Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
   b. Minimum Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
   c. Maximum Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
   d. Movement Capability: [**As indicated on Drawings**] [**As scheduled**] [**-25 percent/+75 percent**] <**Insert percentage**>.
   e. Type of Movement: [**As indicated on Drawings**] [**As scheduled**] [**Thermal**] [**Seismic**].
   f. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than [**that indicated**] [**that of adjacent construction**] [**1 hour**] [**1-1/2 hours**] [**2 hours**] [**3 hours**] [**4 hours**] <**Insert rating**>.

3. Type: [**Cover plate**] [**Glide plate**] [**Snap-on cover**] [**Clip-in cover**] [**Elastomeric seal**] [**Dual elastomeric seal**] [**Accordion**] [**Flat seal**].

   a. Metal: Aluminum.

      1) Finish: [**Mill**] [**Clear anodic, Class I**] [**Clear anodic, Class II**] [**Color anodic, Class I**] [**Color anodic, Class II**] [**Manufacturer's standard**] <**Insert finish**>.

   b. Metal: Stainless steel.

1) Finish: [**No. 2B**] [**No. 4**] [**Manufacturer's standard**] <**Insert finish**>.

c. Metal: [**Bronze**] [**Brass**].

1) Finish: [**Mill**] [**Manufacturer's standard**] <**Insert finish**>.

d. Seal Material: [**Santoprene**] [**PVC**] [**Manufacturer's standard**] <**Insert material**>.

1) Color: [**Black**] [**Brown**] [**Beige**] [**Tan**] [**Gray**] [**White**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

2.4 EXTERIOR WALL EXPANSION CONTROL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or a comparable product by one of the following:

1. Architectural Art Mfg., Inc.; Division of Pittcon Industries.
2. Balco, Inc.
3. Chase Construction Products; Division of Chase Corporation.
4. Construction Specialties, Inc.
5. D. S. Brown Company (The).
6. EMSEAL Corporation.
7. Erie Metal Specialties, Inc.
8. JointMaster/InPro Corporation.
9. LymTal International, Inc.
10. Michael Rizza Company, LLC.
11. MM Systems Corporation.
12. Nystrom, Inc.
13. RJ Watson, Inc.
14. Schul International Company, Inc.
15. Tremco Incorporated.
16. Watson Bowman Acme Corp.; a BASF Construction Chemicals business.
17. Williams Products, Inc.
18. <**Insert manufacturer's name**>.

C. Source Limitations: Obtain expansion control systems from single source from single manufacturer.

D. Wall-to-Wall <**Insert drawing designation**>:

1. Basis-of-Design Product: [**Indicated on Drawings**] <**Insert manufacturer's name; product name or designation**>.
2. Design Criteria:

a. Nominal Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
b. Minimum Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
c. Maximum Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
d. Movement Capability: [**As indicated on Drawings**] [**As scheduled**] [**-25 percent/+75 percent**] <**Insert percentage**>.
e. Type of Movement: [**As indicated on Drawings**] [**As scheduled**] [**Thermal**] [**Seismic**].
f. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than [**that indicated**] [**that of adjacent construction**] [**1 hour**] [**1-1/2 hours**] [**2 hours**] [**3 hours**] [**4 hours**] <**Insert rating**>.

3. Type: Cover plate.

a. Metal: Aluminum.

1) Finish: [**Mill**] [**Clear anodic, Class I**] [**Clear anodic, Class II**] [**Color anodic, Class I**] [**Color anodic, Class II**] [**Manufacturer's standard**] <**Insert finish**>.

b. Metal: Stainless steel.

1) Finish: [**No. 2B**] [**No. 4**] [**Manufacturer's standard**] <**Insert finish**>.

c. Metal: [**Bronze**] [**Brass**].

1) Finish: [**Mill**] [**Manufacturer's standard**] <**Insert finish**>.

4. Type: Flat seal.

a. Metal: [**Aluminum**] [**Stainless steel**].
b. Seal Material: [**Santoprene**] [**Neoprene**] [**Manufacturer's standard**].

1) Color: [**Black**] [**Brown**] [**Beige**] [**Tan**] [**Gray**] [**White**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

c. Pantograph Mechanism: Manufacturer's standard pantographic wind-load support mechanism with stainless-steel fasteners.

5. Type: Preformed cellular foam.

a. Foam Material: [**Manufacturer's standard**] [**Non-extruded, low-density, crosslinked, nitrogen-blown, ethylene-vinyl-acetate copolymer**] [**Polyurethane**].

1) Color: [**Manufacturer's standard**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

E. Wall Corner <**Insert drawing designation**>:

1. Basis-of-Design Product: [**Indicated on Drawings**] <**Insert manufacturer's name; product name or designation**>.
2. Design Criteria:

a. Nominal Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
b. Minimum Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
c. Maximum Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
d. Movement Capability: [**As indicated on Drawings**] [**As scheduled**] [**-25 percent/+75 percent**] <**Insert percentage**>.
e. Type of Movement: [**As indicated on Drawings**] [**As scheduled**] [**Thermal**] [**Seismic**].
f. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than [**that indicated**] [**that of adjacent construction**] [**1 hour**] [**1-1/2 hours**] [**2 hours**] [**3 hours**] [**4 hours**] <**Insert rating**>.

3. Type: Cover plate.

a. Metal: Aluminum.

1) Finish: [**Mill**] [**Clear anodic, Class I**] [**Clear anodic, Class II**] [**Color anodic, Class I**] [**Color anodic, Class II**] [**Manufacturer's standard**] <**Insert finish**>.

b. Metal: Stainless steel.

1) Finish: [**No. 2B**] [**No. 4**] [**Manufacturer's standard**] <**Insert finish**>.

c. Metal: [**Bronze**] [**Brass**].

1) Finish: [**Mill**] [**Manufacturer's standard**] <**Insert finish**>.

4. Type: Flat seal.

a. Metal: [**Aluminum**] [**Stainless steel**].
b. Seal Material: [**Santoprene**] [**Neoprene**] [**Manufacturer's standard**].

1) Color: [**Black**] [**Brown**] [**Beige**] [**Tan**] [**Gray**] [**White**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

c. Pantograph Mechanism: Manufacturer's standard pantographic wind-load support mechanism with stainless-steel fasteners.

5. Type: Preformed cellular foam.

a. Foam Material: [**Manufacturer's standard**] [**Non-extruded, low-density, crosslinked, nitrogen-blown, ethylene-vinyl-acetate copolymer**] [**Polyurethane**].

1) Color: [**Manufacturer's standard**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

F. Wall-to-Soffit <**Insert drawing designation**>:

1. Basis-of-Design Product: [**Indicated on Drawings**] <**Insert manufacturer's name; product name or designation**>.
2. Design Criteria:

a. Nominal Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
b. Minimum Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
c. Maximum Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
d. Movement Capability: [**As indicated on Drawings**] [**As scheduled**] [**-25 percent/+75 percent**] <**Insert percentage**>.
e. Type of Movement: [**As indicated on Drawings**] [**As scheduled**] [**Thermal**] [**Seismic**].
f. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than [**that indicated**] [**that of adjacent construction**] [**1 hour**] [**1-1/2 hours**] [**2 hours**] [**3 hours**] [**4 hours**] <**Insert rating**>.

3. Type: Cover plate.

a. Metal: Aluminum.

1) Finish: [**Mill**] [**Clear anodic, Class I**] [**Clear anodic, Class II**] [**Color anodic, Class I**] [**Color anodic, Class II**] [**Manufacturer's standard**] <**Insert finish**>.

b. Metal: Stainless steel.

1) Finish: [**No. 2B**] [**No. 4**] [**Manufacturer's standard**] <**Insert finish**>.

c. Metal: [**Bronze**] [**Brass**].

1) Finish: [**Mill**] [**Manufacturer's standard**] <**Insert finish**>.

4. Type: Flat seal.

a. Metal: [**Aluminum**] [**Stainless steel**].
b. Seal Material: [**Santoprene**] [**Neoprene**] [**Manufacturer's standard**].

1) Color: [**Black**] [**Brown**] [**Beige**] [**Tan**] [**Gray**] [**White**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

5. Type: Preformed cellular foam.

a. Foam Material: [**Manufacturer's standard**] [**Non-extruded, low-density, crosslinked, nitrogen-blown, ethylene-vinyl-acetate copolymer**] [**Polyurethane**].

1) Color: [**Manufacturer's standard**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

G. Soffit-to-Soffit <**Insert drawing designation**>:

1. Basis-of-Design Product: [**Indicated on Drawings**] <**Insert manufacturer's name; product name or designation**>.
2. Design Criteria:

a. Nominal Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
b. Minimum Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
c. Maximum Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
d. Movement Capability: [**As indicated on Drawings**] [**As scheduled**] [**-25 percent/+75 percent**] <**Insert percentage**>.
e. Type of Movement: [**As indicated on Drawings**] [**As scheduled**] [**Thermal**] [**Seismic**].
f. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than [**that indicated**] [**that of adjacent construction**] [**1 hour**] [**1-1/2 hours**] [**2 hours**] [**3 hours**] [**4 hours**] <**Insert rating**>.

3. Type: Cover plate.

a. Metal: Aluminum.

1) Finish: [**Mill**] [**Clear anodic, Class I**] [**Clear anodic, Class II**] [**Color anodic, Class I**] [**Color anodic, Class II**] [**Manufacturer's standard**] <**Insert finish**>.

b. Metal: Stainless steel.

1) Finish: [**No. 2B**] [**No. 4**] [**Manufacturer's standard**] <**Insert finish**>.

c. Metal: [**Bronze**] [**Brass**].

1) Finish: [**Mill**] [**Manufacturer's standard**] <**Insert finish**>.

4. Type: Flat seal.

a. Metal: [**Aluminum**] [**Stainless steel**].
b. Seal Material: [**Santoprene**] [**Neoprene**] [**Manufacturer's standard**].

1) Color: [**Black**] [**Brown**] [**Beige**] [**Tan**] [**Gray**] [**White**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

5. Type: Preformed cellular foam.

a. Foam Material: [**Manufacturer's standard**] [**Non-extruded, low-density, crosslinked, nitrogen-blown, ethylene-vinyl-acetate copolymer**] [**Polyurethane**].

1) Color: [**Manufacturer's standard**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

2.5 PARKING AND OPEN-AIR STRUCTURE EXPANSION CONTROL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or a comparable product by one of the following:

1. Architectural Art Mfg., Inc.; Division of Pittcon Industries.
2. Balco, Inc.
3. Chase Construction Products; Division of Chase Corporation.
4. Construction Specialties, Inc.
5. D. S. Brown Company (The).
6. EMSEAL Corporation.
7. Erie Metal Specialties, Inc.
8. JointMaster/InPro Corporation.
9. LymTal International, Inc.
10. Michael Rizza Company, LLC.
11. MM Systems Corporation.
12. Nystrom, Inc.
13. RJ Watson, Inc.
14. Schul International Company, Inc.
15. Tremco Incorporated.
16. Watson Bowman Acme Corp.; a BASF Construction Chemicals business.
17. Williams Products, Inc.
18. <**Insert manufacturer's name**>.

C. Source Limitations: Obtain expansion control systems from single source from single manufacturer.

D. Slab-to-Slab <**Insert drawing designation**>:

1. Basis-of-Design Product: [**Indicated on Drawings**] <**Insert manufacturer's name; product name or designation**>.
2. Design Criteria:

a. Nominal Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
b. Minimum Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
c. Maximum Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
d. Movement Capability: [**As indicated on Drawings**] [**As scheduled**] [**-25 percent/+75 percent**] <**Insert percentage**>.
e. Type of Movement: [**As indicated on Drawings**] [**As scheduled**] [**Thermal**] [**Seismic**].
f. Load Capacity:

1) Uniform Load: [**150 lb/sq. ft. (732 kg/sq. m)**] <**Insert load**>.
2) Concentrated Load: [**2000 lb (907 kg)**] <**Insert load**>.
3) Maximum Deflection: [**0.5 inch (13 mm)**] <**Insert deflection**>.

g. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than [**that indicated**] [**that of adjacent construction**] [**1 hour**] [**1-1/2 hours**] [**2 hours**] [**3 hours**] [**4 hours**] <**Insert rating**>.

3. Type: Metal plate.

a. Metal: Aluminum.

1) Finish: [**Mill**] [**Manufacturer's standard**] <**Insert finish**>.

b. Metal: Stainless steel.

1) Finish: [**No. 2B**] [**No. 4**] [**Manufacturer's standard**] <**Insert finish**>.

c. Attachment Method: [**Mechanical anchors**] [**Cast in**].

4. Type: Sealant T-joint.

a. Material: Premolded polyurethane.

1) Color: [**Black**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

5. Type: [**Strip seal**] [**Split-slab membrane**].

a. Metal: Aluminum.

1) Finish: [**Mill**] [**Manufacturer's standard**] <**Insert finish**>.

b. Metal: Stainless steel.

1) Finish: [**No. 2B**] [**No. 4**] [**Manufacturer's standard**] <**Insert finish**>.

c. Seal Material: [**Santoprene**] [**Neoprene**] [**Silicone**] [**EPDM**] [**PVC**] [**Manufacturer's standard**].

1) Color: [**Black**] [**Brown**] [**Beige**] [**Tan**] [**Gray**] [**White**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

d. Attachment Method: [**Mechanical anchors**] [**Cast in**].

6. Type: [**Rubber pad**] [**Compression seal**] [**Winged seal**] [**Epoxy-bonded seal**].

a. Seal Material: [**Santoprene**] [**Neoprene**] [**Silicone**] [**EPDM**] [**PVC**] [**Manufacturer's standard**].

1) Color: [**Black**] [**Brown**] [**Beige**] [**Tan**] [**Gray**] [**White**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

7. Type: Preformed cellular foam.

a. Foam Material: [**Manufacturer's standard**] [**Non-extruded, low-density, crosslinked, nitrogen-blown, ethylene-vinyl-acetate copolymer**] [**Polyurethane**].

1) Color: [**Manufacturer's standard**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

E. Slab-to-Wall <**Insert drawing designation**>:

1. Basis-of-Design Product: [**Indicated on Drawings**] <**Insert manufacturer's name; product name or designation**>.
2. Design Criteria:

a. Nominal Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
b. Minimum Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
c. Maximum Joint Width: [**As indicated on Drawings**] [**As scheduled**] <**Insert width**>.
d. Movement Capability: [**As indicated on Drawings**] [**As scheduled**] [**-25 percent/+75 percent**] <**Insert percentage**>.
e. Type of Movement: [**As indicated on Drawings**] [**As scheduled**] [**Thermal**] [**Seismic**].

f. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than [**that indicated**] [**that of adjacent construction**] [**1 hour**] [**1-1/2 hours**] [**2 hours**] [**3 hours**] [**4 hours**] <**Insert rating**>.

3. Type: Metal plate.

a. Metal: Aluminum.

1) Finish: [**Mill**] [**Manufacturer's standard**] <**Insert finish**>.

b. Metal: Stainless steel.

1) Finish: [**No. 2B**] [**No. 4**] [**Manufacturer's standard**] <**Insert finish**>.

c. Attachment Method: [**Mechanical anchors**] [**Cast in**].

4. Type: Sealant T-joint.

a. Material: Premolded polyurethane.

1) Color: [**Black**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

5. Type: [**Strip seal**] [**Split-slab membrane**].

a. Metal: Aluminum.

1) Finish: [**Mill**] [**Manufacturer's standard**] <**Insert finish**>.

b. Metal: Stainless steel.

1) Finish: [**No. 2B**] [**No. 4**] [**Manufacturer's standard**] <**Insert finish**>.

c. Seal Material: [**Santoprene**] [**Neoprene**] [**Silicone**] [**EPDM**] [**PVC**] [**Manufacturer's standard**].

1) Color: [**Black**] [**Brown**] [**Beige**] [**Tan**] [**Gray**] [**White**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

d. Attachment Method: [**Mechanical anchors**] [**Cast in**].

6. Type: [**Rubber pad**] [**Compression seal**] [**Winged seal**] [**Epoxy-bonded seal**].

a. Seal Material: [**Santoprene**] [**Neoprene**] [**Silicone**] [**EPDM**] [**PVC**] [**Manufacturer's standard**].

1) Color: [**Black**] [**Brown**] [**Beige**] [**Tan**] [**Gray**] [**White**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

7. Type: Preformed cellular foam.

a. Foam Material: [**Manufacturer's standard**] [**Non-extruded, low-density, crosslinked, nitrogen-blown, ethylene-vinyl-acetate copolymer**] [**Polyurethane**].

1) Color: [**Manufacturer's standard**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

2.6 ACCESSORIES

A. Moisture Barriers: Manufacturer's standard moisture barrier consisting of a continuous, waterproof membrane within joint and attached to substrate on sides of joint below the primary cover.

1. Drain-Tube Assemblies: Equip moisture barrier with drain tubes and seals to direct collected moisture [**to drain**] [**to exterior-wall expansion control system**] [**as indicated on Drawings**] <**Insert requirement**>.

2.7 MATERIALS

A. Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063-T5 for extrusions; ASTM B 209 (ASTM B 209M), Alloy 6061-T6 for sheet and plate.

1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.

B. Stainless Steel: ASTM A 240/A 240M or ASTM A 666, Type 304 for plates, sheet, and strips.

1. Remove tool and die marks and stretch lines or blend into finish.

C. Brass: ASTM B 36/B 36M, UNS Alloy C26000 for half hard sheet and coil.

D. Bronze: ASTM B 455, Alloy C38500 for extrusions; Alloy C23000 red brass for plates.

E. Elastomeric Seals: ASTM E 1783; preformed elastomeric membranes or extrusions to be installed in metal frames.

F. Compression Seals: ASTM E 1612; preformed elastomeric extrusions having an internal baffle system and designed to function under compression.

G. Cellular Foam Seals: Extruded, compressible foam designed to function under compression.

H. Elastomeric Concrete: Modified epoxy or polyurethane extended into a prepackaged aggregate blend, specifically designed for bonding to concrete substrates.

I. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to meet performance criteria for required fire-resistance rating.

J. Moisture Barrier: Flexible elastomeric material, [**PVC, minimum 30 mils thick**] [**EPDM, minimum 45 mils thick**] [**Santoprene**].

K. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

L. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.8 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 ALUMINUM FINISHES

A. Mill finish.

B. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.

C. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.

1. Color: [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**] <**Insert color**>.
2. Color: [**Match Architect's sample**] [**As selected by Architect from full range of industry colors and color densities**].

2.10 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: No. 4.

C. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces where expansion control systems will be installed for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to expansion control system manufacturer's written instructions.

B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion control systems. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion control systems.

C. Cast-In Frames: Coordinate and furnish frames to be cast into concrete.

3.3 INSTALLATION

A. Comply with manufacturer's written instructions for storing, handling, and installing expansion control systems and materials unless more stringent requirements are indicated.

B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion control systems.

1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation. Notify Architect where discrepancies occur that will affect proper expansion control system installation and performance.
3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
4. Repair or grout blockout as required for continuous frame support using nonmetallic, shrinkage-resistant grout.
5. Install frames in continuous contact with adjacent surfaces.

   a. Shimming is not permitted.

6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (75 mm) from each end and not more than 24 inches (600 mm) o.c.

C. Seals in Metal Frames: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.

1. Provide in continuous lengths for straight sections.
2. Seal transitions according to manufacturer's written instructions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.

D. Compression Seals: Apply adhesive or lubricant adhesive as recommended by manufacturer to both [**frame interfaces**] [**sides of slabs**] before installing compression seals.

E. Foam Seals: Install with adhesive recommended by manufacturer.

F. Epoxy-Bonded Seals: Pressurize seal for time period and to pressure recommended by manufacturer. Do not overpressurize.

G. Terminate exposed ends of expansion control systems with field- or factory-fabricated termination devices.

H. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion control system materials and associated work so complete assemblies comply with assembly performance requirements.

1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.

I. Moisture Barrier: Provide [**at all exterior joints and**]where indicated on Drawings. Provide drainage fittings[**at a maximum of 50 feet (15.2 m) or**] where indicated on Drawings.

3.4 PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion control systems. Reinstall cover plates or seals prior to Substantial Completion of the Work.

END OF SECTION 079500

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

1.GENERAL

1. SUMMARY

A. Section Includes:

1. Standard hollow metal doors and frames.

2. DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings.

B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

3. SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Samples for Verification:

1. For each type of exposed finish required

4. QUALITY ASSURANCE

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on NFPA 252 .

B. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL
9. Label each individual glazed lite.

5. DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.

1. Provide additional protection to prevent damage to finish of factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

2.PRODUCTS

1. MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amweld Building Products, LLC.
2. Benchmark; a division of Therma-Tru Corporation.
3. Ceco Door Products; an Assa Abloy Group company.
4. Curries Company; an Assa Abloy Group company.
5. Deansteel Manufacturing Company, Inc.
6. Firedoor Corporation.
7. Fleming Door Products Ltd.; an Assa Abloy Group company.
8. Habersham Metal Products Company.
9. Karpen Steel Custom Doors & Frames.
10. Kewanee Corporation (The).
11. Mesker Door Inc.
12. Pioneer Industries, Inc.
13. Security Metal Products Corp.
14. Steelcraft; an Ingersoll-Rand company.
15. Windsor Republic Doors.

2. MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.

D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvaized according to ASTM A 153/A 153M.

F. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

G. Mineral-Fiber Insulation: ASTM C 665, Type I.

H. Glazing: Comply with requirements in Division 08 Section "Glazing."

I. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

3. STANDARD HOLLOW METAL DOORS

A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.

1. Design: Flush panel.

2. Core Construction: Insulated R-6 core.

   a. Fire Door Core: As required to provide fire-protection [and temperature-rise] ratings indicated.

3. Vertical Edges for Single-Acting Doors: Square edge.
4. Top and Bottom Edges: Closed with flush 0.042-inch- thick same material as face sheets.
5. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
   1. Level 4 and Physical Performance Level A (Maximum Duty), Model 2 (Seamless).

C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
   1. Level 4 and Physical Performance Level A (Maximum Duty), Model 2 (Seamless).

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

4. STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Exterior Frames: Fabricated from metallic-coated steel sheet.

   1. Fabricate frames with mitered or coped corners.
   2. Fabricate frames as full profile welded unless otherwise indicated.
   3. Frames for Level 4 Steel Doors: 0.067-inch- thick steel sheet.

C. Interior Frames: Fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated.

   1. Fabricate frames with mitered or coped corners.
   2. Fabricate frames as full profile welded unless otherwise indicated.
   3. Fabricate knocked-down, drywall slip-on frames for in-place gypsum board partitions.
   4. Frames for Level 4 Steel Doors: 0.067-inch- thick steel sheet.
   5. Frames for Wood Doors: 0.053-inch- thick steel sheet.

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6.

5. FRAME ANCHORS

A. Jamb Anchors:

   1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
   2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:

   1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
   2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

6. STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.

B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

D. Terminated Stops: Where indicated on interior door frames, terminate stops 6 inches above finish floor with a 45-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.

7. LOUVERS

A. Provide louvers for interior doors, where indicated, that comply with SDI 111C, with blades or baffles formed of 0.020-inch- thick, cold-rolled steel sheet set into 0.032-inch- thick steel frame.

8. ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch- wide steel.

C. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

9. FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.

C. Hollow Metal Doors:

1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
2. Glazed Lites: Factory cut openings in doors.
3. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.

D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
4. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
5. Jamb Anchors: Provide number and spacing of anchors as follows:

a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

1) Two anchors per jamb up to 60 inches high.
2) Three anchors per jamb from 60 to 90 inches high.
3) Four anchors per jamb from 90 to 120 inches high.
4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

1) Three anchors per jamb up to 60 inches high.
2) Four anchors per jamb from 60 to 90 inches high.
3) Five anchors per jamb from 90 to 96 inches high.
4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
5) Two anchors per head for frames above 42 inches wide and mounted in metal-stud partitions.

c. Compression Type: Not less than two anchors in each jamb.
d. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom

of frame. Space anchors not more than 26 inches o.c.

6. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.

   a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
   b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

   1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
   2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
   3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
   4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

   1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
   2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
   3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
   4. Provide loose stops and moldings on inside of hollow metal work.
   5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

10. STEEL FINISHES

A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

   1. Shop Primer: ANSI/SDI A250.10.

B. Factory-Applied Paint Finish: ANSI/SDI A250.3.

11. Color and Gloss: As selected by Architect from manufacturer's full range.

3.EXECUTION

1. INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

a. At fire-protection-rated openings, install frames according to NFPA 80.
b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
c. Install frames with removable glazing stops located on secure side of opening.
d. Install door silencers in frames before grouting.
e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
8. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
9. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2. ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

SECTION 083323 - OVERHEAD COILING DOORS

1. GENERAL

1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

2. SUMMARY

A. Section Includes:

1. Service doors.
2. Counter doors.

3. PERFORMANCE REQUIREMENTS

A. Structural Performance, Exterior Doors: Exterior overhead coiling doors shall withstand the wind loads, the effects of gravity loads, and loads and stresses within limits and under conditions indicated according to.

1. Wind Loads: As indicated on Drawings.

B. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to.

4. SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Show locations of replaceable fusible links.
3. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Curtain Slats: 12 inches long.
2. Bottom Bar: 6 inches long.
3. Guides: 6 inches long.
4. Brackets: 6 inches square.
5. Hood: 6 inches square.
6. Laminate-Clad Counter Panel Product: 6 inches square; for each type, color, pattern, and surface finish; laminated to core.

D. Seismic Qualification Certificates: For overhead coiling doors, accessories, and components, from manufacturer.

E. Oversize Construction Certification: For door assemblies required to be fire-rated and that exceed size limitations of labeled assemblies.

F. Maintenance Data.

5. QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.PRODUCTS

1. DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
1. Stainless-Steel Door Curtain Slats: ASTM A 666, Type 304; sheet thickness of 0.025 inch (0.64 mm) and as required to meet requirements.

B. Bottom Bar for Service Doors: Consisting of two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; fabricated from manufacturer's standard hot-dip galvanized steel, stainless steel, or aluminum extrusions to match curtain slats and finish.

C. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain[, and a continuous bar for holding windlocks].

2. HOOD

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
1. Stainless Steel: 0.025-inch- thick stainless-steel sheet, Type 304, complying with ASTM A 666.

3. COUNTER DOORS

A. Integral Frame, Hood, and Fascia for Counter Door: Welded sheet metal assembly of the following sheet metal:

1. Stainless Steel: [0.062-inch- (1.59-mm-)] <Insert thickness> thick stainless-steel sheet, Type 304, complying with ASTM A 666.

4. LOCKING DEVICES

A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: Provide cylinders standard with manufacturer and keyed to building system.
2. Keys: Provide Two for each cylinder.

B. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

5. CURTAIN ACCESSORIES

A. Weatherseals: Equip each exterior door with weather-stripping gaskets fitted to entire perimeter of door for a weathertight installation, unless otherwise indicated.

B. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

C. Automatic-Closing Device for Fire-Rated Doors: Equip each fire-rated door with an automaticclosing device that is inoperative during normal door operations and that has a governor unit complying with NFPA 80 and an easily tested and reset release mechanism designed to be activated by the following:

1. Replaceable fusible links with temperature rise and melting point of 165 deg F interconnected and mounted on both sides of door opening.

6. COUNTERBALANCING MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

7. MANUAL DOOR OPERATORS

A. Equip door with manufacturer's recommended manual door operator unless another type of door operator is indicated.

B. Push-up Door Operation: Design counterbalance mechanism so required lift or pull for door operation does not exceed.

8. ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door specified, with electric motor and factory-prewired motor controls, starter, gear-

reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24 V, ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Electric Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 11 Section "Common Motor Requirements for Equipment" unless otherwise indicated.

1. Electrical Characteristics:

a. Phase: Single phase.
b. Volts: 115 V.
c. Hertz: 60.

2. Motor Type and Controller: Reversible motor and controller (disconnect switch) for motor exposure indicated.
3. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
4. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.

D. Obstruction Detection Device: Equip motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel.

1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.

a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained pressure on close button.

E. Remote-Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop."

1. Interior units, full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
2. Exterior units, full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.

F. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.

G. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

H. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

9. DOOR ASSEMBLY

A. Service, Counter Door: Overhead coiling door formed with curtain of interlocking metal slats.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide Overheard Door Company, 651 series or comparable product by one of the following:

a. ACME Rolling Doors.
b. Alpine Overhead Doors, Inc.
c. AlumaTek, Inc.
d. C.H.I. Overhead Doors.
e. City-Gates.
f. Cookson Company.
g. Cornell Iron Works, Inc.
h. Dynamic Closures Corp.
i. Lawrence Roll-Up Doors, Inc.
j. Mahon Door Corporation.
k. McKeon Rolling Steel Door Company, Inc.
l. Metro Door.
m. Overhead Door Corporation.
n. QMI Security Solutions.
o. Raynor.
p. Southwestern Steel Rolling Door Co.
q. Wayne-Dalton Corp.
r. Windsor Door.

B. Operation Cycles: Not less than 50,000.

1. Include tamperproof cycle counter. C. Door Curtain Material: Stainless steel.

D. Door Curtain Slats: Flat profile slats of 1-7/8-inch center-to-center height.

E. Curtain Jamb Guides: Stainless steel with exposed finish matching curtain slats.

F. Hood: Stainless steel.

G. Integral Frame, Hood, and Fascia for Counter Door: Stainless steel.

H. Sill Configuration for Counter Door: [No sill] [Integral metal sill].

Electric Door Operator:

1. Usage Classification: Heavy duty, 60 to 90 cycles per hour.
2. Motor Exposure: Interior.
3. Emergency Manual Operation: Chain type.
4. Obstruction-Detection Device: Automatic electric sensor edge on bottom bar.

5. Remote-Control Station: Where shown on Drawings

I. Door Finish:
1. Stainless-Steel Finish: No. 4 (polished directional satin).

10. GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

11. ALUMINUM FINISHES

A. Mill Finish: Manufacturer's standard.

B. Clear Anodic Finish: AAMA 611, [AA-M12C22A41, Class I, 0.018 mm] [AA-M12C22A31, Class II, 0.010 mm] or thicker.

C. Color Anodic Finish: AAMA 611, [AA-M12C22A42/A44, Class I, 0.018 mm] [AA-M12C22A32/ A34, Class II, 0.010 mm] or thicker.

D. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, application, and baking.

12. STEEL AND GALVANIZED-STEEL FINISHES

A. Factory Prime Finish: Manufacturer's standard primer, compatible with field-applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

B. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

13. STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: No. 4.

C. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

3.EXECUTION

1. EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work. B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

2. INSTALLATION

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install overhead coiling doors, hoods, and operators at the mounting locations indicated for each door.

C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility. D. Fire-Rated Doors: Install according to NFPA 80.

E. Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.

3. STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

4. ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide weathertight fit around entire perimeter.

5. DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 083323

SECTIONAL OVERHEAD DOORS

1.GENERAL

1.1.SECTION INCLUDES

A. Glazed Aluminum Sectional Overhead Doors

B. Electric Operators and Controls.

C. Operating Hardware, tracks, and support.

1.2.RELATED SECTIONS

A. Section 03300 - Cast-In-Place Concrete: Prepared opening in concrete. Execution requirements for placement of anchors in concrete wall construction.

B. Section 04810 - Unit Masonry Assemblies: Prepared opening in masonry. Execution requirements for placement of anchors in masonry wall construction.

C. Section 05500 - Metal Fabrications: Steel frame and supports.

D. Section 06114 - Wood Blocking and Curbing: Rough wood framing and blocking for door opening.

E. Section 07900 - Joint Sealers: Perimeter sealant and backup materials.

F. Section 08710 - Door Hardware: Cylinder locks.

G. Section 09900 - Paints and Coatings: Field painting.

H. Section 11150 – Parking Control Equipment: Remote door control.

I. Section 16130 - Raceway and Boxes: Empty conduit from control station to door operator.

J. Section 16150 - Wiring Connections: Electrical service to door operator.

1.3.REFERENCES

A. ANSI/DASMA 102 - American National Standard Specifications for Sectional Overhead Type Doors.

1.4.DESIGN / PERFORMANCE REQUIREMENTS

A. Wiring Connections: Requirements for electrical characteristics.
   1.115 volts, single phase, 60 Hz.
   2.230 volts, single phase, 60 Hz.
   3.230 volts, three phase, 60 Hz.
   4.460 volts, three phase, 60 Hz.

B. Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.

1.5.SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1.Preparation instructions and recommendations.
   2.Storage and handling requirements and recommendations.
   3.Installation methods.

C. Shop Drawings: Indicate plans and elevations including opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.

D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

E. Operation and Maintenance Data.

1.6.QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Installer Qualifications: Authorized representative of the manufacturer with minimum five years documented experience.

C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.

1.7.DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened labeled packaging until ready for installation.

B. Protect materials from exposure to moisture until ready for installation.

C. Store materials in a dry, ventilated weather tight location.

1.8.PROJECT CONDITIONS

A. Pre-Installation Conference: Convene a pre-installation conference just prior to commencement of field operations, to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.

2.GENERAL

2.1.MANUFACTURERS

A. Acceptable Manufacturer: Overhead Door Corp., 2501 S. State Hwy. 121, Suite 200, Lewisville, TX 75067. ASD. Tel. Toll Free: (800) 275-3290. Phone: (469) 549-7100. Fax: (972) 906-1499. Web Site: www.overheaddoor.com. E-mail: sales@overheaddoor.com.

B. Substitutions: Or Equal – With Architects approval.

C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2.GLAZED ALUMINUM SECTIONAL OVERHEAD DOORS

A. Glazed Sectional Overhead Doors: 511 Series Aluminum Doors by Overhead Door Corporation. Units shall have the following characteristics:
1.Door Assembly: Stile and rail assembly secured with 1/4 inch (6 mm).diameter through rods.
a. Panel Thickness: 1-3/4 inches (44 mm).
b. Center Stile Width: 21/32 inch (17 mm).
c. End Stile Width: 2-3/4 inches (70 mm).
d. Intermediate Rail Pair Width: 1-3/8 inches (35 mm).
e. Top Rail Width:
1) 3-3/4 inches (95 mm).
f. Bottom Rail Width:
1) 4-1/2 inches (114 mm).
g. Aluminum Panels: 0.050 inch (1.3 mm) thick, aluminum.
h. Stiles and Rails: 6063 - T6 aluminum.
i. Springs:
1) 10,000 cycles.
j. Glazing:

1) 1/2 inch (12.5 mm) Insulating glass.

2.Finish and Color:
a. Anodized Finish: Clear anodized.

3.Hardware: Galvanized steel hinges and fixtures. Ball bearing rollers with hardened steel races.

4.Lock: Interior galvanized single unit.

5.Weatherstripping:
a. Flexible bulb-type strip at bottom section.
b. Flexible Jamb seals.
c. Flexible Header seal.

6.Track: Provide track as recommended by manufacturer to suit loading required and clearances available.

7.Manual Operation: Pull rope.

8.Manual Operation: Chain hoist.

9.Electric Motor Operation: Provide UL listed electric operator, size and type as recommended by manufacturer to move door in either direction at not less than 2/3 foot nor more than 1 foot per second. Operator shall meet UL325/2010 requirements for continuous monitoring of safety devices.
a. Entrapment Protection: Required for momentary contact, includes radio control operation.
1) Pneumatic sensing edge up to 18 feet (5.5 m) wide. Constant contact only complying with UL 325/2010.
2) Electric sensing edge monitored to meet UL 325/2010.
3) Photoelectric sensors monitored to meet UL 325/2010.
b. Operator Controls:
1) Key operated control stations with open, close, and stop buttons.
2) Push-button and key operated control stations with open, close, and stop buttons.
3) Surface mounting.
4) Both interior and exterior location.
c. Special Operation:
1) Radio control operation.
2) Card reader control.
3) Photocell operation.

3.EXECUTION

3.1.EXAMINATION

A. Do not begin installation until openings have been properly prepared.

B. Verify wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.

C. Verify electric power is available and of correct characteristics.

D. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2.PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3.INSTALLATION

A. Install overhead doors and track in accordance with approved shop drawings and the manufacturer's printed instructions.

B. Coordinate installation with adjacent work to ensure proper clearances and allow for maintenance.

C. Anchor assembly to wall construction and building framing without distortion or stress.

D. Securely brace door tracks suspended from structure. Secure tracks to structural members only.

E. Fit and align door assembly including hardware.

F. Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components.

3.4.CLEANING AND ADJUSTING

A. Adjust door assembly to smooth operation and in full contact with weather-stripping.

B. Clean doors, frames and glass.

C. Remove temporary labels and visible markings.

3.5.PROTECTION

A. Do not permit construction traffic through overhead door openings after adjustment and cleaning.

B. Protect installed products until completion of project.

C. Touch-up, damaged coatings and finishes and repair minor damage before Substantial Completion.

END OF SECTION

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

1.GENERAL

1. SUMMARY

A. Section Includes:

1. Exterior storefront framing.
2. Exterior manual-swing entrance doors and door-frame units.

2. PERFORMANCE REQUIREMENTS

A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:

1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
2. Dimensional tolerances of building frame and other adjacent construction.
3. Failure includes the following:

a. Deflection exceeding specified limits.
b. Thermal stresses transferring to building structure.
c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
d. Glazing-to-glazing contact.
e. Noise or vibration created by wind and by thermal and structural movements.
f. Loosening or weakening of fasteners, attachments, and other components.
g. Sealant failure.
h. Failure of operating units.

B. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.

2. Seismic Loads: As indicated on Drawings.

D. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch, whichever is smaller.

E. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
1. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
2. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.

3. SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.

B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.

1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.

C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

D. Other Action Submittals:

1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

E. Delegated-Design Submittal: For aluminum-framed systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems, indicating compliance with performance requirements.

G. Field quality-control reports.

H. Warranties: Sample of special warranties.

4. QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

C. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.

D. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

E. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.

F. Preinstallation Conference: Conduct conference at Project site.

5. PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

2.PRODUCTS

1. MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Basis-of-Design Product: Kawneer 451-T. Subject to compliance with requirements, provide Kawneer or comparable product by one of the following:

1. Arcadia, Inc.
2. Arch Aluminum & Glass Co., Inc.
3. CMI Architectural
4. Commercial Architectural Products, Inc.
5. EFCO Corporation.
6. Kawneer North America; an Alcoa company.
7. Leed Himmel Industries, Inc.
8. Pittco Architectural Metals, Inc.
9. TRACO.
10. Tubelite.
11. United States Aluminum.
12. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.
13. YKK AP America Inc.
14. Wausau.

2. MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

3. FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken.

2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Center.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads[, finished to match framing system.

D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.

E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

4. SINGLE HUNG AND OPERABLE WINDOW UNITS

A. Window Type: Single hung and Operable.

B. AAWA/WDMA Performance Requirement: Provide aluminum window of performance class and grade of HC70, that complies with AAMA/WDMA 101/I.S.2/NAFS.

C. Condensation-resistance factor: (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503 , showing a CRF of 49.

D. Thermal Transmittance; Provide aluminum window with a whole-window, U-Factor maximum indicated at 15-mph exterior wind velocity and winter condition temperatures when tested according to AAMA 1503.
1. U-Factor: 0.45 Btu/sq.ft x h x deg F.

E. Air infiltration: Maximum rate not more than indicated when tested according to AAMA/WDMA 101/I.S.2/NAFAS, air infiltration test. Maximum Rate: 0.2 cfm/sq.ft. of air at inward test pressure of 6.24 lbf/sq.ft.

F. Water Resistance: No water resistance as defined in AAMA/WDMA refrenced test methods at a water test pressure equaling that indicated, when testing according to AAMA/WDMA 101.I.S.2/NAFS, water resistance test.
1. Test Pressure: 20 percent of positive design pressure, but not more than 15 lbs/sq.ft.

G. Glazing: Match the adjacent storefront system.

H. Provide heavy duty hinges, balances and standard sweep lock.

5. GLAZING SYSTEMS

A. Glazing: As specified in Division 08 Section "Glazing."

B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

6. ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.

1. Door Construction: [1-3/4-inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

2. Door Design: Narrow stile; 2-1/8-inch nominal width.

a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches above floor or ground plane.

3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

a. Provide non-removable glazing stops on outside of door.

B. Entrance Door Hardware: As specified in Division 08 Section "Door Hardware."

7. ENTRANCE DOOR HARDWARE

A. General: Provide entrance door hardware and entrance door hardware sets indicated in "Entrance Door Hardware Sets" Article for each entrance door to comply with requirements in this Section.

1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and [named manufacturers' products] [products equivalent in function and comparable in quality to named products] [products complying with BHMA standard referenced].
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
3. Opening-Force Requirements:

a. Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbf to set the door in motion[and not more than 15 lbf to open the door to its minimum required width.
b. Accessible Interior Doors: Not more than 5 lbf to fully open door.

8. ACCESSORY MATERIALS

A. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.

9. FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Provisions for field replacement of glazing from [exterior] [interior] [interior for vision glass and exterior for spandrel glazing or metal panels].
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At exterior doors, provide compression weather stripping at fixed stops.
2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

10. ALUMINUM FINISHES

A. High-Performance Organic Finish: 2-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

3.EXECUTION

1. INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.

2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

F. Install glazing as specified in Division 08 Section "Glazing."

G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

H. Install perimeter joint sealants as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

2. FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections.

B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive phases as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.
1. Water Spray Test: Before installation of interior finishes has begun, a minimum area of 75 feet (23 m) by 1 story of aluminum-framed systems designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

C. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.

END OF SECTION 084113

SECTION 084126 - ALL-GLASS ENTRANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 PRE-INSTALLATION MEETINGS

A. Pre-installation Conference: Refer to Division 01 Section "Project Requirements".

1.3 SUBMITTALS

A. Product Data: For each type of all-glass entrance component specified. Details of construction relative to materials, dimensions of individual components, profiles, and finishes, including:

1. Glass panels.
2. Rail and Patch fittings.
3. Closer and pivots.
4. Door hardware and accessories.

B. Shop Drawings: Show details of fabrication and installation, including the following:

1. Plans, elevations, and sections.
2. Details of fittings.
3. Hardware quantities, locations, and installation requirements.
4. Anchorages and reinforcement.
5. Glazing details.
6. Door hardware locations, mounting heights, and installation requirements.

C. Samples for Verification: For each type of exposed finish indicated, prepared on Samples of size indicated below as required by Architect.

1. Metal Finishes: 6-inch (150-mm) long sections of rail fittings.
2. Glass: 12-inch (300 mm) square, showing exposed-edge finish and tint.

D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, sidelites, transoms, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

E. Maintenance Data: For all-glass systems to include in maintenance manuals.

1.4 PROJECT CONDITIONS

A. Field Measurements: Verify opening dimensions of all-glass entrances by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.5 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: Submit a written warranty executed by the manufacturer agreeing to repair or replace components of all-glass entrances that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:

1. Structural failures.
2. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
3. Failure of operating components to function normally.

C. General Warranty Period: Two years from date of Substantial Completion.

1. Concealed Floor Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design all-glass entrances and storefronts.

B. General Performance: Comply with performance requirements specified, as determined by testing of all-glass entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings
3. Deflection Limits: In accordance with GANA “Fully Tempered Heavy Glass Door and Entrance Systems Design Guide.”

D. Seismic Performance: All-glass entrances and storefronts shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. Coordinate requirements with structural engineer.

E. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

F. Accessibility Standards: Comply with applicable provisions in Accessibility Guidelines for Buildings and Facilities ICC (ANSI) A117.1 and requirements of authorities having jurisdiction.

2.2 MANUFACTURERS

A. Basis-of-Design Products: Subject to compliance with requirements, provide the named product, or the comparable product by one of the alternate specified manufacturers. Comparable products are subject to review and approval through the submittal process specified.

B. Manufacturers (All Glass Doors): Subject to compliance with requirements, provide products by one of the following:

1. Rockwood (All Glass Door components).

2.3 ENTRANCE DOOR MATERIALS

A. Clear Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated surfaces), Type I (transparent), Class 1 (clear) requirements. Provide products of thickness indicated that have been tested for surface and edge compression according to ASTM C 1048 and for impact strength according to CPSC 16 CFR, Part 1201 for Category II materials.

1. Thickness: 1/2 inch (13 mm)
2. Exposed Edges: Flat polished.
3. Butt Edges: Flat polished.
4. Corner Edges: Mitered.

B. Aluminum: Alloy and temper recommended by manufacturer for use and finish indicated, but not less than the strength and durability properties of ASTM B 221 (M), alloy 6063-T5.

2.4 ENTRANCE DOOR COMPONENTS

A. Patch Fittings: Provide manufacturer's standard patch fittings for all-glass entrance configurations required, unless otherwise indicated, and as follows:

1. Material: Aluminum.
2. Basis of Design: Rockwood #PFD.

B. Floating Transom Bar: Manufacturer's standard aluminum, floating transom bar clad in metal matching fittings in size recommended by manufacturer for application indicated.

1. Support Fins: Tempered glass matching the transom glass.

C. Sidelite Channels: Provide manufacturer's standard head and sill channels for sidelite and transom-head support matching fitting-metal finish, unless otherwise indicated.

D. Concealed Sidelite Channels: Provide manufacturer's standard recessed head and sill channels for concealed sidelite and transom-head support, unless otherwise indicated.

E. Rails: Manufacturer's standard continuous horizontal fittings and as follows:

1. Rail Locations: As follows:

   a. Door tops and bottoms.
   b. Transom tops. Provide with manufacturer's standard fixed-mounting system.
   c. Sidelite tops. Provide with manufacturer's standard fixed-mounting system.
   d. Sidelite bottoms. Provide with manufacturer's standard fixed-mounting system.

2. Top Rail Height: 4 inch tapered (102 mm).
3. Top Rail Profile: Tapered no less than 60 degrees from horizontal.
4. Bottom Rail Height: 6 inch (153 mm).
5. Bottom Rail Profile: Tapered no less than 60 degrees from horizontal.
6. One piece dry glazed compression system that accommodates 3/8” to 9/16” or 5/8” to 13/16” thick glass.
7. End Caps: One-piece aluminum, beveled.
8. Material: Aluminum.
9. Material: Bright or satin stainless-steel-cladding.
10. Basis of Design: Rockwood #DRT/DRS x Height.

F. Accessory Fittings: Manufacturer's standard accessory fittings matching patch fitting or rail metal and finish for the following:

1. Overhead doorstop.
2. Center-housing lock.
3. Glass-support fins.

G. Anchors and Fastenings: Manufacturer's standard concealed anchors and fastenings.

H. Weather Stripping; Brush type; replaceable without removing all-glass entrance doors from pivots.

2.5 ENTRANCE DOOR HARDWARE

A. General: Heavy-duty entrance door hardware units in sizes, quantities, and types recommended by manufacturer for all-glass entrance systems indicated. For exposed parts, match metal and finish of patch fittings and rail fittings.

B. Refer to section 080671 “Door Hardware Schedule” for specific hardware sets.

C. Pivots: ANSI/BHMA A156.4, Grade 1.

1. Center and Offset Hung Top Pivots:

a. Walking beam type (overhead).
b. Surface mounted offset type (top rails).

2. Bottom Pivots:

a. End load type (bottom rails).
b. Adjustable bottom types compatible with bottom patches.

3. Manufacturers:

a. Rockwood (GS) - PV and PF Series.

D. Cylinders and Keying: Refer to Section 087100 Door Hardware.

E. Panic Devices: Certified panic devices conforming to ANSI/BHMA A156.3, Grade 1 Certified complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Device to be ADA compliant requiring less than 5 lbs. of force to activate and meet California Building Code (2013) Sec 11B.309.4.Post mounting with optional mechanical dogging. Provide proper fasteners as required by manufacturer to meet application requirements. Provide exit devices on both leaves of pairs of doors.

1. Style: Exposed vertical rod. 1-1/4” grip diameter with interior operating panic handle in combination with exterior fixed pull handle. Panic mechanism shall be concealed within brass or stainless steel tubing. Optional entrance from exterior by a keyed cylinder.
2. Configurations (provide as specified):

a. Full Height L-Shape Pull.
b. Half Height L-Shape Pull.
c. Full Height Straight Pull.
d. Half Height Straight Pull.
e. Half Height Centered Straight Pull.
f. Horizontal Straight Pull.
g. Exit Only (No Exterior Pull).

3. Push/pull operation when dogged from the inside.
4. Latching: Top latching. Reversed, flat, Pullman style. Roller-type latching not acceptable.

5. Options for engraved "PUSH" signage infill and boundary grooves.

6. Manufacturers:

a. Rockwood (GS) - PDU8000 Series.

F. Locking Pull System: Post-mount style door pulls with integrated deadbolt locking system in type and design as specified in the Hardware Sets. Pulls available in multiple head, floor, or combination locking and strike options, with outside keyed rim cylinder operation and inside turn piece activation. Customized sizing and configuration options.

1. Manufacturers:

a. Rockwood (GS) - LP/DP Series.

G. Overhead Concealed Closers (Medium Duty): Center hung, BHMA A156.4, Grade 1; units including arms, pivots, cover plates, mounting clips, and accessories required for complete installation. Provide separate closing and latching valves for closing speed, latch speed, backcheck, and optional hold open.

1. Compact cast iron closers capable of being fully concealed in the frame head for center hung applications.
2. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, interior or exterior application, and exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ICC/ANSI A117.1.
3. Closer Accessories: Provide door closer accessories including custom spindles and templates as required for proper installation.
4. Double acting, non-handed with adjustable spring power size 1 through 3.

5. Manufacturers:

a. Rockwood (GS) - OHC 609 Series.

H. Floor Stops and Overhead Door Stops and Holders: ANSI/BHMA A156.16, Grade 1 certified. Provide floor stops as specified unless overhead door stops and holders are indicated in the hardware sets. Overhead stops and holders to be concealed type. Track, slide, arm and header bracket to be constructed of stainless steel and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:

a. Rockwood (GS).

2.6 FABRICATION

A. General: Fabricate all-glass entrance components in sizes, profiles, and configurations indicated on Drawings.

B. Provide holes and cutouts in glass to receive hardware, fittings, and accessory fittings before tempering glass. Do not cut, drill, or make other alterations to glass after tempering.

1. Fully temper glass using horizontal (roller-hearth) process, and fabricate so that when glass is installed, roll-wave distortion is parallel with bottom edge of door or lite.

C. Factory assemble components and factory install hardware and fittings to greatest extent possible.

2.7 FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

2.8 ALUMINUM FINISHES

A. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

B. Clear Anodic Finish: AA-M21C22A41 (Mechanical Finish: smooth specular, buffed; Chemical Finish: etched, medium matte; Anodic Coating: Comply with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 DOOR INSTALLATION

A. General: Comply with all-glass entrance manufacturer's written installation instructions and approved shop drawings.

B. Install all-glass door assemblies after other finishing operations have been completed. Coordinate installation of recesses housings with installation of adjacent finishes.

C. Set units level, plumb, and true to line, with uniform joints.

D. Maintain uniform clearances between adjacent components.

E. Set, seal, and grout floor closer cases as required to suit hardware and substrate indicated.

F. Install butt-joint sealants according to manufacturer's instructions and as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

3.3 ADJUSTING AND CLEANING

A. Adjust all-glass entrance doors and hardware to produce smooth operation and tight fit at contact points and weather stripping.

B. Remove excess sealant and glazing compounds and dirt from surfaces.

3.4 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure all-glass entrances are without damage or deterioration at the time of Substantial Completion.

3.5 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.

2. The supplier is responsible for handing and sizing all products.

3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

B. Refer to Section 080671, Door Hardware Sets, for hardware sets.

END OF SECTION 084126

SECTION 085113 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes fixed and operable aluminum-framed windows.

1.2 PERFORMANCE REQUIREMENTS

A. General: Provide aluminum windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified, and that are of minimum test size required by AAMA/WDMA 101/I.S.2/NAFS.

B. Structural Performance: Provide aluminum windows capable of withstanding the effects of the following loads, based on testing units representative of those indicated for Project that pass AAMA/WDMA 101/I.S.2/NAFS, Uniform Load Structural Test:

1. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour at 33 feet above grade, according to ASCE 7, Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.

   a. Basic Wind Speed: 93 mph (40 m/s)]
   b. Importance Factor: See structural Drawings.
   c. Exposure Category: **C**

2. Deflection: Design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or 3/4 inch (19 mm), whichever is less, at design pressure based on testing performed according to AAMA/WDMA 101/I.S.2/NAFS, Uniform Load Deflection Test or structural computations.

C. Windborne-Debris Resistance: Provide glazed windows capable of resisting impact from windborne debris, based on the pass/fail criteria as determined from testing glazed windows identical to those specified, according to ASTM E 1996 or AAMA 506 and requirements of authorities having jurisdiction.

D. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C) material surfaces.

1.3 SUBMITTALS

A. Product Data: For each type of aluminum window indicated.

B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, and installation details

C. Samples: For each exposed finish.

D. Product Schedule: Use same designations indicated on Drawings.

E. Field quality-control test reports.

F. Product test reports.

G. Maintenance data.

1.4 QUALITY ASSURANCE

A. Installer: A qualified installer, approved by manufacturer to install manufacturer's products.

B. Glazing Publications: Comply with published recommendations of glass manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

D. Pre-installation Conference: Conduct conference at Project site.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to meet performance requirements.
b. Structural failures including excessive deflection, water leakage, air infiltration, or condensation.
c. Faulty operation of movable sash and hardware.
d. Deterioration of metals, other materials, and metal finishes beyond normal weathering.
e. Failure of insulating glass.

2. Warranty Period:

a. Window: Three years from date of Substantial Completion.
b. Glazing: 10 years from date of Substantial Completion.
c. Metal Finish: **15** from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. All Seasons Windows & Doors; All Seasons Commercial Division, Inc.
2. Boyd Aluminum Manufacturing.
3. Custom Window Company.
4. EFCO Corporation.

5. EXTECH Exterior Technologies, Inc.
6. Fleetwood Aluminum Products, Inc.
7. Graham Architectural Products Corp.
8. Peerless Products Inc.
9. Thermal Windows, Inc.
10. Wausau Window and Wall Systems.
11. Window Technologies, Inc.; Century Manufacturing, Inc.
12. Marvin Windows

D. Window Type: Double hung, Fixed, Horizontal sliding As indicated in a schedule

E. Comply with AAMA/WDMA 101/I.S.2/NAFS.

1. Performance Class and Grade: R[20
2. Performance Class and Grade: LC35
3. Performance Class and Grade: C35

F. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 52

G. Thermal Transmittance: Provide aluminum windows with a whole-window, U-factor maximum indicated at 16-mph (24-km/h) exterior wind velocity and winter condition temperatures when tested according to ASTM E 1423

1. U-Factor: 0.40 Btu/sq. ft. x h x deg F

2. First option in paragraph below is the maximum SHGC per IECC 2003 requirements for the area-weighted average SHGC of all fenestration installed in climates up to 3500 HDD (cooling climates). Second and third options are recommended by the Efficient Window Collaborative for the northern and central zones of the U.S., respectively, for spaces where cooling is a concern.

H. Solar Heat-Gain Coefficient (SHGC): Provide aluminum windows with a whole-window SHGC maximum of 0.40 determined according to NFRC 200 procedures.

2.2 GLAZING

A. Glass and Glazing Materials: Refer to Division 08 Section "Glazing" for glass units and glazing requirements applicable to glazed aluminum window units.

B. Glass complying with Division 08 Section "Glazing."

2.3 INSECT SCREENS

A. General: Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches. Fabricate insect screens to fully integrate with window frame. Locate screens on inside of window and provide for each operable exterior sash or ventilator.

1. Aluminum Tubular Frame Screens: Comply with SMA 1004, "Specifications for Aluminum Tubular Frame Screens for Windows," Architectural C-24

B. Aluminum Insect Screen Frames: Manufacturer's standard aluminum alloy complying with SMA 1004. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners and removable PVC spline/anchor concealing edge of frame.

1. Aluminum Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet with minimum wall thickness as required for class indicated.
2. Finish: Match aluminum window members.

3. Finish: Anodized aluminum or Baked-on organic coating in manufacturer's standard color.
4. Finish: Anodized aluminum or Baked-on organic coating in color selected by Architect from manufacturer's full range.
5. Finish: Manufacturer's standard.

6. Mesh Color: Silver gray

C. Aluminum Wire Fabric: mesh of 0.011-inch- (0.28-mm-) diameter, coated aluminum wire.

D. Wickets: Provide hinged wickets, framed and trimmed for a tight fit and for durability during handling.

2.4 FABRICATION

A. Fabricate aluminum windows that are reglazable without dismantling sash or ventilator framing.

B. Weather Stripping: Provide full-perimeter weather stripping for each operable sash and ventilator.

C. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.

D. Provide water-shed members above side-hinged ventilators and similar lines of natural water penetration.

E. Mullions: Provide mullions and cover plates as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads of window units.

F. Subframes: Provide subframes with anchors for window units as shown, of profile and dimensions indicated but not less than 0.062-inch- (1.6-mm-) thick extruded aluminum. Miter or cope corners, and weld and dress smooth with concealed mechanical joint fasteners. Finish to match window units. Provide subframes capable of withstanding design loads of window units.

G. Glazing Stops: Provide snap-on glazing stops coordinated with Division 08 Section "Glazing" and glazing system indicated. Provide glazing stops to match sash and ventilator frames.

2.5 ALUMINUM FINISHES

1. Color: As selected by Architect from full range of industry colors and color densities.

B. High-Performance Organic Finish 2-coat, thermocured system with fluoropolymer coats containing not less than 50 percent polyvinylidene fluoride resin by weight, complying with AAMA 2604

C. High-Performance Organic Finish: 3-coat, thermocured system with fluoropolymer coats containing not less than 70 percent polyvinylidene fluoride resin by weight, complying with AAMA 2605.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

C. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.

D. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

F. Adjust operating sashes and ventilators, screens, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

G. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

H. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.

I. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Testing Services: Testing and inspecting of installed windows shall take place as follows:

1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502, Test Method A by applying same test pressures required to determine compliance with AAMA/WDMA 101/I.S.2/NAFS in Part 1 "Performance Requirements" Article.
2. Testing Extent: Three windows as selected by Architect and a qualified independent testing and inspecting agency. Windows shall be tested immediately after installation.
3. Test Reports: Shall be prepared according to AAMA 502.

END OF SECTION 085113

SECTION 085653 - SECURITY WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Vision security windows.
2. Fixed, transaction security windows; Ticket Window
3. Sliding, transaction security windows.

B. Related Sections:

1. Division 08 Section "Glazing" for aluminum sorefront windows, sidelights, and door transoms.
2. Division 09 Section "Exterior Painting" for field painting exterior security windows.
3. Division 09 Section "Interior Painting" for field painting interior security windows.

1.3 PERFORMANCE REQUIREMENTS

A. Ballistics-Resistance Performance: Provide units identical to those tested for compliance with requirements indicated, and as follows:

1. Listed and labeled as bullet resisting according to UL 752.

B. Forced-Entry-Resistance Performance: Provide units identical to those tested for compliance with requirements indicated, and as follows:

1. Tested for forced-entry resistance according to ASTM F 1233 by a testing agency acceptable to authorities having jurisdiction.

C. Windborne-Debris-Impact-Resistance-Test Performance: Provide automatic entrances that pass large missile-impact and cyclic-pressure tests of ASTM E 1996 according to the IBC

1. Basic Wind Speed: As indicated in miles per hour at 33 feet above grade. Determine wind loads and resulting design pressures applicable to Project according to SEI/ASCE 7, "Minimum Design Loads for Buildings and Other Structures," Section 6.4.2, "Analytic Procedure," based on mean roof heights above grade as indicated on Drawings.

D. Air Infiltration for Operable Windows: Not more than 0.370 cfm/ft. of operable sash joint at an inward test pressure of 1.56 lbf/sq. ft. when tested according to ASTM E 283.

E. Air Infiltration for Fixed Windows: Not more 0.060 cfm/ft of crack length at an inward test pressure of 1.56 lbf/sq. ft. (75 Pa) when tested according to ASTM E 283.

F. Water Penetration: No water penetration as defined in test method at an inward test pressure of 1.56 lbf/sq. ft. when tested according to ASTM E 331.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for window units.

B. Shop Drawings: For security windows. Include plans, elevations, sections, details, and attachments to other work.

1. Full-size section details of framing members, including internal armoring, reinforcement, and stiffeners.
2. Location of weep holes.
3. Hardware for sliding window units.
4. Glazing details.
5. Details of transaction counter and speaking aperture.

C. Samples for Initial Selection: For frame members with factory-applied color finishes.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Framing: Reference plan for exact throat depth
2. Transaction Drawer: 6 inches square.

E. Cutaway Sample: Corner of security window, made from 12-inch lengths of full-size components, and showing details of the following:

1. Joinery.
2. Anchorage.
3. Glazing.
4. Flashing and drainage.

F. Welding certificates.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of security window and accessory indicated as ballistics resistant.

H. Configuration Disclosure Drawing: For each type of forced-entry-resistant security window, complying with ASTM F 1233.

I. Warranty: Sample of special warranty.

J. Other Informational Submittals:

1. Examination reports documenting inspections of substrates, areas, and conditions.
2. Anchor inspection reports documenting inspections of built-in and cast-in anchors.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 and experienced in ballistics-resistance testing.

C. Source Limitations: Obtain security windows from single source from single manufacturer.

D. Retain "Welding Qualifications" Paragraph below if shop or field welding is required. If retaining, also retain "Welding certificates" Paragraph in "Submittals" Article.

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."
3. AWS D1.6, "Structural Welding Code - Stainless Steel."

E. Pre installation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Pack security windows in wood crates for shipment. Crate glazing separate from frames unless factory glazed.

B. Label security window packaging with drawing designation.

C. Store crated security windows on raised blocks to prevent moisture damage.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.8 COORDINATION

A. Coordinate installation of anchorages for security windows. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in masonry or integrated in aluminum mullion. Deliver such items to Project site in time for installation.

1.9 SEQUENCING

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace security windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including deflections exceeding 1/4 inch (6 mm).
b. Failure of welds.
c. Excessive air leakage.
d. Faulty operation of voice hardware.
e. Faulty operation of transaction drawers.
f. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Manufactures standard warranty from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Extrusions: ASTM B 221 Provide alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength and not less than 0.125 inch thick at any location for main frame and sash members.

B. Sealants: For sealants required within fabricated security windows, provide type recommended by manufacturer for joint size and movement. Sealant shall remain permanently elastic, non-shrinking, and non-migrating.

2.2 WINDOW COMPONENTS

A. Glazing: Comply with requirements in Division 08 Section "Glazing" for performance indicated.

1. Comply with requirements of UL listing for ballistics-resistance level.

B. Compression-Type Glazing Strips and Weather Stripping: Unless otherwise indicated, provide compressible stripping for glazing and weather stripping, such as molded EPDM or neoprene gaskets complying with ASTM D 2000, Designations 2BC415 to 3BC620; molded PVC gaskets complying with ASTM D 2287; or molded, expanded EPDM or neoprene gaskets complying with ASTM C 509, Grade 4.

C. Miscellaneous Glazing Materials: Provide material, size, and shape complying with requirements of glass manufacturers, and with a proven record of compatibility with surfaces contacted in installation.

1. Cleaners, Primers, and Sealers: Type recommended by sealant or gasket manufacturer.
2. Setting Blocks: Elastomeric material with a Type A Shore durometer hardness of 85, plus or minus 5.
3. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement.

D. Anchors, Clips, and Window Accessories: Stainless steel; hot-dip, zinc-coated steel or iron, complying with ASTM B 633; provide sufficient strength to withstand design pressure indicated.

2.3 VISION SECURITY WINDOWS

A. Vision Security Windows: Provide fixed vision security windows with framing on four sides and no operable sash or ventilator.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

a. Action Bullet Resistant Corp.; a division of Action Storefronts, Inc.
b. American Vault Corporation.
c. Chicago Bullet Proof Systems.
d. Collier Safe Company, Inc.
e. Creative Industries, Inc.

B. Ballistics Resistance: Level 1 when tested according to UL 752.

C. Forced-Entry Resistance: Level I when tested according to HPW-TP-0500.03.

D. Framing: Fabricate perimeter framing, mullions, and glazing stops from metal sheet as follows:
1. Material: Extruded aluminum with Class I, clear anodized finish.

2.4 FIXED, TRANSACTION SECURITY WINDOWS

A. Fixed, Transaction Security Windows: Provide fixed, framed transaction windows with operable sash or ventilator capable of allowing transfer of currency and documents.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Chicago Bullet Proof Systems.
b. Collier Safe Company, Inc.
c. Creative Industries, Inc.

B. Configuration: One fixed-glazed panel

C. Retain ballistics-resistance or forced-entry-resistance requirements, or both. Verify availability with manufacturers.Retain one of first five paragraphs below. Coordinate test standard with that indicated in "Ballistics-Resistance Performance" Paragraph in "Performance Requirements" Article.

D. Ballistics Resistance: Level 1

E. Forced-Entry Resistance: Level I when tested according to HPW-TP-0500.03.

F. Framing: Fabricate perimeter framing, mullions, and glazing stops from metal sheet as follows:
1. Material: Extruded aluminum with Class I, clear anodized finish.

a. Manufacturer's standard.

2. Provide thermally improved construction for aluminum framing.

G. Head and Jamb Framing: Designed for voice communication by speech at normal volume.

H. Channel-Frame Sill: Formed from stainless steel and designed for sealant glazing.

1. Transaction Counter: Stainless steel, 18 inches (457 mm) deep by width of security window, with integral deal tray centered in opening.

I. Voice-Communication-Type Sill: Formed from stainless steel and designed to allow passage of speech at normal speaking volume without distortion.
1. Integral Transaction-Drawer Sill: Formed from framing to match head and jamb framing; with transaction drawer integrated into framing and contained in a stainless-steel housing that forms a transaction counter on both sides of opening. Drawer front shall be flush with housing when drawer is closed.

~~2.5 SLIDING, TRANSACTION SECURITY WINDOWS~~

~~A. Sliding, Transaction Security Windows: Provide horizontal-sliding, transaction security windows.~~

~~1. Manufacturers: Subject to compliance with requirements, provide products by one of the following~~

~~a. Action Bullet Resistant Corp.; a division of Action Storefronts, Inc.~~
~~b. Collier Safe Company, Inc.~~
~~c. Creative Industries, Inc.~~
~~d. General Electric Company; GE Polymer shapes Insulgard.~~

~~B. Configuration: One fixed-glazed panel and one horizontal-sliding glazed panel.~~

~~C. Retain ballistics resistance or forced-entry resistance requirements, or both. Verify availability with manufacturers. See Evaluations.~~

~~D. Ballistics Resistance: Level 1 when tested according to UL 752.~~

~~E. Forced-Entry Resistance: Level I when tested according to HPW-TP-0500.03.~~

~~F. Framing: Fabricate perimeter framing, mullions, and glazing stops from metal sheet as follows:~~
~~1. Material: Extruded aluminum with Class I, clear anodized finish.~~

~~a. Manufacturer's standard and overall dimensions shall be indicated on drawings.~~

~~2. Provide thermally improved construction for aluminum framing.~~

~~G. Sill: Stainless-steel channel frame designed for gasket glazing.~~

~~1. Shelf: Stainless steel, 12 inches deep by width of security window, with integral deal tray.~~

2.6 ACCESSORIES

A. Recessed Deal Trays: Formed from stainless steel with sliding stainless-steel cover; fabricated in curved shape with exposed flanges for recessed installation into horizontal surface.

1. Clear Opening Size: per drawings

B. Recessed, Non-ricochet Deal Trays: Formed from stainless steel; fabricated with recessed bullet trap to ricochet bullets away from secure side, with exposed flanges for recessed installation into horizontal surface, and with sliding stainless-steel cover.

1. Clear Opening Size: per drawings
2. Ballistics Resistance: level 1.
3. Listed and labeled as bullet resisting according to UL 752.

C. Rotating Deal Trays: Formed from stainless steel, with rotating recessed deal tray on each side of secure opening and with handle that rotates deal trays 180 degrees.

1. Mounting: per drawings
2. Ballistics Resistance: same as security window
3. Listed and labeled as bullet resisting according to UL 752.

D. Transaction Drawers: Formed from stainless steel; with ball-bearing, telescoping sliding mechanism; with cover on secure side of top of drawer that automatically closes when drawer is extended to non-secure side.

1. Inside Dimensions: 11-7/8 inches wide by 12 inches deep by 2-1/16 inches high, verify final dimensions with location on floor plans.
2. Listed and labeled as bullet resisting according to UL 752.
3. Formed from type 304 stainless steel cold rolled annealed ASTM A 240 16 gauge.

E. Speaking Apertures: Fabricate from stainless steel designed to allow passage of speech at normal speaking volume without distortion.

1. Shape: Circular
2. Ballistics Resistance: security window
3. Listed and labeled as bullet resisting according to UL 752.

2.7 FABRICATION

A. General: Fabricate security windows to provide a complete system for assembly of components and anchorage of window units.

B. Provide weep holes and internal water passages for exterior security windows to conduct infiltrating water to the exterior.

C. Framing: Miter or cope corners the full depth of framing; weld and dress smooth.

D. Welding: Weld components to comply with referenced AWS standard. To greatest extent possible, weld before finishing and in concealed locations to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

E. Metal Protection: Separate dissimilar metals to protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

F. Factory-cut openings in glazing for speaking apertures.

2.8 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.9 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of security windows.

3.2 INSTALLATION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing security windows to in-place construction. Include threaded fasteners for masonry inserts, security fasteners, and other connectors.

1. Install an attached or integral flange to secure side of security windows extending over rough-in opening gap so that gap has same ballistics-resistance performance as security window.

3.3 ADJUSTING

A. Adjust horizontal-sliding, transaction security windows to provide a tight fit at contact points for smooth operation and a secure enclosure.

B. Adjust transaction drawers to provide a tight fit at contact points and weather stripping for smooth operation and weather tight and secure enclosure.

3.4 CLEANING AND PROTECTION

A. Clean surfaces promptly after installation of security windows. Take care to avoid damaging the finish. Remove excess glazing and sealant compounds, dirt, and other substances.

B. Clean glass of pre-glazed security windows promptly after installation. Comply with requirements in Division 08 Section "Glazing" for cleaning and maintenance.

C. Provide temporary protection to ensure that security windows are without damage at time of Substantial Completion.

END OF SECTION 085653

SECTION 088000 - GLAZING

1.GENERAL

1. SUMMARY

A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Doors
2. Storefront framing
3. Windows

2. SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass 12 inches square.

C. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Preconstruction adhesion and compatibility test report.

E. Warranties: Sample of special warranties.

3. QUALITY ASSURANCE

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA's "Laminated Glazing Manual" and GANA's "Glazing Manual."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

D. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for glazing during and after installation.

4. DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

5. PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

2.PRODUCTS

1. GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

2. LAMINATED GLASS

A. Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

B. Laminated Glass Units LG-1 – For use at all suite windows facing the field (impact resistant).
1. Kind LA, consisting of two lites of annealed float glass, or tempered as required by code.
a. Outer Lite: Class 1 (clear) float glass, 6.0 mm thick.
b. Interlayer: 0.060 PVB clear interlayer
c. Inner Lite: Class 1 (clear) float glass, 6.0 mm thick.
2. Characteristics
a. Visible Light Transmittance: 79 percent minimum
b. Winter Nighttime U-Factor: 0.47 maximum
c. Summer Daytime U-Factor: 0.49 maximum
d. Solar Heat Gain Coefficient: 0.64 maximum
e. Outdoor visible reflectance 15 percent maximum

3. INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.

B. Basis of Design: Solarban 60 Solar Control Low-E Glass as manufactured by PPG. Subject to compliance with requirements other manufacturers with products of equivalent design include:
1. Viracon
2. Guardian

C. Insulated Glass Type GL-2 – Low-E-Coated, clear insulating glass, for use in storefront not glazed with laminated glass.

1. Overall unit thickness: 1-inch.
2. Thickness of each glass lite: 6.0 mm.
3. Outdoor Lite: Heat strengthened float glass or fully tempered float glass.
4. Interspace Content: Air.
5. Indoor Lite Float glass or Fully tempered float glass.
6. Low E coating on 2nd surface.
7. Visible light transmittance: 70 percent minimum.
8. Winter Nighttime U-Factor: .29 minimum.
9. Summer Daytime U-Factor: .38 maximum.
10. Solar heat gain coefficient: .38 maximum.

4. GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:

1. Neoprene complying with ASTM C 864.
2. EPDM complying with ASTM C 864.
3. Silicone complying with ASTM C 1115.
4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

5. GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

6. MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

7. FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

8. GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

9. TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

10. GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

11. SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

12. CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

SECTION 088300 - MIRRORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the following types of silvered flat glass mirrors:

1. Annealed monolithic glass mirrors.

B. Related Requirements:

1. Section 088000 "Glazing" for glass with reflective coatings used for vision and spandrel lites.
2. Section 102800 "Toilet, Bath, and Laundry Accessories" for metal-framed mirrors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Mirrors. Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.

B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For mirrors to include in maintenance manuals.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing.

1. Testing is not required if data are submitted based on previous testing of mirror mastic products and mirror backing matching those submitted.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.

B. Source Limitations for Mirror Accessories: Obtain mirror glazing accessories from single source.

2.2 SILVERED FLAT GLASS MIRRORS

A. Mirrors, General: ASTM C 1503.

B. Annealed Monolithic Glass Mirrors: Mirror Select Quality, clear.

1. Nominal Thickness: 6.0 mm.

2.3 MISCELLANEOUS MATERIALS

A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.

C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.

D. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

2.4 MIRROR HARDWARE

A. Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover edges of mirrors in a single piece.

1. Bottom Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch (9.5 and 22 mm) in height, respectively, and a thickness of not less than 0.04 inch (1.0 mm).
2. Finish: Clear bright anodized.

B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

C. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield, expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

2.5 FABRICATION

A. Fabricate mirrors in the shop to greatest extent possible.

B. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.

C. Mirror Edge Treatment: Flat polished.

1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.

D. Film-Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint, as recommended in writing by film-backing manufacturer, to produce a surface free of bubbles, blisters, and other imperfections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.

B. Verify compatibility with and suitability of substrates, including compatibility of existing finishes or primers with mirror mastic.

C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.

1. GANA Publications: "Glazing Manual" and "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."

B. Provide a minimum airspace of 1/8 inch (3 mm) between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.

C. Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.

1. Aluminum J-Channels and Cleat: Fasten J-channel directly to wall and attach top trim to continuous cleat fastened directly to wall.
2. Install mastic as follows:

a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
b. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
c. After mastic is applied, align mirrors and press into place while maintaining a minimum airspace of 1/8 inch (3 mm) between back of mirrors and mounting surface.

3.4 CLEANING AND PROTECTION

A. Protect mirrors from breakage and contaminating substances resulting from construction operations.

B. Do not permit edges of mirrors to be exposed to standing water.

C. Maintain environmental conditions that prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.

D. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer.

END OF SECTION 088300

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
2. Protective Coating: ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized unless otherwise indicated.

B. Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners.

1. Steel Studs and Runners:

a. Minimum Base-Metal Thickness: 0.027 inch (0.64 mm), minimum.
b. Depth: As indicated on Drawings.
c. Verify thickness for job specific requirements.

2. Dimpled Steel Studs and Runners:

a. Minimum Base-Metal Thickness: 0.025 inch (0.64 mm), minimum.
b. Depth: As indicated on Drawings.
c. Verify thickness for job specific requirements.

C. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
2. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

D. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: As indicated on Drawings.
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch (0.8 mm).
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

2.2 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.

C. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
2. Steel Studs and Runners: ASTM C 645.

a. Minimum Base-Metal Thickness: 0.027 inch (0.68 mm).
b. Depth: As indicated on Drawings.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
2. Tile Backing Panels: 16 inches (406 mm) o.c. unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.

2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

   a. Install two studs at each jamb unless otherwise indicated.
   b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.

3. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

E. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: 48 inches (1219 mm) o.c.
2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.
3. Furring Channels (Furring Members): 16 inches (406 mm) o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

   a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Do not attach hangers to steel roof deck.
5. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092400 - PORTLAND CEMENT PLASTERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Exterior portland cement plasterwork (stucco) on metal lath.

B. Product Data: For each type of product indicated.

C. Shop Drawings: Show locations and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other work.

D. Samples for Initial Selection: For each type of factory-prepared finish coat indicated.

E. Samples for Verification: For each type of colored textured finish coat indicated; 12 by 12 inches (305 by 305 mm), and prepared on rigid backing.

1.2 QUALITY ASSURANCE

A. Fire-Resistance Ratings: Where indicated, provide portland cement plaster assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

   1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

B. Sound-Transmission Characteristics: Where indicated, provide portland cement plaster assemblies identical to those of assemblies tested for STC ratings per ASTM E 90 and classified according to ASTM E 413 by a qualified testing agency.

C. Mockups: Before plastering, install mockups of at least 100 sq. ft. (9.3 sq. m) in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

   1. Install mockups for each type of finish indicated.
   2. For interior plasterwork, simulate finished lighting conditions for review of mockups.
   3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Preinstallation Conference: Conduct conference at Project site.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.4 PROJECT CONDITIONS

A. Comply with ASTM C 926 requirements.

B. Exterior Plasterwork:

1. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.
2. Apply plaster when ambient temperature is greater than 40 deg F (4.4 deg C).
3. Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.

PART 2 - PRODUCTS

2.1 METAL LATH

A. Paper Backing: FS UU-B-790, Type I, Grade D, Style 2 vapor-permeable paper.

1. Provide paper-backed lath at exterior locations.

B. Expanded-Metal Lath: ASTM C 847 with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Alabama Metal Industries Corporation; a Gibraltar Industries company.
b. CEMCO.
c. Clark Western Building Systems.
d. Dietrich Metal Framing; a Worthington Industries company.
e. MarinoWARE.
f. Phillips Manufacturing Co.

2.2 ACCESSORIES

A. General: Comply with ASTM C 1063 and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Metal Accessories:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Alabama Metal Industries Corporation; a Gibraltar Industries company.
b. CEMCO.
c. Clark Western Building Systems.
d. Dietrich Metal Framing; a Worthington Industries company.
e. MarinoWARE.
f. Phillips Manufacturing Co.

2. Foundation Weep Screed: Fabricated from hot-dip galvanized-steel sheet, ASTM A 653/A 653M, G60 (Z180) zinc coating.
3. Cornerite: Fabricated from metal lath with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.
4. External-Corner Reinforcement: Fabricated from metal lath with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.
5. Cornerbeads: Fabricated from [zinc] [or] [zinc-coated (galvanized) steel].

a. Small nose cornerbead with expanded flanges; use unless otherwise indicated.
b. Small nose cornerbead with perforated flanges; use on curved corners.
c. Small nose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing masonry corners.

d. Bull nose cornerbead, radius 3/4 inch (19.1 mm) minimum, with expanded flanges; use at locations indicated on Drawings.

6. Casing Beads: Fabricated from zinc-coated (galvanized) steel; square-edged style; with expanded flanges.
7. Control Joints: Fabricated from zinc-coated (galvanized) steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
8. Expansion Joints: Fabricated from zinc-coated (galvanized) steel; folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.
9. Two-Piece Expansion Joints: Fabricated from zinc-coated (galvanized) steel; formed to produce slip-joint and square-edged reveal that is adjustable from 1/4 to 5/8 inch (6.34 to 16 mm) wide; with perforated flanges.

2.3 MISCELLANEOUS MATERIALS

A. Water for Mixing: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

B. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, 1/2 inch (13 mm) long, free of contaminants, manufactured for use in portland cement plaster.

C. Bonding Compound: ASTM C 932.

D. Steel Drill Screws: For metal-to-metal fastening, ASTM C 1002 or ASTM C 954, as required by thickness of metal being fastened; with pan head that is suitable for application; in lengths required to achieve penetration through joined materials of no fewer than three exposed threads.

E. Fasteners for Attaching Metal Lath to Substrates: Complying with ASTM C 1063.

F. Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch (1.21-mm) diameter, unless otherwise indicated.

G. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
2. Recycled Content: Provide blankets with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of <Insert number> percent by weight.

2.4 PLASTER MATERIALS

A. Portland Cement: ASTM C 150, Type I.

1. Color for Finish Coats: Gray

B. Colorants for Job-Mixed Finish Coats: Colorfast mineral pigments that produce finish plaster color to match Architect's sample selected from manufactures full color range.

C. Lime: ASTM C 206, Type S; or ASTM C 207, Type S.

D. Sand Aggregate: ASTM C 897.

1. Color for Job-Mixed Finish Coats: In color matching Architect's sample selected from manufactures full color range.

E. Perlite Aggregate: ASTM C 35.

F. Exposed Aggregates for Finish Coats: [For marblecrete finish, clean, sound, crushed marble matching color and size gradation of Architect's sample] <Insert requirements>.

G. Acrylic-Based Finish Coatings: Factory-mixed acrylic-emulsion coating systems, formulated with colorfast mineral pigments and fine aggregates; for use over portland cement plaster base coats. Include manufacturer's recommended primers and sealing topcoats for acrylic-based finishes.

1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:

a. Acrocrete, BASF Wall Systems, Inc.; Acrotex.
b. California Stucco Products Corp.; Texture Flex.
c. Dryvit Systems, Inc.; Dryvit TAFS.
d. El Rey Stucco Company, Inc., a brand of ParexLaHabra, Inc.; Prema-Flex.
e. Finestone, BASF Wall Systems, Inc.; PebbleTex.
f. LaHabra, a brand of ParexLaHabra, Inc.; Acrylic Finish.
g. Master Wall Inc.; Superior Finishes.
h. Omega Products International, Inc.; Omega Flex Finishes.
i. Parex, Inc., a brand of ParexLaHabra, Inc.; e-lastic.
j. Pleko Group LLC Products, Inc.; Pleko Structure Finishes.
k. Senergy, BASF Wall Systems, Inc.; Senerflex.
l. Shamrock Stucco LLC; Stucco Acrylic Finish.
m. Sto Corp.; Powerwall Finish.
n. Stuc-O-Flex International, Inc.; Elastomeric Finish
o. Surewall, a brand of ParexLaHabra, Inc.; Acrylic Finish.
p. SonoWall, BASF Wall Systems, Inc.; StuccoTex Finish.

2. Color: As selected by Architect from manufacturer's full range.

2.5 PLASTER MIXES

A. General: Comply with ASTM C 926 for applications indicated.

1. Fiber Content: Add fiber to base-coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 1 lb of fiber/cu. yd. (0.6 kg of fiber/cu. m) of cementitious materials.

B. Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork as follows:

1. Portland Cement Mixes:

a. Scratch Coat: For cementitious material, mix 1 part portland cement and [0 to 3/4] [3/4 to 1-1/2] parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
b. Brown Coat: For cementitious material, mix 1 part portland cement and [0 to 3/4] [3/4 to 1-1/2] parts lime. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.

2. Portland and Masonry Cement Mixes:

a. Scratch Coat: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
b. Brown Coat: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.

C. Base-Coat Mixes: Single base coats for two-coat plasterwork as follows:

1. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 0 to 3/4 part lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
2. Portland and Masonry Cement Mix: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
3. Plastic Cement Mix: Use 1 part plastic cement and 2-1/2 to 4 parts aggregate.

D. Base-Coat Mixes: Single base coats for two-coat plasterwork as follows:

1. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
2. Masonry Cement Mix: Use 1 part masonry cement and 2-1/2 to 4 parts aggregate.
3. Plastic Cement Mix: Use 1 part plastic cement and 2-1/2 to 4 parts aggregate.

E. Job-Mixed Finish-Coat Mixes:

1. Portland Cement Mix: For cementitious materials, mix 1 part portland cement and [3/4 to 1-1/2] [1-1/2 to 2] parts lime. Use 1-1/2 to 3 parts aggregate per part of cementitious material.
2. Masonry Cement Mix: 1 part masonry cement and 1-1/2 to 3 parts aggregate.
3. Portland and Masonry Cement Mix: For cementitious materials, mix 1 part portland cement and 1 part masonry cement. Use 1-1/2 to 3 parts aggregate per part of cementitious material.
4. Plastic Cement Mix: 1 part plastic cement and 1-1/2 to 3 parts aggregate.

F. Factory-Prepared Finish-Coat Mixes: For [ready-mixed finish-coat plasters] [acrylic-based finish coatings], comply with manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.

B. Prepare solid substrates for plaster that are smooth or that do not have the suction capability required to bond with plaster according to ASTM C 926.

3.3 INSTALLATION, GENERAL

A. Fire-Resistance-Rated Assemblies: Install components according to requirements for design designations from listing organization and publication indicated on Drawings.

B. Sound Attenuation Blankets: Where required, install blankets before installing lath unless blankets are readily installed after lath has been installed on one side.

C. Acoustical Sealant: Where required, seal joints between edges of plasterwork and abutting construction with acoustical sealant.

3.4 INSTALLING METAL LATH

A. Expanded-Metal Lath: Install according to ASTM C 1063.

1. Partition Framing and Vertical Furring: Install [flat diamond-mesh] [flat rib] [welded-wire] [woven-wire] lath.
2. Flat-Ceiling and Horizontal Framing: Install [flat diamond-mesh] [flat rib] [3/8-inch (9.5-mm) rib lath] [welded-wire] [woven-wire] lath.
3. Curved-Ceiling Framing: Install [flat diamond-mesh] [welded-wire] [flat woven-wire] lath.
4. On Solid Surfaces, Not Otherwise Furred: Install self-furring, [diamond-mesh] [welded-wire] [woven-wire] lath.

3.5 INSTALLING ACCESSORIES

A. Install according to ASTM C 1063 and at locations indicated on Drawings.

B. Reinforcement for External Corners:

1. Install lath-type, external-corner reinforcement at exterior locations.
2. Install cornerbead at interior[and exterior] locations.

C. Control Joints: Install control joints [at locations indicated on Drawings.] [in specific locations approved by Architect for visual effect as follows:]

1. As required to delineate plasterwork into areas (panels) of the following maximum sizes:

a. Vertical Surfaces: 144 sq. ft. (13.4 sq. m).
b. Horizontal and other Nonvertical Surfaces: 100 sq. ft. (9.3 sq. m).

2. At distances between control joints of not greater than 18 feet (5.5 m) o.c.
3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
4. Where control joints occur in surface of construction directly behind plaster.
5. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

3.6 PLASTER APPLICATION

A. General: Comply with ASTM C 926.

1. Do not deviate more than plus or minus 1/4 inch in 10 feet (6.4 mm in 3 m) from a true plane in finished plaster surfaces, as measured by a 10-foot (3-m) straightedge placed on surface.
2. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
3. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

B. Bonding Compound: Apply on [unit masonry] [and] [concrete] plaster bases.

C. Walls; Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork[, on masonry] [, on concrete]; 3/4-inch (19-mm) thickness.

1. Portland cement mixes.
2. Masonry cement mixes.
3. Portland and masonry cement mixes.
4. Plastic cement mixes.

5. Portland and plastic cement mixes.

D. Ceilings; Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork; [1/2 inch (13 mm) thick] [3/4 inch (19 mm) thick on concrete].

1. Portland cement mixes.
2. Masonry cement mixes.
3. Portland and masonry cement mixes.
4. Plastic cement mixes.
5. Portland and plastic cement mixes.

E. Walls; Base-Coat Mix: Scratch coat for two-coat plasterwork [3/8 inch (10 mm) thick on concrete masonry] [, 1/4 inch (6 mm) thick on concrete].

1. Portland cement mixes.
2. Masonry cement mixes.
3. Portland and masonry cement mixes.
4. Plastic cement mixes.
5. Portland and plastic cement mixes.

F. Ceilings; Base-Coat Mix: Scratch coat for two-coat plasterwork, 1/4 inch (6 mm) thick on concrete.

1. Portland cement mixes.
2. Masonry cement mixes.
3. Portland and masonry cement mixes.
4. Plastic cement mixes.
5. Portland and plastic cement mixes.

G. Plaster Finish Coats: Apply to provide [float] [dash] [scraped trowel-textured] [skip trowel-textured] [brocade (knock-down dash)] [trowel sweep] [combed] [sacked (California mission)] [English] [marblecrete] <Insert requirements> finish to match Architect's sample.

H. Acrylic-Based Finish Coatings: Apply coating system, including primers, finish coats, and sealing topcoats, according to manufacturer's written instructions.

I. Concealed Exterior Plasterwork: Where plaster application will be used as a base for adhered finishes, omit finish coat.

J. Concealed Interior Plasterwork:

1. Where plaster application will be concealed behind built-in cabinets, similar furnishings, and equipment, apply finish coat.
2. Where plaster application will be concealed above suspended ceilings and in similar locations, finish coat may be omitted.
3. Where plaster application will be used as a base for adhesive application of tile and similar finishes, omit finish coat.

3.7 PLASTER REPAIRS

A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

3.8 PROTECTION

A. Remove temporary protection and enclosure of other work. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION 092400

SECTION 092900 - GYPSUM BOARD

1.GENERAL

1. SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Exterior gypsum board for ceilings and soffits.
3. Tile backing panels.
4. Texture finishes.

2. ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.
2. Textured Finishes: Manufacturer's standard size for each textured finish indicated and on same backing indicated for Work.

3. QUALITY ASSURANCE

A. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install mockups for the following:

a. Each level of gypsum board finish indicated for use in exposed locations.
b. Each texture finish indicated.

2. Apply or install final decoration indicated, including painting and wall coverings, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

4. DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

5. FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

2.PRODUCTS

1. PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Low Emitting Materials: For ceiling and wall assemblies, provide materials and construction identical to those tested in assembly and complying with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2. GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

3. INTERIOR GYPSUM BOARD

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Gypsum.
2. CertainTeed Corp.
3. Georgia-Pacific Gypsum LLC.
4. Lafarge North America Inc.
5. National Gypsum Company.
6. PABCO Gypsum.
7. Temple-Inland.
8. USG Corporation.

B. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch (15.9 mm).
2. Long Edges: Tapered.

C. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Georgia-Pacific Corp.; DensArmor Plus Interior Wallboard.
b. National Gypsum; XP Wallboard.
c. United States Gypsum Co.; Sheetrock Brand Mold Tough Gypsum Panel.

3. Core: 5/8 inch, Type X.
4. Long Edges: Tapered.

D. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.

1. Core: 5/8 inch (15.9 mm), Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10.

4. SPECIALTY GYPSUM BOARD

A. Gypsum Board, Type C: ASTM C 1396/C 1396M. Manufactured to have increased fire-resistive capability.

1. Products: Subject to compliance with requirements,:

a. American Gypsum; Firebloc Type C.
b. CertainTeed Corp.; ProRoc Type C.
c. Georgia-Pacific Gypsum LLC; Fireguard C.
d. Georgia-Pacific Gypsum LLC; Tough Rock Soffit Board
e. Lafarge North America Inc.; Firecheck Type C.
f. National Gypsum Company; Gold Bond Fire-Shield C.
g. PABCO Gypsum; Flame Curb Type Super C.
h. Temple-Inland; Type TG-C.
i. USG Corporation; Fire-code C Core.

2. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
3. Long Edges: Tapered.

5. EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

A. Exterior Gypsum Soffit Board: ASTM C 1396/C 1396M, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. Georgia-Pacific Gypsum LLC; Tough Rock Soffit Board

2. Core: 5/8 inch (15.9 mm), Type X.

6. TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:

a. Cornerbead.
b. Bullnose bead.
c. LC-Bead: J-shaped; exposed long flange receives joint compound.
d. L-Bead: L-shaped; exposed long flange receives joint compound.
e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
f. Expansion (control) joint.

g. Curved-Edge Corner-bead: With notched or flexible flanges.

B. Exterior Trim: ASTM C 1047.

1. Material: Hot-dip galvanized steel sheet, plastic, or rolled zinc.
2. Shapes:

a. Corner-bead.
b. LC-Bead: J-shaped; exposed long flange receives joint compound.
c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

7. JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

D. Joint Compound for Exterior Applications:

1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

8. AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

3.EXECUTION

1. EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

2. APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc., except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

I. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3. APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Wallboard Type: Vertical surfaces unless otherwise indicated.
2. Type X: Where required for fire-resistance-rated assembly.
3. Ceiling Type: Ceiling surfaces.
4. Moisture- and Mold-Resistant Type: Located in wet areas in kitchens and bathrooms.
5. Type C: Where required for specific fire-resistance-rated assembly indicated.
6. Glass-Mat Interior Type: Located in wet areas in kitchens and bathrooms.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

4. APPLYING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

A. Apply panels perpendicular to supports, with end joints staggered and located over supports.

1. Install with 1/4-inch (6.4-mm) open space where panels abut other construction or structural penetrations.
2. Fasten with corrosion-resistant screws.

5. INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges.
3. L-Bead: Use where indicated.

D. Exterior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.

2. LC-Bead: Use at exposed panel.

6. FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 5: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 4: General application.

E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

7. APPLYING TEXTURE FINISHES

A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.

B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture[matching approved mockup and] free of starved spots or other evidence of thin application or of application patterns.

C. Prevent texture finishes from coming into contact with surfaces not indicated to receive texture finish by covering them with masking agents, polyethylene film, or other means. If, despite these precautions, texture finishes contact these surfaces, immediately remove droppings and overspray to prevent damage according to texture-finish manufacturer's written recommendations.

8. PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Glazed wall tile.
2. Metal edge strips.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
2. Section 092900 "Gypsum Board" for glass-mat, water-resistant backer board.

1.3 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."

C. Module Size: Actual tile size plus joint width indicated.

D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples for Verification:

1. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 36 inches (900 mm) square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
2. Full-size units of each type of trim and accessory for each color and finish required.
3. Metal edge strips in 6-inch (150-mm) lengths.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer is a five-star member of the National Tile Contractors Association.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.

1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:

1. Metal edge strips.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

2.3 TILE PRODUCTS

A. Ceramic Tile:

1. Manufacturers: Subject to compliance with requirements, as indicated on Drawings.
2. Tile Selection As indicated on Drawings.
3. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

a. Internal Corners: Field-butted square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.

2.4 SETTING MATERIALS

A. Latex-Portland Cement Mortar (Thinset): ANSI A118.4.

1. Manufacturers: Subject to compliance with requirements, provide products as indicated on Drawings.
2. Provide prepackaged, dry-mortar mix combined with acrylic resin liquid-latex additive at Project site.
3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.5 GROUT MATERIALS

A. Grout for Pregrouted Tile Sheets: Same product used in factory to pregrout tile sheets.

2.6 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Vapor-Retarder Membrane: Polyethylene sheeting, ASTM D 4397, 4.0 mils (0.1 mm) thick.

C. Metal Edge Strips: As indicated on Drawings; nickel silver.

D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.7 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with bonded mortar bed comply with surface finish requirements in ANSI A108.01 for installations indicated.

   a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
   b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 CERAMIC TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

B. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

C. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

D. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Glazed Wall Tile: 1/8 inch (3.2 mm).

E. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated and per TCNA EJ171 recommendations. Field verify locations. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

F. Metal Edge Strips: Install at locations indicated.

3.4 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.5 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.6 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Wall Installations, Wood or Metal Studs or Furring:

1. Ceramic Tile Installation: TCNA W245 or TCNA W248; thinset mortar on glass-mat, water- resistant gypsum backer board.

a. Ceramic Tile Type: As indicated on Drawings.
b. Thinset Mortar: Latex-portland cement mortar.
c. Grout: Standard unsanded cement grout.

END OF SECTION 093013

SECTION 095000 – ACOUSTICAL CEILINGS

1. GENERAL

1.1 RELATED DOCUMENTS

Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.2 SUMMARY

A. Section Includes

1. Acoustical ceiling panels
2. Exposed grid suspension system
3. Wire hangers, fasteners, main runners, cross tees, and wall angle moldings
4. Perimeter Trim

B. Related Selections

1. Section 09 51 00 - Acoustical Ceilings
2. Section 09 51 13 - Acoustical Fabric-Faced Panel Ceilings
3. Section 09 53 00 - Acoustical Ceiling Suspension Assemblies
4. Section 09 20 00 - Plaster and Gypsum Board
5. Section 02 42 00 - Removal and Salvage of Construction Materials
6. Divisions 23 - HVAC Air Distribution
7. Division 26 - Electrical

C. Alternates

1. Prior Approval: Unless otherwise provided for in the Contract documents, proposed product substitutions may be submitted no later than TEN (10) working days prior to the date established for receipt of bids. Acceptability of a proposed substitution is contingent upon the Architect's review of the proposal for acceptability and approved products will be set forth by the Addenda. If included in a Bid are substitute products that have not been approved by Addenda, the specified products shall be provided without additional compensation.
2. Submittals that do not provide adequate data for the product evaluation will not be considered. The proposed substitution must meet all requirements of this section, including but not necessarily limited to, the following: Single source materials suppliers (if specified in Section 1.5); Underwriters' Laboratories Classified Acoustical performance; Panel design, size, composition, color, and finish; Suspension system component profiles and sizes; Compliance with the referenced standards.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
2. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
3. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
4. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
5. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
6. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
7. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber

8. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
9. ASTM E 119 Standard Test Methods for Fire Tests of Building Construction and Material

A. Armstrong Fire Guard Products

10. ASTM E 580 Installation of Metal Suspension Systems in Areas Requiring Moderate Seismic Restraint
11. ASTM E 1111 Standard Test Method for Measuring the Interzone Attenuation of Ceilings Systems
12. ASTM E 1414 Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
13. ASTM E 1264 Classification for Acoustical Ceiling Products

B. International Building Code

C. ASHRAE Standard 62.1-2004, Ventilation for Acceptable Indoor Air Quality

D. NFPA 70 National Electrical Code

E. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures

F. International Code Council-Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components

G. International Code Council-Evaluation Services Report - Seismic Engineer Report

1. ESR 1308 - Armstrong Suspension Systems

H. International Association of Plumbing and Mechanical Officials - Seismic Engineer Report

1. 0244 - Armstrong Single Span Suspension System

I. California Department of Public Health CDPH/EHLB Emission Standard Method Version 1.1 2010

J. LEED - Leadership in Energy and Environmental Design is a set of rating systems for the design, construction, operation, and maintenance of green buildings

1.4 SYSTEM DESCRIPTION

Discontinuous/Open Plenum

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of acoustical ceiling unit and suspension system required.
B. Samples: Minimum 6 inch x 6 inch samples of specified acoustical panel; 8 inch long samples of exposed wall molding and suspension system, including main runner and 4 foot cross tees.
C. Shop Drawings: Layout and details of acoustical ceilings show locations of items that are to be coordinated with, or supported by the ceilings.
D. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. For acoustical performance, each carton of material must carry an approved independent laboratory classification of NRC, CAC, and AC.
E. If the material supplied by the acoustical subcontractor does not have an Underwriter's Laboratory classification of acoustical performance on every carton, subcontractor shall be required to send material from every production run appearing on the job to an independent or NVLAP approved laboratory for testing, at the architect's or owner's discretion. All products not conforming to manufacturer's current published values must be removed, disposed of and replaced with complying product at the expense of the Contractor performing the work.

1.6 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.

1. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.
2. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 Classification.
3. Fire Resistance: As follows tested per ASTM E119 and listed in the appropriate floor or roof design in the Underwriters Laboratories Fire Resistance Directory

B. Acoustical Panels: As with other architectural features located at the ceiling, may obstruct or skew the planned fire sprinkler water distribution pattern through possibly delay or accelerate the activation of the sprinkler or fire detection systems by channeling heat from a fire either toward or away from the device. Designers and installers are advised to consult a fire protection engineer, NFPA 13, or their local codes for guidance where automatic fire detection and suppression systems are present.

C. Coordination of Work: Coordinate acoustical ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

1.8 PROJECT CONDITIONS

A. Space Enclosure: HumiGuard Plus Ceilings: Building areas to receive ceilings shall be free of construction dust and debris. Products with HumiGuard Plus performance and hot dipped galvanized steel, aluminum or stainless steel suspension systems can be installed up to 120°F (49°C) and in spaces before the building is enclosed, where HVAC systems are cycled or not operating. Cannot be used in exterior applications where standing water is present or where moisture will come in direct contact with the ceiling.

1.9 ALTERNATE CONSTRUCTION WASTE DISPOSAL

A. Ceiling material being reclaimed must be kept dry and free from debris

B. Contact the Armstrong Recycle Center a consultant will verify the condition of the material and that it meets the Armstrong requirements for recycling. The Armstrong consultant with provide assistance to facilitate the recycling of the ceiling.

C. Recycling may qualify for LEED Credits:

a. LEED 2009 - Category 4: Material and Resources (MR) i. Credit MRc2: Construction Waste Management
b. LEEDv4 - MRp2 - Construction Waste Management Planning Qualifies as a material stream (non-structural) targeted for diversion. Ceilings will be source-separated and diverted through the Armstrong Ceiling Recycling Program.
c. LEEDv4-MRc5 - i. Option 1: Divert ceilings to qualify for one of the 3 material streams (50%)
ii. Option 2: Divert ceilings to qualify for one of the 4 material streams (75%)

1.10 WARRANTY

A. Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:

1. Acoustical Panels: Sagging and warping
2. Grid System: Rusting and manufacturer's defects

B. Warranty Period:

1. Acoustical panels: Ten (10) years from date of substantial completion.
2. Grid: Ten (10) years from date of substantial completion.
3. Acoustical panels and grid systems with HumiGuard Plus or HumiGuard Max performance supplied by one source manufacturer is Thirty (30) years from date of substantial completion.

C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.11 MAINTENANCE

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.

1. Acoustical Ceiling Units: Furnish quality of full-size units equal to 5.0 percent of amount Installed.
2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Ceiling Panels:

1. Armstrong World Industries, Inc.

B. Suspension Systems:

1. Armstrong World Industries, Inc.

C: Perimeter Systems

1. Armstrong World Industries, Inc.

2.2.1 ACOUSTICAL CEILING UNITS *(REVISED - 08/29/2018)*

A. Acoustical Panels Type AP

1. Surface Texture: Fine
2. Composition: Mineral Fiber
3. Color White
4. Size 24IN x 24IN
5. Edge Profile: Beveled Tegular 9/16IN for interface with Sonata 9/16 Dimensional Tee grid
6. Noise Reduction Coefficient(NRC)
7. Ceiling Attenuation Class (CAC): ASTM C 1414; Classified with UL label on product carton 35.

8. Articulation Class (AC):
9. Flame Spread: (ASTM E 1264; Class A (UL)
10. Light Reflectance White Panel: ASTM E 1477; 0.90
11. Dimensional Stability: HumiGuard Plus
12. Recycle Content: Post Consumer Waste – 1% - 2% Pre-Consumer Waste – undefined
13. Acceptable Product: Ultima Lay-In and Tegular, 1916 as manufactured by Armstrong World Industries.

2.3.1 METAL SUSPENSION SYSTEMS

A. Components: Main beams and cross tees, base metal and end detail, fabricated from commercial quality hot dipped galvanized steel complying with ASTM A 653. Main beams and cross tees are double-web steel construction with exposed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.
   a. Structural Classification: ASTM C 635 normal duty
   b. Color: White and match the actual color of the selected ceiling tile, unless noted otherwise.
   c. Acceptable Product: Sonata 9/16" Dimensional Tee as manufactured by Armstrong World Industries

B. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

C. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft annealed, with a yield stress load of at least time three design load, but not less than 12 gauge.

D. Edge Moldings and Trim:
   7821 - 144in Shadow Molding

E. Accessories
   ALBERC2 - aluminum systems - 2" Aluminum Beam End Retaining Clip
   ES4 - for 15/16" Prelude Expansion Sleeves
   ES49 - for 9/16" Suprafine
   ES76004 for 1/4" Silhouette Suspension
   ES76008 - for 1/8" Silhouette Suspension
   STAC - Single Tee Adapter Clip
   7445 - 48" Stabilizer bar - not required when using the BERC2
   7425 - 24" Stabilizer bar - not required when using the BERC2

2.3.2 METAL SUSPENSION SYSTEMS

A. Components: Main beams and cross tees, base metal and end detail, fabricated from commercial quality hot dipped galvanized steel complying with ASTM A 653. Main beams and cross tees are double-web steel construction with exposed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.
   a. Structural Classification: ASTM C 635 normal duty
   b. Color: White and match the actual color of the selected ceiling tile, unless noted otherwise.
   c. Acceptable Product: Sonata 9/16" Dimensional Tee as manufactured by Armstrong World Industries

B. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

C. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft annealed, with a yield stress load of at least time three design load, but not less than 12 gauge.

D. Edge Moldings and Trim:
   7821 - 144in Shadow Molding

2.4.1 ALUMINUM CUSTOM TRIM - EXTRUDED

Product/Manufacturer: Axiom Trim Channel: 4in Axiom Classic Straight Armstrong World Industries, Incorporated

A. Commercial quality extruded aluminum alloy 6063 trim channel, factory finished in baked polyester paint. Commercial quality galvanized steel unfinished T-bar connection clips; galvanized steel splice plates.

1. Color: White
2. Size: 120IN x 4IN
3. Recycle Content: Post-Consumer - 50% Pre-Consumer - 0%
4. Acceptable Product: 4in Axiom Classic Straight, AX4STR as manufactured by Armstrong World Industries

B. Axiom Trim Channel:
4in Axiom Classic Straight

C. Axiom Outside Corner Posts (Straight Only):
4in Axiom Classic Outside Corner Post

D. Axiom Inside Corners (Straight Only):
4in Axiom Classic Inside Corner Post

E. Critical Installation Accessories:
   a. AXSPLICE - Splice with set screws, galvanized steel, unfinished, used to attached factory-mitered inside corners
   b. AX4SPLICE - Splice with setscrews, galvanized steel, unfinished, used to attach joints between sections of trim.
   c. AXTBC - T-bar Connector Clip, galvanized steel, unfinished, used to attach channel trim to supporting suspension members.

2.4.2 ALUMINUM CUSTOM TRIM – EXTRUDED

Product/Manufacturer: Axiom Trim Channel: 4in Axiom Classic Straight Armstrong World Industries, Incorporated

A. Commercial quality extruded aluminum alloy 6063 trim channel, factory finished in baked polyester paint. Commercial quality galvanized steel unfinished T-bar connection clips; galvanized steel splice plates.

1. Color: White
2. Size: 120IN x 4IN
3. Recycle Content: Post-Consumer - 50% Pre-Consumer - 0%
4. Acceptable Product: 4in Axiom Classic Straight, AX4STR as manufactured by Armstrong World Industries

B. Axiom Trim Channel:
4in Axiom Classic Straight

C. Axiom Outside Corner Posts (Straight Only):
4in Axiom Classic Outside Corner Post

D. Axiom Inside Corners (Straight Only):
4in Axiom Classic Inside Corner Post

E. Critical Installation Accessories:

a. AXSPLICE - Splice with set screws, galvanized steel, unfinished, used to attached factory-mitered inside corners
b. AX4SPLICE - Splice with setscrews, galvanized steel, unfinished, used to attach joints between sections of trim.
c. AXTBC - T-bar Connector Clip, galvanized steel, unfinished, used to attach channel trim to supporting suspension members.

F. Axiom Accessories:
1. AXSPLICE - Splice Plate

PART 3 – EXECUTION

3.1 EXAMINATION

A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations. (Exception: HumiGuard Max Ceilings)

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

3.3 INSTALLATION

A. Follow manufacturer installation instructions.

B. Install suspension system and panels in accordance with the manufacturer's instructions, and in compliance with ASTM C 636 and with the authorities having jurisdiction.

C. Suspend main beam from overhead construction with hanger wires spaced 4-0 on center along the length of the main runner. Install hanger wires plumb and straight.

D. Install wall moldings at intersection of suspended ceiling and vertical surfaces. Miter corners where wall moldings intersect or install corner caps.

E. For reveal edge panels: Cut and reveal or rabbet edges of ceiling panels at border areas and vertical surfaces.

F. Install acoustical panels in coordination with suspended system, with edges resting on flanges of main runner and cross tees. Cut and fit panels neatly against abutting surfaces. Support edges by wall moldings.

G. Installation must conform to CISCA recommendations for areas subject to severe seismic activity. IBC categories D, E and F must also meet these additional requirements:
Minimum 2″ wall molding
Grid must be attached to two adjacent walls –opposite walls must have a 3/4″ clearance
Ends of main beams and cross tees must be tied together to prevent their spreading
Heavy-duty grid system
Ceiling areas over 1,000 SF must have horizontal restraint wire or rigid bracing
Ceiling areas over 2,500 SF must have seismic separation joints or full height partitions
Ceilings without rigid bracing must have 2″ oversized trim rings for sprinklers and other penetrations
Changes in ceiling plane must have positive bracing
Cable trays and electrical conduits must be independently supported and braced
Suspended ceilings will be subject to special inspection
Perimeter support wires within 8"
NOTE: Consult your local code professional for information specific to your region.

3.4 ADJUSTING AND CLEANING

A. Replace damaged and broken panels.

B. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove any ceiling products that cannot be successfully cleaned and or repaired. Replace with attic stock or new product to eliminate evidence of damage.

C. Before disposing of ceilings, contact the Armstrong Recycling Center at 877-276-7876, select option #1 then #8 to review with a consultant the condition and location of building where the ceilings will be removed. The consultant will verify the condition of the material and that it meets the Armstrong requirements for recycling. The Armstrong consultant with provide assistance to facilitate the recycle of the ceiling.

END OF SECTION 095000

SECTION 096510 - RESILIENT TILE (LVT)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes Luxury Vinyl Tile (LVT).

B. Related Sections include the following:

1. Division 09 Section "Resilient Wall Base and Accessories" for resilient wall base, reducer strips, and other accessories installed with vinyl floor tile.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to static-control resilient flooring including, but not limited to, the following:

a. Examination and preparation of substrates to receive static-control resilient flooring.
b. Installation including seamless installation techniques.

1.4 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of resilient flooring

C. Samples for Verification: Full-size units of each color and pattern of vinyl floor tile required.

1.5 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store vinyl products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store tiles on flat surfaces.

1.7 PROJECT CONDITIONS

A. Close spaces to traffic during floor covering installation.

B. Close spaces to traffic for 48 hours after floor covering installation.

C. Install vinyl products after other finishing operations, including painting, have been completed.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

PART 2 - PRODUCTS

2.1 LUXURY VINYL TILE (LVT1)

A. Description: Layered construction consisting of a tough, clear, vinyl wear layer protecting a high-fidelity print layer on a solid vinyl backing. Protected by UV-cured polyurethane finish, the wear surface is embossed with different textures to enhance each of the printed visuals. Colors insoluble in water and resistant to cleaning agents and light.

B. Product: Basis of Design (BOD): Refer to Drawings.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic cement based formulation provided or approved by vinyl product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit vinyl products and substrate conditions indicated.

1. VOC Limit: 50 g/l

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of vinyl products.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of vinyl products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
3. Moisture Testing:

a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
b. Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

E. Move vinyl products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

1. Do not install vinyl products until they are same temperature as space where they are to be installed.

F. Sweep and vacuum clean substrates to be covered by vinyl products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 TILE INSTALLATION

A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

B. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tile pattern as recommended by Architect

C. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosing.

D. Extend tiles into toe spaces, door reveals, closets, and similar openings.

E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

F. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing vinyl product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

a. Do not wash surfaces until after time period recommended by manufacturer.

B. Protect vinyl products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

1. Apply protective floor polish, as recommended by tile manufacturer, to horizontal surfaces that are free from soil, visible adhesive and surface blemishes if recommended in writing by manufacturer.

a. Use commercially available product acceptable to manufacturer.
b. Coordinate selection of floor polish with Owner's maintenance service.

2. Cover products installed on horizontal surfaces with undyed, untreated building paper until Substantial Completion.
3. Do not move heavy and sharp objects directly over surfaces. Place hardboard or plywood panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION 096510

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Resilient base.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches (300 mm) long.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 VINYL BASE [B1]

A. Product Standard: ASTM F 1861, Type TV (vinyl, thermoplastic).

1. Group: I (solid, homogeneous).
2. Style and Location: As indicated on Drawings.

B. Minimum Thickness: 0.125 inch (3.2 mm).

C. Height: As indicated on Drawings.

D. Lengths: Coils in manufacturer's standard length.

E. Outside Corners: Job formed.

F. Inside Corners: Job formed.

G. Colors and Patterns: As selected by Architect from full range of industry colors.

2.2 INSTALLATION MATERIALS

A. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Do not install resilient products until they are the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

C. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.

a. Form without producing discoloration (whitening) at bends.

2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from exposed surfaces.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

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SECTION 096566 - RESILIENT ATHLETIC FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Rubber floor tile.

B. Related Sections:

1. Section 096513 "Resilient Base and Accessories" for wall base and accessories installed with flooring.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show installation details and locations of the following:

1. Border tiles.
2. Floor patterns.
3. Layout, colors, widths, and dimensions of game lines and markers.
4. Locations of floor inserts for athletic equipment installed through flooring.

C. Samples for Verification: For each type, color, and pattern of flooring indicated, 6-inch-(150-mm-) square Samples of same thickness and material indicated for the Work.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For flooring to include in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storing.

B. Store materials to prevent deterioration. Store tiles on flat surfaces.

1.6 FIELD CONDITIONS

A. Adhesively Applied Products:

1. Maintain temperatures during installation within range recommended in writing by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive flooring 48 hours before installation, during installation, and 48 hours after installation unless longer period is recommended in writing by manufacturer.
2. After postinstallation period, maintain temperatures within range recommended in writing by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
3. Close spaces to traffic during flooring installation.
4. Close spaces to traffic for 48 hours after flooring installation unless manufacturer recommends longer period in writing.

B. Install flooring after other finishing operations, including painting, have been completed.

1.7 COORDINATION

A. Coordinate layout and installation of flooring with floor inserts for gymnasium equipment.

PART 2 - PRODUCTS

2.1 RUBBER FLOOR TILE ATH1

A. Description: Athletic flooring consisting of modular rubber tiles with smooth edges for adhered application.

B. Material: Rubber wear layer and rubber shock-absorbent layer, vulcanized together.

C. Color and Pattern: As selected by Architect from manufacturer's full range.

2.2 ACCESSORIES

A. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by flooring manufacturer.

B. Adhesives: Water-resistant type recommended in writing by manufacturer for substrate and conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of flooring.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Alkalinity Testing: Perform pH testing according to ASTM F 710. Proceed with installation only if pH readings are not less than 7.0 and not greater than 8.5.
3. Moisture Testing:

a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.

1) Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than two tests in each installation area and with test areas evenly spaced in installation areas.

C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by manufacturer. Do not use solvents.

D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

E. Move flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation unless manufacturer recommends a longer period in writing.

1. Do not install flooring until they are same temperature as space where they are to be installed.

F. Sweep and vacuum clean substrates to be covered by flooring immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust.

G. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 FLOORING INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions.

B. Scribe, cut, and fit flooring to butt neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.

C. Extend flooring into toe spaces, door reveals, closets, and similar openings unless otherwise indicated.

D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating subfloor markings on flooring. Use nonpermanent, nonstaining marking device.

3.4 FLOOR TILE INSTALLATION

A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles in pattern indicated.

B. Discard broken, cracked, chipped, or deformed tiles.

C. Adhered Flooring: Adhere products to substrates using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturers' written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.

1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.5 CLEANING AND PROTECTING

A. Perform the following operations immediately after completing flooring installation:

1. Remove adhesive and other blemishes from flooring surfaces.
2. Sweep and vacuum flooring thoroughly.
3. Damp-mop flooring to remove marks and soil after time period recommended in writing by manufacturer.

B. Protect flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

1. Do not move heavy and sharp objects directly over flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION 096566

SECTION 096766 - FLUID-APPLIED ATHLETIC FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Polyurethane flooring fluid-applied directly on substrates.
2. Polyurethane flooring fluid-applied over base mats.

B. Related Sections:

1. Division 09 Section "Resilient Base and Accessories" for wall base and accessories installed with fluid-applied athletic flooring.
2. Division 09 Section "Resilient Athletic Flooring" for roll and tile resilient athletic flooring.
3. Division 09 Section "Resinous Flooring" for polymer floor covering systems intended for other uses.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit EQ 4.1: For adhesives, documentation including printed statement of VOC content and chemical components.
2. Product Data for Credit EQ 4.2: For liquid-applied flooring components,[**and game-line and marker paints,**] documentation including printed statement of VOC content and chemical components.
3. Product Data for Credit EQ 4: For liquid-applied flooring, [**base mat adhesives,**] [**and game-line and marker paints,**] documentation including laboratory test reports indicating compliance with California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: Show installation details for flooring including layout, colors, widths, and dimensions of game lines and markers and locations of athletic equipment floor inserts.

D. Samples for Initial Selection: Manufacturer's color charts showing colors and glosses available for flooring and game-line and marker paints.

E. Samples for Verification: For each color, gloss, and texture of flooring required, 12 inches (305 mm) square, applied to a rigid backing.[**Include sample sets showing the game-line and marker paint colors applied to the flooring.**]

F. Qualification Data: For qualified Installer.

G. Maintenance Data: For fluid-applied athletic flooring to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An Installer (Applicator) who is approved, trained, or certified by fluid-applied athletic flooring manufacturer.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with flooring manufacturer's written instructions for substrate temperature, ambient temperature, humidity, ventilation, and other conditions affecting flooring application.

1. Do not apply flooring until spaces are enclosed and weatherproof; wet work in spaces is complete and dry; and overhead work, including installing mechanical systems, lighting, and athletic equipment, is complete.
2. Maintain temperatures during installation within range recommended in writing by manufacturer, but not less than [**70 deg F (21 deg C)**] <**Insert temperature**> or more than [**95 deg F (35 deg C)**] <**Insert temperature**>, in spaces to receive flooring 48 hours before installation, during installation, and 48 hours after installation unless longer period is recommended in writing by manufacturer.
3. After installation period, maintain temperatures within range recommended in writing by manufacturer, but not less than [**55 deg F (13 deg C)**] <**Insert temperature**> or more than [**95 deg F (35 deg C)**] <**Insert temperature**>.
4. Close spaces to traffic during flooring installation.

1.6 COORDINATION

A. Coordinate layout and installation of flooring with floor inserts for gymnasium equipment.

PART 2 - PRODUCTS

2.1 DIRECT-APPLIED FLOORING <**Insert drawing designation**>

A. Products: Subject to compliance with requirements, [**provide the following**] [**provide one of the following**] [**available products that may be incorporated into the Work include, but are not limited to, the following**]:

1. Athletic Polymer Systems, Inc.; Tartan High Performance Resin System.
2. Beynon Sports Surfaces, Inc.; [**BSS 1000**] [**PolyTurf**] [**PolyTurf Plus**].
3. Horner Flooring Company, Inc.; AllCourt.
4. Robbins, Inc.; [**ChemTurf**] [**ChemTurf D/D**].
5. Surface America Incorporated; [**ElastoFloor Full-Pour**] [**Evertop**].
6. <**Insert manufacturer's name; product name or designation**>.

B. Description: Fluid-applied athletic flooring system consisting of primer and polyurethane body and top coats applied directly to substrate.

C. Performance:

1. Low-Emitting Materials: Provide products with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

a. Primer: VOC content of not less than 250 g/L.
b. Body and Top Coats: VOC content of not more than 100 g/L.

2. Low-Emitting Materials: Provide adhesives, paints and coatings, and flooring systems that comply with the maximum allowable concentrations of VOC's when tested according to California

Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Materials:

1. Primer: Manufacturer's primer recommended for substrate indicated.
2. Body Coat(s): Two-component, self-leveling, pigmented, polyurethane containing no rubber fillers and no mercury.
3. Topcoat (Finish Coat): Manufacturer's standard pigmented polyurethane.

E. Finishes:

1. Color: [**As selected by Architect from manufacturer's full range**] [**As indicated by manufacturer's designations**] <**Insert color**>.
2. Surface Texture: [**Manufacturer's standard**] <**Insert texture**>.

2.2 FLOORING APPLIED OVER BASE MATS <**Insert drawing designation**>

A. Products: Subject to compliance with requirements, [**provide the following**] [**provide one of the following**] [**available products that may be incorporated into the Work include, but are not limited to, the following**]:

1. Aacer Flooring, LLC; MP Sport.
2. Abacus Sports Installations Ltd.; Padenpor.
3. Action Floor Systems, LLC; Herculan.
4. Beynon Sports Surfaces, Inc.; PolyTurf Plus Pad & Pour.
5. Horner Flooring Company, Inc.; [**CushionCourt System**] [**CushionCourt (GPS)**] [**CushionCourt TRACKtion**] [**EcoCourt**].
6. Robbins, Inc.; Pulastic [**2000**] [**DG**] [**FA**] [**FL**] [**JV**] [**SP**] [**TB**].
7. Sport Court, Subsidiary of Connor Sport Court International; ElastiPlus [**DIN**].
8. Surface America Incorporated; ElastoFloor Roll-Pour.
9. <**Insert manufacturer's name; product name or designation**>.

B. Description: Fluid-applied athletic flooring system consisting of resilient base mat adhered to substrate, base mat sealer, and fluid-applied polyurethane body and top coats.

C. Performance:

1. Low-Emitting Materials: Provide products with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

   a. Base Mat Adhesive: VOC content of not more than 60 g/L.
   b. Base Mat Sealer: VOC content of not more than 200 g/L.
   c. Body and Topcoats: VOC content of not more than 100 g/L.

2. Low-Emitting Materials: Provide adhesives, paints and coatings, and flooring systems that comply with the maximum allowable concentrations of VOC's when tested according to California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Materials:

1. Base Mat: Manufacturer's standard base mats of granulated recycled rubber in polyurethane binder.

   a. Thickness: [**5/32 inch (4 mm)**] [**1/4 inch (6 mm)**] [**9/32 inch (7 mm)**] [**11/32 inch (9 mm)**] [**15/32 inch (12 mm)**] <**Insert dimension**>.

2. Base-Mat Adhesive: Manufacturer's standard two-component polyurethane.
3. Base-Mat Sealer: Manufacturer's standard two-component polyurethane compound formulated for sealing base mat.
4. Body Coat(s): Two-component, self-leveling, pigmented, polyurethane containing no rubber fillers and no mercury.
5. Topcoat (Finish Coat): Manufacturer's standard pigmented polyurethane.

E. Finishes:

1. Color: [**As selected by Architect from manufacturer's full range**] [**As indicated by manufacturer's designations**] <**Insert color**>.
2. Surface Texture: [**Manufacturer's standard**] <**Insert texture**>.

2.3 ACCESSORIES

A. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by flooring manufacturer.

B. Game-Line and Marker Paint: Complete system including primer, if any, compatible with flooring and recommended in writing by flooring and paint manufacturers for use indicated.

1. VOC content: Provide products with VOC content of not more than 150 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Concrete Substrates: Prepare substrates according to manufacturer's written instructions to ensure adhesion of flooring.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners. Remove contaminants using mechanical means.
2. Alkalinity Testing: Perform pH testing according to ASTM F 710. Proceed with installation only if pH readings are not less than 7.0 and not greater than 8.5.
3. Moisture Testing:

a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of [**3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)**] <**Insert rate**> in 24 hours.

1) Perform tests so that each test area does not exceed [**200 sq. ft. (18.6 sq. m)**] <**Insert area**>, and perform not less than 2 tests in each installation area and with test areas evenly spaced in installation areas.

b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum [**75**] <**Insert number**> percent relative humidity level measurement.

B. Remove substrate coatings and other substances that are incompatible with [**flooring**] [**adhesives**] and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by manufacturer. Do not use solvents.

C. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

D. Treat nonmoving substrate cracks and control joints to prevent cracks from telegraphing (reflecting) through flooring according to manufacturer's written instructions.

E. Protect substrate voids and joints to prevent flooring resins from flowing into or leaking through them.

F. Move flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation unless manufacturer recommends a longer period in writing.

1. Do not install flooring until it is same temperature as space where it is to be installed.

G. Sweep and vacuum clean substrates to be covered by flooring immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust.

H. Proceed with installation only after unsatisfactory conditions have been corrected.

I. Protect walls, floor openings, athletic equipment inserts, electrical openings, door frames, and other obstructions during installation. Cover floor and wall areas at mixing stations.

3.3 FLOORING INSTALLATION, GENERAL

A. General: Mix and apply flooring components according to manufacturer's written instructions.

1. At substrate expansion, isolation, and other moving joints, install continuous joint of same width through flooring.

3.4 INSTALLATION OF DIRECT-APPLIED FLOORING

A. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

B. Apply body coat(s) and topcoat to produce a uniform, level surface and finish.

3.5 INSTALLATION OF FLOORING APPLIED OVER BASE MATS

A. Adhesively apply resilient base mats to substrate according to manufacturer's written instructions.

1. Do not compress mats when fitting into place. Leave gap of width recommended in writing by manufacturer at butted base-mat sheets, walls, floor openings, athletic equipment inserts, electrical openings, door frames, and other obstructions.
2. Roll base mats to set them into adhesive and eliminate air pockets.
3. Repair ridges at seams, loose areas, and air pockets according to manufacturer's written instructions.

B. Apply seal coat to base mats before applying body coat(s).

C. Smooth ridges and high spots in seal coat before applying body coat(s).

D. Apply body coat(s) and topcoat to produce a uniform surface and finish.

3.6 GAME LINES AND MARKERS

A. Mask flooring at game lines and markers, and apply paint to produce sharp edges. Where crossing, break minor game line at intersection; do not overlap lines.

B. Lay out game lines and markers to comply with rules and diagrams published by [**National Collegiate Athletic Association (NCAA)**] [**National Federation of State High School Associations**] <**Insert organization**> for athletic activities indicated.

3.7 PROTECTION

A. Close spaces to traffic for [**48 hours**] [**96 hours**] [**seven days**] <**Insert time**> after flooring installation unless manufacturer recommends longer period in writing.

B. Protect flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

1. Do not move heavy and sharp objects directly over flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION 096766

SECTION 096816 – TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Tufted carpet Tiles
2. Woven carpet.
3. Carpet substrate

B. Related Requirements:
1. Division 09 Section "Resilient Tile Flooring, Resilient Base and Accessories" for resilient wall base and accessories installed with carpet.
2. Division 09 Section "Tile Carpeting."

1.3 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1. Review methods and procedures related to carpet installation including, but not limited to, the following:

a. Review delivery, storage, and handling procedures.
b. Review ambient conditions and ventilation procedures.
c. Review subfloor preparation procedures.

1.4 ACTION SUBMITTALS

A. Product Data: For the following, including installation recommendations for each type of substrate:

1. Carpet: For each type indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Carpet Cushion: For each type indicated. Include manufacturer's written data on physical characteristics and durability.

B. Shop Drawings: Show the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
2. Carpet type, color, and dye lot.
3. Seam locations, types, and methods.
4. Type of subfloor.
5. Type of installation.
6. Pattern type, repeat size, location, direction, and starting point.
7. Pile direction.
8. Type, color, and location of insets and borders.

9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.
11. Type of carpet cushion.

C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet: 12-inch- (300-mm-) square Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.
3. Carpet Cushion: 6-inch- (150-mm-) square Sample.
4. Carpet Seam: 6-inch (150-mm) Sample.
5. Mitered Carpet Border Seam: 12-inch- (300-mm-) square Sample. Show carpet pattern alignment.

D. Product Schedule: For carpet and carpet cushion. Use same designations indicated on Drawings or in finish schedule

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Test Reports: For carpet and carpet cushion, for tests performed by a qualified testing agency.

C. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet and carpet cushion.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet: Full-width Tiles equal to [5] percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An experienced Installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

B. Fire-Test-Response Ratings: Where indicated, provide carpet and carpet cushion identical to those of assemblies tested for fire response per NFPA 253 by a qualified testing agency.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockups at locations and in sizes shown on Drawings.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104.

1.10 FIELD CONDITIONS

A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet[and carpet cushion] until spaces are enclosed and weather-tight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.

C. Do not install carpet and carpet cushion over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and have pH range recommended by carpet manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

1.11 WARRANTY

A. Special Warranty for Carpet: Manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, [loss of tuft bind strength,] [excess static discharge,] and delamination.
3. Warranty Period: [10] years from date of Substantial Completion.

B. Special Warranty for Carpet Cushion: Manufacturer agrees to repair or replace components of carpet cushion installation that fail in materials or workmanship within specified warranty period.

1. Warranty includes consequent removal and replacement of carpet and accessories.
2. Warranty does not include deterioration or failure of carpet cushion due to unusual traffic, failure of substrate, vandalism, or abuse.
3. Failure includes, but is not limited to, permanent indentation or compression.
4. Warranty Period: [10] years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TUFTED CARPET

A. Products: Subject to compliance with requirements, provide the following or equal:
1. Shaw Floors

B. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following and per finish schedule:

1. Shaw Floors – Philadelphia Commercial Collection

C. Color: Basis for Design – Shaw Floors – Philadelphia Commercial Collection
   1. Style 54498
   2.

D. Pattern - Intuition

E. Fiber Content: 100 percent nylon 6

F. Pile Characteristic: As shown on drawing and finish scheule

G. Yarn Twist: TPI (TPCM)

H. Density: <19 oz./cu. yd. (g/cu. cm)>.

I. Primary Backing: Manufacturer's standard material

J. Secondary Backing: Manufacturer's standard material.

K. Back-coating: Manufacturer's standard material.

L. Width: Per drawings and Finish Schedule

M. Applied Soil-Resistance Treatment: Manufacturer's standard material.

N. Antimicrobial Treatment: Manufacturer's standard material.

O. Performance Characteristics: As follows:

   1. Appearance Retention Rating: [Heavy traffic, 3.0] minimum per ASTM D 7330.
   2. Critical Radiant Flux Classification: Not less than [0.45 W/sq. cm].
   3. Dry Breaking Strength: Not less than 100 lbf (445 N) per ASTM D 2646.
   4. Tuft Bind: Not less than [3 lbf (13 N)] per ASTM D 1335.
   5. Delamination: Not less than [2.5 lbf/in. (12 N/mm)] per ASTM D 3936.
   6. Resistance to Insects: Comply with AATCC 24.
   7. Colorfastness to Crocking: Not less than 4, wet and dry, per AATCC 165.
   8. Colorfastness to Light: Not less than 4 after [40] AFU (AATCC fading units) per AATCC 16, Option E.
   9. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria; not less than 1-mm halo of inhibition for gram-negative bacteria; no fungal growth; per AATCC 174.
   10. Electrostatic Propensity: Less than [3.5] kV per AATCC 134.
   11. Emissions: Provide carpet that complies with testing and product requirements of CRI's "Green Label Plus" program.
   12. Emissions: Provide carpet that complies with the product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Examine carpet for type, color, pattern, and potential defects.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

   1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet[cushion] manufacturer.

2. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. For wood subfloors, verify the following:

1. Underlayment over subfloor complies with requirements specified in Division 06 Section "Rough Carpentry."
2. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

2.3 PREPARATION

A. General: Comply with CRI 104, Section 7.3, "Site Conditions; Floor Preparation," and with carpet manufacturer's written installation instructions for preparing substrates.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet[cushion] manufacturer.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet.

2.4 INSTALLATION

A. Comply with CRI 104 and [carpet manufacturer's] written installation instructions for the following:

1. Direct-Glue-Down Installation: Comply with CRI 104, Section 9, "Direct Glue-Down Installation."
2. Double-Glue-Down Installation: Comply with CRI 104, Section 10, "Double-Glue-Down Installation."
3. Carpet with Attached-Cushion Installation: Comply with CRI 104, Section 11, "Attached-Cushion Installations."
4. Pre-applied Adhesive Installation: Comply with CRI 104, Section 11.4, "Pre-Applied Adhesive Systems (Peel and Stick)."
5. Hook-and-Loop Installation: Comply with CRI 104, Section 11.5, "Hook and Loop Technology."
6. Stretch-in Installation: Comply with CRI 104, Section 12, "Stretch-in Installations."

B. Comply with carpet manufacturer's written recommendations and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.

C. Do not bridge building expansion joints with carpet.

D. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.

E. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

G. Install pattern parallel to walls and borders to comply with CRI 104, Section 15, "Patterned Carpet Installations" and with carpet manufacturer's written recommendations.

H. Comply with carpet cushion manufacturer's written recommendations.[Install carpet cushion seams at 90-degree angle with carpet seams.

2.5 CLEANING AND PROTECTING

A. Perform the following operations immediately after installing carpet:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
2. Remove yarns that protrude from carpet surface.
3. Vacuum carpet using commercial machine with face-beater element.

B. Protect installed carpet to comply with CRI 104, Section 16, "Protecting Indoor Installations."

C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer and carpet cushion and adhesive manufacturers.

END OF SECTION 096816

SECTION 097720 – DECORATIVE FIBERGLASS REINFORCED WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Prefinished polyester glass reinforced plastic sheets and adhered to unfinished gypsum or cementitous wallboard.
   1. PVC trim.
   2. PVC Wall base.

B. Products Not Furnished or Installed under This Section:
   1. Gypsum or Cementitious substrate board.
   2. Resilient Base.

1.2 RELATED SECTIONS

A. Section 092900– Gypsum [Cementitious] substrate board.

B. Section 092216- Metal Stud Framing

1.3 REFERENCES

A. American Society for Testing and Materials: Standard Specifications (ASTM)
   1. ASTM D 256 - Izod Impact Strengths (ft #/in)
   2. ASTM D 570 - Water Absorption (%)
   3. ASTM D 638 - Tensile Strengths (psi) & Tensile Modulus (psi)
   4. ASTM D 790 - Flexural Strengths (psi) & Flexural Modulus (psi)
   5. ASTM D 2583- Barcol Hardness
   6. ASTM D 5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels.
   7. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

A. Product Data: Submit sufficient manufacturer's data to indicate compliance with these specifications, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

B. Shop Drawings: Submit elevations of each wall showing location of paneling and trim members with respect to all discontinuities in the wall elevation.

C. Selection Samples: Submit manufacturer’s standard color pattern selection samples representing manufacturer's full range of available colors and patterns.

D. Samples for Verification: Submit appropriate section of panel for each finish selected indicating the color, texture, and pattern required.
   1. Submit complete with specified applied finish.
   2. For selected patterns show complete pattern repeat.
   3. Exposed Molding and Trim: Provide samples of each type, finish, and color.

E. Manufacturers Material Safety Data Sheets (MSDS) for adhesives, sealants and other pertinent materials prior to their delivery to the site (available as downloads for most Marlite's products at http://www.marlite.com/tech-details.aspx or by contacting Marlite at info@marlite.com).

1.5 QUALITY ASSURANCE

A. Conform to building code requirements for interior finish for smoke and flame spread requirements as tested in accordance with:
   1. ASTM E 84 (Method of test for surface burning characteristics of building Materials)
      a. Wall Required Rating – Class [A] [C].

B. Sanitary Standards: System components and finishes to comply with:
   1. United States Department of Agriculture (USDA) requirements for food preparation facilities, incidental contact.
   2. Food and Drug Administration (FDA) 1999 Food Code 6-101.11.
   3. Canadian Food Inspection Agency (CFIA) requirements.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials factory packaged on strong pallets.

B. Store panels and trim lying flat, under cover and protected from the elements. Allow panels to acclimate to room temperature (70°) for 48 hours prior to installation.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Building are to be fully enclosed prior to installation with sufficient heat (70°) and ventilation consistent with good working conditions for finish work

B. During installation and for not less than 48 hours before, maintain an ambient temperature and relative humidity within limits required by type of adhesive used and recommendation of adhesive manufacturer.
   1. Provide ventilation to disperse fumes during application of adhesive as recommended by the adhesive manufacturer.

1.8 WARRANTY

A. Furnish one year guarantee against defects in material and workmanship.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

A. Marlite; 202 Harger Street, Dover, OH 44622. 800-377-1221 FAX (330) 343-4668 Email: info@marlite.com www.marlite.com.

B. Product:
   1. Standard FRP
   2. Induro FRP
   3. Artizan FRP with Sani-Coat.
   4. Envue with Sani-Coat.
   5. Symmetrix with Sani-Coat.

2.2 PANELS

A. Fiberglass reinforced thermosetting polyester resin panel sheets complying with ASTM D 5319.
1. Coating: Multi-layer print, primer and finish coats or applied over-layer.
2. Dimensions:
a. Thickness – 0.090 " (2.29mm) nominal
b. Width - 4'-0" (1.22m) nominal
c. Length –10'-0" or indicated on the drawings] nominal
3. Tolerance:
a. Length and Width: +/-1/8 " (3.175mm)
b. Square - Not to exceed 1/8 " for 8 foot (2.4m) panels or 5/32 " (3.96mm) for 10 foot (2.4m) panels

B. Properties: Resistant to rot, corrosion, staining, denting, peeling, and splintering.
1. Flexural Strength - 1.0 x 10^4 psi per ASTM D 790. (7.0 kilogram-force/square millimeter)
2. Flexural Modulus - 3.1 x 10^5 psi per ASTM D 790. (217.9 kilogram-force/square millimeter)
3. Tensile Strength - 7.0 x 10^3 psi per ASTM D 638. (4.9 kilogram-force/square millimeter)
4. Tensile Modulus - 1.6 x 10^5 psi per ASTM D 638. (112.5 kilogram-force/square millimeter)
5. Water Absorption - 0.72% per ASTM D 570.
6. Barcol Hardness (scratch resistance) of 35 55 as per ASTM D 2583.
7. Izod Impact Strength of 72 ft. lbs./in ASTM D 256

C. Back Surface: Smooth. Imperfections which do not affect functional properties are not cause for rejection.

D. Front Finish: As Indicated on the Drawings

Specifier Note: Marlite's Standard FRP, Induro FRP, Artizan FRP, Envue FRP & Symmetrix with Sani-Coat Panels are available in several configurations, including Class A (I) and Class C (III) Fire-rated, along with various surface textures for both Standard FRP & Symmetrix with Sani-Coat. All Marlite FRP products can be made available with standard surface grooving and customized groove layouts to match architectural specifications.

a. Color: per manufactures full range selection/ architects selction
1) Marlite Standard FRP is available in a variety of colors, including;
a) 100 White
b) 106 Beige,
c) 118 Natural Almond
d) 140 Ivory
e) 145 Silver
f) 151 Light Grey
g) P807 Black
h) 199 Bright White

2) Marlite Induro FRP is available in a variety of colors and patterns, including;
a) D354 Designer White
b) D381 Fashion Grey
c) FP610 Hard Rock Maple
d) FP612 Graphite Spectrum
e) 4143 Neutral Glace
f) 4745 Maroochy Brush
g) 4746 Woolamai Brush
h) 4810 Titanium

3) Marlite Artizan FRP is available in a variety of colors and patterns, including;
a) 148 Monticello Anigre
b) 310 Sierra Maple
c) 715 Mahogany
d) 925 Autumn Cherry
e) 5408 Monterey Sand
f) 5409 Townsend
g) 5410 Sebring

h) 5411 Rainier
i) 194 Cody
j) 192 Laramie
k) 209 Adara
l) 211 Grizel
m) 181-G1212 Dusk
n) 182-G1212 Oxide

4) Marlite Envue FRP includes full custom graphics capabilities and are provided as;
   a) Customer supplied artwork, in a digital file format compatible with Marlite's requirements and in a layout compatible with the panel dimensions as required for the installation. Revisions by Marlite Graphics Services to customer supplied artwork are to be submitted for customer approval. It is the customer's responsibility to contact their Marlite representative for Marlite's digital file format requirements. Charges may apply if revisions are required to re-format artwork files.
   b) Marlite supplied artwork, for customer review and approval. Graphic serviced and set-up charges may apply.

5) Marlite Symmetrix with Sani-Coat FRP is available in a variety of colors, patterns and groove configurations, including;
   a) C100-G44 White
   b) C100-G66 White
   c) C118-G44 Almond
   d) C140-G44 Ivory
   e) C105-G44 Black
   f) C150-G44 White with Black
   g) C151-G44 White with Everglade
   h) C153-G44 White with Periwinkle

   Custom patterns and colors are available. Minimum quantities may apply. Contact a Marlite representative for details.

b. Surface [Specifier to choose.] Marlite Standard FRP and Symmetrics are available on two standard surface textures. Pebbled (indicated by "P" designation i.e., P 100 White) and Smooth (indicated by "S" designation i.e., S 100 White). All other Marlite FRP products are smooth surface texture.

c. Fire Rating [Specifier to choose.] Marlite FRP is available in either Class A (I) or Class C (III) Fire Rating. Specifier should add designation to product number only for Class A (i.e., P 100 White, Class A).

d. Size: [Specifier to choose, or as indicated on drawings.] standard sizes are;

   1) Marlite FRP / Symmetrics / Artizan / Envue
      a) 48" x 96" [1.2m x 2.4m] x .090" (3mm) nom.
      b) 48" x 108" [1.2m x 2.7m] x .090" (3mm) nom.
      c) 48" x 120" [1.2m x 3m] x .090" (3mm) nom.

   2) Marlite Induro FRP
      a) 47.5" x 95.5" [1.2m x 2.4m] x .090" (3mm) nom.

   3) Ceiling panels (designed for suspended ceiling installation)
      a. 23 ¾" x 47 ¾" (0.6m x 1.2m) x .090" (3mm)
      b. 23 ¾" x 23 ¾" (0.6m x 0.6m) x .090" (3mm)

   Can be specified as FRP panels only or backed with 5/8" FR Drywall.

2.3 BASE

A. Marlite Base Molding for 0.090 " (2.29mm) thick FRP Panels
1. Color: [Black] [Quarry Red].
2. Profiles:
a. M 612 FRP Base Molding, 10' length
b. M 651 Inside Corner
c. M 660 Outside Corner
d. M 620 LH End Cap
e. M 625 RH End Cap

2.4 MOLDINGS

Aluminum Trim: Heavy weight extruded aluminum 6063-T5 alloy prefinished at the factory.
1. Profiles :
a. F 550 Inside Corner, 8' length
b. F 561 Outside Corner, 8' length
c. F 565 Division, 8' length
d. F 570 Edge, 8' length
e. Color: Brite Anodized

B. Aluminum Trim: Heavy weight extruded aluminum 6063-T5 alloy prefinished at the factory.
a. A551Inside Corner, 8' length
b. A560 Outside Corner, 8' length
c. A565 Division, 8' length
d. A570 Edge, 8' length
2. Color: [Factory Oven-Baked Finish to match spec'd panel][Black Satin Anodized][Clear Satin Anodized]

C. PVC Trim: Thin-wall semi-rigid extruded PVC.
1. M 350 Inside Corner, [8' length][10' length]
2. M 360 Outside Corner, [8' length][10' length]
3. M 365 Division, [8' length][10' length]
4. M 370 Edge, [8' length][10' length]
5. Color: [White][Beige][Natural Almond][Ivory][Silver][Light Grey][Black]

D. SaniSeal Trim: Co-extruded, dual-durometer polypropylene/monprene profiles with Dual-Seal Technology and high-performance pressure sensitive adhesive.
1. S650 Inside Corner, 10' length
2. S660 Outside Corner, 10' length
3. S665 Division, 8' length
4. S670 Edge, 10' length
5. Color: [White][Umber][Slate][Tan][Black][Custom, per specification]

E. Outside Corner Guard:
1. F 560SS Stainless Corner Guard, [8' length][10' length]
2. Finish: #4 brushed satin
3. M 961 PVC Outside Corner Guard
a. Color: [White, [8' length][10' length]][Natural Almond, [8' length][10' length]][Ivory, 10' length][Silver, 10' length][Light Grey, 10' length]

2.5 ACCESSORIES

A. Fasteners: Non-staining nylon drive rivets.
1. Match panel colors.

2. Length to suit project conditions.

B. Adhesive: Either of the following construction adhesives complying with ASTM C 557.
1. Marlite C-551 FRP Adhesive - Water- resistant, non-flammable adhesive.
2. Marlite C-375 Construction Adhesive - Flexible, water-resistant, solvent based adhesive, formulated for fast, easy application.
3. Titebond Advanced Polymer Panel Adhesive – VOC compliant, non-flammable, environmentally safe adhesive.

C. Sealant:
1. Marlite Brand MS-250 Clear Silicone Sealant.
2. Marlite Brand MS-251 White Silicone Sealant.

3. Marlite Brand - Color Match Sealant .

PART 3 - EXECUTION

3.1 PREPARATION

A. Repair defects prior to installation.
1. Level wall surfaces to panel manufacturer's requirements. Remove protrusions and fill indentations.

3.2 INSTALLATION

A. Comply with manufacturer's recommended procedures and installation sequence.

B. Cut sheets to meet supports allowing 1/8" (3 mm) clearance for every 8 foot (2.4m) of panel.
1. Cut and drill with carbide tipped saw blades or drill bits, or cut with shears.
2. Pre-drill fastener holes 1/8" (3mm) oversize with high speed drill bit.
a. Space at 8" (200mm) maximum on center at perimeter, approximately 1" from panel edge.
b. Space at in field in rows 16' (40.64cm) on center, with fasteners spaced at 12" (30.48 cm) maximum on center.

C. Apply panels to board substrate, above base, vertically oriented with seams plumb and pattern aligned with adjoining panels.
1. Install panels with manufacturer's recommended gap for panel field and corner joints.
a. Adhesive trowel and application method to conform to adhesive manufacturer's recommendations.
b. Drive fasteners for snug fit. Do not over-tighten.

D. Apply panel moldings to all panel edges using silicone sealant providing for required clearances.
1. All moldings must provide for a minimum 1/8 " (3mm) of panel expansion at joints and edges, to insure proper installation.
2. Apply sealant to all moldings, channels and joints between the system and different materials to assure watertight installation.

3.3 CLEANING

A. Remove excess sealant from panels and moldings. Wipe panel down using a damp cloth and mild soap solution or cleaner.

B. Refer to manufacturer's specific cleaning recommendations Do not use abrasive cleaners.

END OF SECTION 09 7720

SECTION 099000 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes surface preparation and field painting of following:

1. Exposed exterior items and surfaces.
2. Exposed interior items and surfaces.
3. Surface preparation, priming, and finish coats specified in this Section in addition to shop priming and surface treatment specified in other Sections.
4. High performance coatings.

B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from paint manufacturer's standard colors and finishes available.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

1. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

D. Related Sections:

1. Section 078123 "Intumescent Fireproofing" for fireproofing coating on exposed steel.
2. Section 099600 "High Performance Coatings" for metal coatings.
3. Section 099620 "Exterior Textured Coating – Heat Reflective" for textured, cool wall coating.

1.3 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Eggshell refers to low-sheen finish with a gloss range between 5 and 20 when measured at a 60-degree meter.
3. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60-degree meter.
4. Semigloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.

5. Full gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.

1.4 SUBMITTALS

A. Product Data: For each paint system specified. Include block fillers and primers.

1. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.

B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.

C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample of each type of coating and substrate required on the Project. Comply with procedures specified in PDCA P5.

1. The Architect will select one room surface to represent surfaces and conditions for each type of coating and substrate to be painted.

a. Wall Surfaces: Provide samples on at least 100 sq. ft. of wall surface.
b. Small Areas and Items: The Architect will designate an item or area as required.

2. After permanent lighting and other environmental services have been activated, apply coatings in this room or to each surface according to the Schedule or as specified. Provide required sheen, color, and texture on each surface.
3. Final approval of colors will be from job-applied samples.
4. Mockup of upper level floor(s) and concrete hollow core planks. Finish shall be consistent.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.

1. Protection: Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.7 PROJECT CONDITIONS

A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90 deg F.

B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 and 95 deg F.

C. Do not apply paint in rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design (BOD): Unless otherwise specified, paint materials and systems specified herein are those of Sherwin Williams (S-W) or PPG Pittsburgh / Porter Paint Co. (PPG). Subject to compliance with requirements, (BOD) materials and systems by one of the following manufacturers acceptable:

1. Sherwin Williams (BOD)
2. PPG Pittsburgh / Porter Paint Co. (BOD)
3. Sikkens
4. Scott Paints
5. Benjamin Moore and Co.
6. ICI Paints

B. Basis of Design (BOD) Selections: As indicated on Drawings.

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

C. Colors: Provide color selections made by the Architect.

2.3 LEAD CONTENT

A. Provide paint complying with latest requirements of Federal Government for maximum allowable lead content. State compliance on MSDS and container clearly identifying product.

2.4 VOC COMPLIANCE

A. Chemical Components of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and following chemical restrictions; requirements do not apply to primers or finishes applied in a fabrication or finishing shop:

1. Flat Paints and Coatings: VOC content of not more than 50 g/L.
2. Non-flat Paints and Coatings: VOC content of not more than 150 g/L.
3. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
4. Restricted Components: Paints and coatings shall not contain any of the following:

a. Acrolein.
b. Acrylonitrile.
c. Antimony.
d. Benzene.
e. Butyl benzyl phthalate.
f. Cadmium.
g. Di (2-ethylhexyl) phthalate.
h. Di-n-butyl phthalate.
i. Di-n-octyl phthalate.
j. 1, 2-dichlorobenzene.
k. Diethyl phthalate.
l. Dimethyl phthalate.
m. Ethylbenzene.
n. Formaldehyde.
o. Hexavalent chromium.
p. Isophorone.
q. Lead.
r. Mercury.
s. Methyl ethyl ketone.
t. Methyl isobutyl ketone.
u. Methylene chloride.
v. Naphthalene.
w. Toluene (methylbenzene).
x. 1, 1, 1-trichloroethane.
y. Vinyl chloride.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.

1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
2. Start of painting construed as Applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections where primers provided to ensure compatibility of total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify the Architect about anticipated problems using materials specified over substrates primed by others.

3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.
2. Cementitious Materials: Prepare concrete and concrete masonry surfaces to b**e** painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

   a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
   b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.

3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.

   a. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.

4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.

a. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.

5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

D. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Use only thinners approved by paint manufacturer and only within recommended limits.

3.3 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Paint colors, surface treatments, and finishes are indicated in the schedule.
2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
3. Provide finish coats that are compatible with primers used.
4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
9. Sand lightly between each succeeding enamel or varnish coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and the film thickness required same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce smooth, even surface according to manufacturer's written instructions, sand between applications.
2. Omit primer on metal surfaces that have been shop primed and touchup painted.
3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions. All metal surfaces shall be sprayed except that piping, conduit, and ductwork may be brushed or rolled.

1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.
2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturers recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.

E. Electrical items to be painted include, but are not limited to, the following:

1. Exposed conduit and fittings.
2. Exterior switchgear.

F. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

G. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.

H. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

I. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.

1. Provide satin finish for final coats.

J. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.

K. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 FIELD QUALITY CONTROL

A. The Owner reserves the right to invoke the following test procedure at any time and as often as the Owner deems necessary during the period when paint is being applied:

1. The Owner will engage the services of an independent testing agency to sample the paint material being used. Samples of material delivered to the Project will be taken, identified, sealed, and certified in the presence of the Contractor.
2. The testing agency will perform appropriate tests for the following characteristics as required by the Owner:

a. Quantitative material analysis.
b. Abrasion resistance.
c. Apparent reflectivity.
d. Flexibility.
e. Washability.
f. Absorption.
g. Accelerated weathering.
h. Dry opacity.
i. Accelerated yellowness.
j. Recoating.
k. Skinning.
l. Color retention.
m. Alkali and mildew resistance.

3. The Owner may direct the Contractor to stop painting if test results show material being used does not comply with specified requirements. The Contractor shall remove noncomplying paint from the site, pay for testing, and repaint surfaces previously coated with the rejected paint. If necessary, the Contractor may be required to remove rejected paint from previously painted surfaces if, on repainting with specified paint, the 2 coatings are incompatible.

3.5 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

3.6 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.

1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.7 PAINT SCHEDULE

A. General: Provide the following paint systems for the various substrates, as indicated. Provide an equal substitute for any product shown below that does not comply with the limits of VOC content listed in this specification.

3.8 EXTERIOR PAINT SCHEDULE

A. Concrete and Masonry Surfaces (Surfaces not scheduled for Heat Reflective Coating)

1. Prime Coat: S-W Loxon Concrete & Masonry Primer, A24W8300 (8 mils wet; 3.2 mils dry); PPG, 4-603.

2. Intermediate Coat: S-W Resilience Exterior Latex Satin, K43 Series (4 mils wet; 1.52 mils dry); PPG, PP739.
3. Finish Coat: S-W Resilience Exterior Latex Satin, K43 Series (4 mils wet; 1.52 mils dry); PPG, PP739.

B. Cementitious (Stucco):

1. Prime Coat: S-W Loxon Concrete & Masonry Primer, A24W8300 (8 mils wet; 3.2 mils dry); PPG, 4-603.
2. Intermediate Coat: S-W Resilience Exterior Latex Satin, K43 Series (4 mils wet; 1.52 mils dry); PPG, PP739.
3. Finish Coat: S-W Resilience Exterior Latex Satin, K43 Series (4 mils wet; 1.52 mils dry); PPG PP739.

C. Metal Galvanized (Include metal doors and frames)

1. Prime Coat: S-W Macropoxy 646 Fast Cure Epoxy, B58-600 Series (7-13.5 mils wet; 5-10 mils dry); PPG, Amerlock 2.
2. Intermediate Coat: S-W Hi-Solids Polyurethane Semi-Gloss, B65-350 Series (4.5-8 mils wet; 3-5 mils dry);PPG, Amercoat 450.
3. Finish Coat: S-W Hi-Solids Polyurethane Semi-Gloss, B65-350 Series (4.5-8 mils wet; 3-5 mils dry); PPG, Amercoat 450.

D. Metal Steel (Surfaces not scheduled for High Performance Coatings):

1. Prime Coat: SP6 commercial blast or near white, with Zinc Clad III prime coat.
2. Intermediate Coat S-W Macropoxy 646 Fast Cure Epoxy, B58-600 Series (7-13.5 mils wet; 5-10 mils dry); PPG, Amerlock 2.
3. Finish Coat: Hi-Solids Polyurethane Semi-Gloss, B65-350 Series (4.5-8 mils wet; 3-5 mils dry); PPG, Amercoat 450.

3.9 INTERIOR PAINT SCHEDULE

A. Cementitious Ceilings:

1. Prime Coat: S-W Loxon Concrete & Masonry Primer, A24W8300 (8 mils wet; 3.2 mils dry); PPG, 4-603.
2. Intermediate Coat: S-W Resilience Exterior Latex Satin, K43 Series (4 mils wet; 1.52 mils dry); PPG, 16-310.
3. Finish Coat: S-W Resilience Exterior Latex Satin, K43 Series mils wet; 1.52 mils dry); PPG, 16-310.

B. Masonry Surfaces

1. Prime Coat: S-W Loxon Block Surfacer, A24W00200 (16 mils wet; 8 mils dry); PPG, 4-100X1.
2. Intermediate Coat: S-W Pro Industrial Pre-Catalyzed Water-Based Epoxy Eggshell, K46-150 Series (4 mils wet; 1.5 mils dry); PPG, 16-310.
3. Finish Coat: S-W Pro Industrial Pre-Catalyzed Water-Based Epoxy Eggshell, K46-150 Series (4 mils wet; 1.5 mils dry); PPG, 16-310.

C. Drywall Surfaces:

1. Prime Coat: S-W ProMar 200 Zero VOC Latex Primer, B28W02600 (4 mils wet; 1 mils dry); PPG, 6-4900X1.

2. Intermediate Coat: S-W Pro Industrial Pre-Catalyzed Water-Based Epoxy Egshell, K46-150 Series (4 mils wet; 1.5 mils dry); PPG, 16-310.
3. Finish Coat: S-W Pro Industrial Pre-Catalyzed Water-Based Epoxy Eggshell, K46-150 Series (4 mils wet; 1.5 mils dry); PPG, 16-310.

END OF SECTION 099000

SECTION 099113 - EXTERIOR PAINTING

1.GENERAL

1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

2. SUMMARY

A. Section includes surface preparation and the application of paint systems on the following exterior substrates:
   1. Concrete masonry units (CMU).
   2. Steel visual and underside
   3. Galvanized metal.
   4. Exterior gypsum board.

3. ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.

   1. Submit Samples on rigid backing, 8 inches square.
   2. Step coats on Samples to show each coat required for system.
   3. Label each coat of each Sample.
   4. Label each Sample for location and application area.

C. Product List: For each product indicated, include the following:

   1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
   2. Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
   3. VOC content.

4. QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

   1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.

      a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
      b. Other Items: Architect will designate items or areas required.

   2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

5. DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

6. FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

2.PRODUCTS

1. MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Benjamin Moore & Co.
2. ICI Paints.
3. Insl-x.
4. Kelly-Moore Paints.
5. PPG Architectural Finishes, Inc.
6. Sherwin-Williams Company (The).
7. Tenemec Company Inc.

2. PAINT, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.

D. Colors: As selected by Architect from manufacturer's full range.

3. BLOCK FILLERS

A. Block Filler, Latex, Interior/Exterior: MPI #4.

4. PRIMERS/SEALERS

A. Masonry Primer:
1. SW: Loxon Masonry Primer A24 Series.

B. Metal Primer:

1. SW: Recoatable Epoxy Primer B67 Series.

2. TN: Series 66-1211 Epoxoline Primer.

C. Galvanied metal Primer:

1. SW: Recoatable Epoxy Primer B67 Series.

2. TN: Series 66-1211 Epoxoline Primer.

D. Latex Wall Primer:

1. SW: PrepRite 200 Latex Wall Primer B28W200

2. ICI: Ultra-Hide PVA Primer Sealer General Purpose Wall Primer 1030-1200.

5. EXTERIOR PAINTS

A. Acrylic Polyurethane Enamel Topcoat:

1. SW: Corothane II B65W400 Series.

2. TN: Series 1075 Endura-Shield II

B. Polyamide Epoxy Intermediate Coat:

1. TN: Series N27 Typoxy

C. Acrylic Latex Topcoat:

1. SW: Latex House and Trim Paint Series A8.

2. ICI: Decra-Shield Acrylic Semi-Gloss Series 2406

3. TN: Tufcryl Series 29

3.EXECUTION

1. EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (Clay and CMU): 12 percent.
3. Wood: 15 percent.
4. Portland Cement Plaster: 12 percent.
5. Gypsum Board: 12 percent.

C. Portland Cement Plaster Substrates: Verify that plaster is fully cured.

D. Exterior Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

E. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

F. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

2. PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer[.] [but not less than the following:]

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."
3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."

G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

H. Exterior Gypsum board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

3. APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
4. Paint entire exposed surface of window frames and sashes.
5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

4. CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

5. EXTERIOR PAINTING SCHEDULE

A. CMU Substrates:
1. Prime Coat: Masonry Primer, 3.0 mils DFT
2. Intermediate Coat: Acrylic Semi-Gloss Latex Coating, 1.5 mils DFT
3. Topcoat: Acrylic Semi-floss Latex Coating, 1.5 mils DFT

B. Non-Structural Steel Substrates:
1. Prime Coat: Metal Primer, 3.0 Mils DFT
2. Intermediate Coat: Polyamide Epoxy Intermediate Coat, 4.5 mils DFT
3. Topcoat: Acrylic Polyurethane Enamel, 4.5 mils DFT

C. Non-Structural Galvanized Metal substrates:
1. 1. Prime Coat: Galvanized Metal Primer, 4.5 Mils DFT
2. Intermediate Coat: Polyamide Epoxy Intermediate Coat, 4.5 mils DFT
3. Topcoat: Acrylic Polyurethane Enamel, 4.5 mils DFT

D. Gypsum Board Soffit Substrates:

1. 1. Prime Coat: Latex Wall Primer, 1.4 Mils DFT
2. Intermediate Coat: Acrylic semi-gloss Latex Topcoat, 1.5 mils DFT
3. Topcoat: Acrylic semi-gloss Latex Topcoat, 1.5 mils DFT

E. Exposed Galvanized Metal Roof Deck:
1. 1. Prime Coat: Galvanized Metal Primer, 4.5 Mils DFT
2. Intermediate Coat: Polyamide Epoxy Intermediate Coat, 4.5 mils DFT
3. Topcoat: Acrylic Polyurethane Enamel, 4.5 mils DFT

END OF SECTION 099113

SECTION 099600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of high-performance coating systems on the following substrates:

1. Exterior Substrates:

a. Concrete, horizontal surfaces, dugout flooring

1.2 ACTION SUBMITTALS

A. Samples: For each type of coating system and in each color and gloss of topcoat indicated.

1.3 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Rhino Linings
2. Armor Thane
3. Line-X

B. Products: Subject to compliance with requirements, provide product listed in the Exterior High-Performance Coating Schedule or Interior High-Performance Coating Schedule for the coating category indicated.

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

A. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
3. Products shall be of same manufacturer for each coat in a coating system.

B. Colors: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations applicable to substrates and coating systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions.

B. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Concrete Substrates, Horizontal Surfaces:

1. Rhino Linings Tuff Grip HP11-90 basis of design at dug out floors

END OF SECTION 099600

SECTION 101400 - SIGNS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Dimensional characters (letters and numbers).
2. Signage accessories.
3. Panel signs

B. Related Sections include the following:

1. Division 09 Section “Gypsum Board”.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of sign.

B. Shop Drawings: Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, grounds, mounting heights, layout, spacing, reinforcement, accessories, and installation details.

1. Provide message list for each sign, including large-scale details of wording, lettering, and braille layout.
2. One set of preliminary drawings shall be provided for submittal to Owner for review and approval.

C. Samples for Initial Selection: For each type of sign material indicated that involves color selection.

D. Samples for Verification: For each type of sign, include the following Samples to verify color selected:

1. Panel Signs: Full-size Samples of each type of sign required.
2. Dimensional Characters: Full-size Samples of each type of dimensional character (letter and number) required. Show character style, material, finish, and method of attachment.
3. Casting: Show representative texture, character style, spacing, finish, and method of attachment.

E. Qualification Data: For Installer.

F. Maintenance Data: For signage cleaning and maintenance requirements to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by signage manufacturer.

B. Source Limitations: Obtain each sign type through one source from a single manufacturer.

C. Regulatory Requirements: Comply with the Americans with Disabilities Act (ADA) and with code provisions as adopted by authorities having jurisdiction.

1. Interior Code Signage: Provide signage as required by accessibility regulations and requirements of authorities having jurisdiction. These include, but are not limited to, the following:

a. Illuminated Exit Signs: Refer to Division 26.
b. Illuminated Building Signs: Refer to Division 26.
c. Required signs at spaces typical within jurisdiction for the Project.
d. Signs as scheduled on the drawings.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 PROJECT CONDITIONS

A. Field Measurements: Where sizes of signs are determined by dimensions of surfaces on which they are installed, verify dimensions by field measurement before fabrication and indicate measurements on Shop Drawings.

1.6 COORDINATION

A. For signs supported by or anchored to permanent construction, advise installers of anchorage devices about specific requirements for placement of anchorage devices and similar items to be used for attaching signs.

1. For signs supported by or anchored to permanent construction, furnish templates for installation of anchorage devices.

B. Coordinate location of remote transformers with building construction. Ensure that transformers are accessible after completion of Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:

1. Basis-of-Design Product: The design for each sign is based on the products named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 PERFORMANCE REQUIREMENTS

A. All signage shall comply with all current Federal, State, and Local jurisdictions codes and regulations.

B. Comply with ADA Accessibility Guidelines and ICC/ANSI A117.1.

2.3 PANEL SIGNS

A. General: Provide panel signs that comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.

1. Produce smooth panel sign surfaces constructed to remain flat under installed conditions within tolerance of plus or minus 1/16 inch (1.5 mm) measured diagonally.

B. Manufacturers:

1. ASI Sign Systems, Inc.(BOD)
2. Best Manufacturing Co.
3. Supersine Company (The).

C. Cast-Acrylic Sheet: Manufacturer's standard and as follows:

1. Color: As selected by Architect from manufacturer's full range of colors.

D. Brackets: Fabricate brackets and fittings for bracket-mounted signs from extruded aluminum to suit panel sign construction and mounting conditions indicated. Factory-paint brackets in color matching background color of panel sign. Adhesive mounted signs are not acceptable.

E. Graphic Content and Style: Provide sign copy that complies with requirements indicated on Drawings for size, style, spacing, content, mounting height and location, material, finishes, and colors of signage.

F. Tactile and Braille Copy: Manufacturer's standard process for producing copy complying with ADA Accessibility Guidelines and ICC/ANSI A117.1. Text shall be accompanied by Grade 2 braille. Produce precisely formed characters with square cut edges free from burrs and cut marks.

1. Panel Material: Opaque acrylic sheet, Photopolymer.
2. Raised-Copy Thickness: Not less than 1/32 inch (0.8 mm).

G. Colored Coatings for Acrylic Sheet: For colors, provide Pantone Matching System (PMS) colored coatings, including inks and paints that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and are nonfading for application intended.

2.4 DIMENSIONAL CHARACTERS

A. Manufacturers:

1. ASI Sign Systems, Inc.(BOD)
2. Mills Manufacturing, Inc.
3. Signature Sign Signs, Inc.

B. Exterior Character Sign Schedule:

1. As noted on plans.

C. Interior Character Sign Schedule:

1. As noted on plans, as located by Architect.

2.5 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

A. Clear Anodic Finish: Manufacturer's standard clear anodic coating, 0.018 mm or thicker, over a satin (directionally textured) mechanical finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Verify that items, including blocking, anchor inserts, and electrical power provided under other sections of Work are sized and located to accommodate signs.

C. Examine supporting members to ensure that surfaces are at elevations indicated or required to comply with authorities having jurisdiction and are free from dirt and other deleterious matter.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Locate signs and accessories where indicated, using mounting methods of types described and in compliance with manufacturer's written instructions.

1. Install signs level, plumb, and at heights indicated, with sign surfaces free from distortion and other defects in appearance.
2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches (75 mm) of sign without encountering protruding objects or standing within swing of door.
3. Bracket-Mounted Units: Provide manufacturer's standard brackets, fittings, and hardware as appropriate for mounting signs that project at right angles from walls and ceilings. Attach brackets and fittings securely to walls and ceilings with concealed fasteners and anchoring devices to comply with manufacturer's written instructions.
4. Characters: Mount characters using standard fastening methods recommended in writing by manufacturer for character form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish character spacing and to locate holes for fasteners.

5. Flush Mounting: Mount characters with backs in contact with wall surface.

3.3 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

END OF SECTION 101400

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SECTION 102113 - PLASTIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Solid-plastic toilet compartments configured as toilet enclosures.

B. Related Requirements:

1. Division 03 and Structural Drawings for support that attaches to structure above.
2. Section 055000 "Metal Fabrications" for supports that attach ceiling-hung compartments to overhead structural system.
3. Section 102800 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories mounted on toilet compartments.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

B. Shop Drawings: For toilet compartments.

1. Include plans, elevations, sections, details, and attachment details.
2. Show locations of cutouts for compartment-mounted toilet accessories.
3. Show locations of centerlines of toilet fixtures.
4. Show locations of floor drains.
5. Show overhead support or bracing locations.

C. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

1. Each type of material, color, and finish required for toilet compartments, prepared on 6-inch- (152-mm-) square Samples of same thickness and material indicated for Work.
2. Each type of hardware and accessory.

D. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

1.6 WARRANTY

A. Special Manufacturer's Warranty: Provide manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship during the following period after Substantial Completion:

1. Plastic Toilet Partitions: Against corrosion, breakage, and delamination: 25 years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 75 or less.
2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

2.2 SOLID-PLASTIC TOILET COMPARTMENTS.

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product accepted by substitution, per Section 012500.

C. Toilet-Enclosure Style: Ceiling hung.

D. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch (25 mm) thick, seamless, with eased edges, no-sightline system, and with homogenous color and pattern throughout thickness of material.

1. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.
2. Color and Pattern: One color and pattern in each room as selected by Architect from manufacturer's full range.

E. Pilaster Sleeves (Caps): Manufacturer's standard design; polymer.

1. Polymer Color and Pattern: Matching pilaster.

F. Brackets (Fittings):

1. Full-Height (Continuous) Type: Manufacturer's standard design; polymer or extruded aluminum.

a. Polymer Color and Pattern: Matching panel.

G. Overhead Cross Bracing for Ceiling-Hung Units: As recommended by manufacturer and fabricated from solid polymer.

2.3 HARDWARE AND ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard operating hardware and accessories.

1. Material: Stainless steel.
2. Hinges: Manufacturer's standard continuous, spring-loaded type, allowing emergency access by lifting door.
3. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 MATERIALS

A. Aluminum Castings: ASTM B 26/B 26M.

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M).

C. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.

D. Stainless-Steel Castings: ASTM A 743/A 743M.

2.5 FABRICATION

A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

B. Ceiling-Hung Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.

C. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide, out-swinging doors with a minimum 32- inch- (813-mm-) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.

1. Confirm location and adequacy of blocking and supports required for installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels: 1/2 inch (13 mm).
b. Panels and Walls: 1 inch (25 mm).

2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.

a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

B. Ceiling-Hung Units: Secure pilasters to supporting structure and level, plumb, and tighten. Hang doors and adjust so bottoms of doors are level with bottoms of pilasters when doors are in closed position.

3.3 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Public-use shower room accessories.
3. Underlavatory guards.
4. Custodial accessories.

B. Owner-Furnished Material: Items noted on Drawings as "By Owner".

C. Related Sections:

1. Section 093013 "Ceramic Tiling" for ceramic toilet and bath accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

1.7 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.8 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Sizes and products indicated on Drawings for accessories take precedence over this specification section.

2.2 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.

B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9- mm) minimum nominal thickness.

C. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.

D. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

F. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

G. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

H. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.3 PUBLIC-USE WASHROOM ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AJW Architectural Products, Inc.

2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation.

B. Grab Bar (As noted on Drawings):

1. Basis-of-Design Product: Lengths noted on Drawings.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.

   a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.

4. Outside Diameter: 1-1/2 inches (38 mm).
5. Configuration and Length: As indicated on Drawings.

C. Mirror Unit (As indicated on Drawings):

1. Basis-of-Design Product: Size noted on Drawings.
2. Frame: Stainless-steel angle, 0.05 inch (1.3 mm) thick.

   a. Corners: Mitered and mechanically interlocked.

3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.

   a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
   b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

4. Size: As indicated on Drawings.

D. Baby Changing Station:

1. Product: Koala Kare KB110-SSWM
2. Mounting: Surface wall mounted.
3. Material and Finish: 18 gauge, type 304 stainless steel exterior with FDA approved blow molded high-density grey polyethylene with Microban® antimicrobial interior.

2.4 PUBLIC-USE SHOWER ROOM ACCESSORIES

A. Shower Curtain Rod (As indicated on Drawings):

1. Description: 1-1/4-inch (32-mm) OD; fabricated from nominal 0.05-inch- (1.3-mm-) thick stainless steel.
2. Mounting Flanges: Stainless-steel flanges designed for exposed fasteners.
3. Finish: No. 4 (satin).

B. Shower Curtain:

1. Size: Minimum 6 inches (152 mm) wider than opening by 72 inches (1828 mm) high.
2. Material: Nylon-reinforced vinyl, minimum 10 oz. (284 g) or 0.008-inch- (0.2-mm-) thick vinyl, with integral antibacterial agent.
3. Color: As selected from manufacturer's full range.
4. Grommets: Corrosion resistant at minimum 6 inches (152 mm) o.c. through top hem.

5. Shower Curtain Hooks: Chrome-plated or stainless-steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.

C. Folding Shower Seat (As indicated on Drawings):

1. Basis-of-Design Product: Sized to fit in shower.
2. Configuration: L-shaped seat, designed for wheelchair access.
3. Seat: Phenolic or polymeric composite of slat-type or one-piece construction in color as selected by Architect.
4. Mounting Mechanism: Stainless steel, No. 4 finish (satin).
5. Dimensions: To suite conditions.

D. Robe Hook:

1. Description: Single-prong unit (2 at each shower, or number of prongs as indicated on Drawings).
2. Material and Finish: Stainless steel, No. 4 finish (satin).

E. Shelf:

1. Description: Single shelf, 18 x 5 inches (457 x 127 mm) or as indicated on Drawings.
2. Number of support brackets: 2.
3. Material and Finish: Stainless steel, No. 4 finish (satin).

2.5 UNDERLAVATORY GUARDS

A. Underlavatory Guard (As indicated on Drawings):

1. Manufacturers, subject to compliance:

a. Plumberex Specialty Products, Inc.
b. Truebro by IPS Corporation.

2. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
3. Material and Finish: Antimicrobial, molded plastic, white.

2.6 CUSTODIAL ACCESSORIES

A. Mop and Broom Holder (As indicated on Drawings):

1. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
2. Length: 36 inches (914 mm).
3. Hooks: Three.
4. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
5. Material and Finish: Stainless steel, No.4 finish (satin).

a. Shelf: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel.
b. Rod: Approximately 1/4-inch- (6-mm-) diameter stainless steel.

2.7 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion- resistant backing plates.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800

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SECTION 104413 - FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fire protection cabinets for the following:

a. Portable fire extinguishers.
b. Fire hose valves.
c. Fire hoses and racks.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.

1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
2. Show location of knockouts for hose valves.

B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Initial Selection: For each type of fire protection cabinet indicated.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Size: 6 by 6 inches (150 by 150 mm) square.

E. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

1.5 COORDINATION

A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate size of fire protection cabinets to ensure that type and capacity of fire hoses, hose valves, and hose racks indicated are accommodated.

C. Coordinate sizes and locations of fire protection cabinets with wall depths.

1.6 SEQUENCING

A. Apply decals on field-painted, fire protection cabinets after painting is complete.

PART 2 - PRODUCTS

2.1 FIRE PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Fire End & Croker Corporation.
b. J. L. Industries, Inc., a division of Activar Construction Products Group.
c. Kidde Residential and Commercial Division, Subsidiary of Kidde plc.
d. Larsen's Manufacturing Company.
e. Modern Metal Products, Division of Technico Inc.
f. Moon-American.
g. Potter Roemer LLC.
h. Watrous Division, American Specialties, Inc.

B. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated. Cabinet box must be rated for a 30 minute rated wall condition in all corridors.

1. Trimless with Concealed Flange: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet. Provide recessed flange, of same material as box, attached to box to act as drywall bead.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where semirecessed (no more than 4 inch protrusion from face of wall) cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for semi-recessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire protection cabinets in locations and at mounting heights indicated at heights acceptable to authorities having jurisdiction.

1. Fire Protection Cabinets: 54 inches (1372 mm) above finished floor to top of cabinet.

B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semi-recessed fire protection cabinets.
2. Provide inside latch and lock for break-glass panels.
3. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.

C. Identification: Apply decals at locations indicated.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.

E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

B. Owner-Furnished Material: Hand-carried fire extinguishers.

C. Related Sections:

1. Division 10 Section "Fire Extinguisher Cabinets."

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher**.**

B. Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings**.**

C. Closeout Submittals:

1. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.
2. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FMG.

1.5 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet indicated.
1. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:

a. Amerex Corporation.
b. Ansul Incorporated; Tyco International Ltd.
c. Badger Fire Protection; a Kidde company.
d. Buckeye Fire Equipment Company.
e. Fire End & Croker Corporation.
f. J. L. Industries, Inc.; a division of Activar Construction Products Group.
g. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
h. Larsen's Manufacturing Company.
i. Moon-American.
j. Pem All Fire Extinguisher Corp.; a division of PEM Systems, Inc.
k. Potter Roemer LLC.
l. Pyro-Chem; Tyco Safety Products.

2. Valves: Manufacturer's standard.
3. Handles and Levers: Manufacturer's standard
4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

END OF SECTION 104416

SECTION 107500 - FLAGPOLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes ground-mounted flagpoles made from [aluminum].

B. Owner-Furnished Material: Flags.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Flagpole assemblies, including anchorages and supports, shall withstand the effects of gravity loads, and the following loads and stresses within limits and under conditions indicated according to the following design criteria:

1. Seismic Loads: according to SEI/ASCE 7.
2. Wind Loads: SEI/ASCE 7.
3. Base flagpole design on owner selected flags of maximum standard size suitable for use with flagpole or flag size indicated, whichever is more stringent.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.

B. Shop Drawings: For flagpoles. Include plans, elevations, details, and attachments to other work. Show general arrangement, jointing, fittings, accessories, grounding, anchoring, and support.

1. Include section, and details of foundation system for ground-mounted flagpoles.

C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

D. Delegated-Design Submittal: For flagpole assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Include loads, point reactions, and locations for attachment of flagpoles to building's structure.

E. Qualification Data: For qualified professional engineer.

F. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain flagpole as complete unit, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. General: Spiral wrap flagpoles with heavy paper and enclose in a hard fiber tube or other protective container.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Flagpole; a Kearney-National Inc. company.
2. Atlantic Fiberglass Products, Inc.
3. Baartol Company.
4. Concord Industries, Inc.
5. Eder Flag Manufacturing Company, Inc.
6. Ewing Flagpoles.
7. Lingo Inc.; Acme Flagpole Company Division.
8. Millerbernd Manufacturing Company.
9. Morgan-Francis; Division of Original Tractor Cab Co., Inc.
10. PLP Composite Technologies, Inc.
11. Pole-Tech Company Inc.
12. U.S. Flag & Flagpole Supply, LP.
13. USS Manufacturing Inc.

2.2 FLAGPOLES

A. Flagpole Construction, General: Construct flagpoles in one piece if possible. If more than one piece is necessary, comply with the following:

1. Fabricate shop and field joints without using fasteners, screw collars, or lead calking.
2. Provide flush hairline joints using self-aligning, snug-fitting, internal sleeves.
3. Provide self-aligning, snug-fitting joints.

B. Aluminum Flagpoles: Provide entasis-tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B 241/B 241M, Alloy 6063, with a minimum wall thickness of 3/16 inch.

2.3 FITTINGS

A. Finial Ball: Manufacturer's standard flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.

1. 0.063-inch spun aluminum, finished to match flagpole.
2. 20-oz. copper with 23-karat gold leaf finish.
3. Spun stainless steel, finished to match flagpole.
4. Spun copper alloy, finished to match flagpole.

B. Internal Halyard, Cam Cleat System : 5/16-inch- diameter, braided polypropylene halyard; cam cleat; and concealed revolving truck assembly with plastic-coated counterweight and sling. Provide flush access door secured with cylinder lock. Finish truck assembly to match flagpole.

1. Halyard Flag Snaps: Provide two stainless-steel swivel snap hooks per halyard.

a. Provide with neoprene or vinyl covers.

2.4 MISCELLANEOUS MATERIALS

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.

B. Drainage Material: Crushed stone, or crushed or uncrushed gravel; coarse aggregate.

C. Sand: ASTM C 33, fine aggregate.

D. Elastomeric Joint Sealant: Multicomponent nonsag urethane

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

A. Natural Satin Finish: AA-M32, fine, directional, medium satin polish; buff complying with AA-M20; seal aluminum surfaces with clear, hard-coat wax.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, including foundation; accurate placement, pattern, orientation of anchor bolts, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare uncoated metal flagpoles that are set in foundation tubes by painting below-grade portions with a heavy coat of bituminous paint.

B. Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete. Place and compact drainage material at excavation bottom.

C. Provide forms where required due to unstable soil conditions and for perimeter of flagpole base at grade. Secure and brace forms to prevent displacement during concreting.

D. Place concrete, as specified in Division 03 Section "[Cast-in-Place Concrete] [Miscellaneous Cast-in-Place Concrete]." Compact concrete in place by using vibrators. Moist-cure exposed concrete for not less than seven days or use nonstaining curing compound.

E. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.

3.3 FLAGPOLE INSTALLATION

A. General: Install flagpoles where shown and according to Shop Drawings and manufacturer's written instructions.

B. Ground Set: Place sleeve, center, and brace to prevent displacement during concreting. Place concrete. Plumb and level sleeve and allow concrete to cure. Install flagpole, plumb, in sleeve.

1. Foundation Tube: Place tube seated on bottom plate between steel centering wedges and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch 50-mm layer of elastomeric joint sealant and cover with flashing collar.

C. Baseplate: Cast anchor bolts in concrete foundation. Install baseplate on washers placed over leveling nuts on anchor bolts and adjust until flagpole is plumb. After flagpole is plumb, tighten retaining nuts and fill space under baseplate solidly with nonshrink, nonmetallic grout. Finish exposed grout surfaces smooth and slope 45 degrees away from edges of baseplate.

D. Mounting Brackets and Bases: Anchor brackets and bases securely through to structural support with fasteners as indicated on Shop Drawings.

END OF SECTION 107500

SECTION 114000 - FOODSERVICE EQUIPMENT

PART 1 – GENERAL

1.01 SCOPE:

Provide labor, equipment, and material, and perform all necessary procedures for installation of foodservice equipment. Work shall be in accordance with the Contract Documents and shall include all miscellaneous labor and materials which is reasonably inferred for installation of foodservice equipment.

1.02 DEFINITIONS AND ABBREVIATIONS

A. PROVIDE – Supply all materials, labor and equipment necessary for final connection.

B. FURNISH – Supply and deliver equipment ready for installation.

C. INSTALL – Set in place, level, secure and connect.

D. Abbreviations

ADA	Americans Disabilities Act
AFF	Above Finished Floor
AGA	American Gas Association
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society for Mechanical Engineers
EC	Electrical Contractor
FEC	Foodservice Equipment Contractor
GC	General Contractor
HVAC	Heating, Ventilation and Air Conditioning Contractor
MC	Mechanical Contractor
NEC	National Electric Code
NEMA	National Electric Manufacturer's Association
NFPA	National Fire Protection Association
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Agency
PC	Plumbing Contractor
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
UL	Underwriters Laboratory

1.03 CODES AND STANDARDS

A. Ordinances and Laws: All work to comply with all prevailing ordinances, laws, codes and regulations related to construction and installation.

B. Standards: All equipment must comply with ADA, AGA, ASHRAE, ASME, NEC, NEMA, NFPA 17A, 54, 70 and 96, NSF, OSHA and UL.

C. Extra charges for the providing of items or furnishing work which is required by the regulations even though items required may not be specifically called for on the drawings or in the specifications will not be paid. Should a conflict occur between these codes and the equipment specified, the code will take precedence. Notification of the code variance shall be made to the Architect.

1.04 DESCRIPTION OF WORK

A. Equipment: Fabricate, deliver, unload, uncrate, assemble, set in place and level equipment for final connection by appropriate trades.

B. Coordination:

1. Coordinate all mechanical, plumbing and electrical rough-in services including field verification of all stub-up and rough-in locations before flooring is poured and before walls and ceilings are finished. FEC to notify Architect and Consultant of any discrepancies.

2. Coordinate existing building conditions and all other building conditions related to the installation of Section 11 40 00 equipment with GC.

3. Coordinate requirements for all existing equipment, owner furnished equipment, future equipment and purveyor supplied equipment with appropriate trades.

4. Verify all delivery access, wall openings and overhead obstructions for delivery and installation of large equipment.

5. Supervise and inspect final connections of utilities to foodservice equipment.

C. Schedule: Perform work in a timely manner in accordance with the construction schedule. Submit written notice to Foodservice Consultant, Architect and General Contractor of any construction or manufacturer related problems that may cause delay in the delivery or installation of equipment. Substitutions for failing to order equipment in a timely manner are not acceptable.

D. Contract Documents: Drawings and Specifications are intended to be advisory and for informational purposes only. Contract Documents are not intended to be and shall not be used for construction purposes.

E. Document discrepancy: If drawings and specifications contain conflicting information, FEC to request clarification in writing or provide equipment and work of better quality and quantity. FEC is responsible for all costs incurred from the failure to request resolution of conflicting requirements.

F. Model Number Changes: When specified equipment is no longer available, the Owner reserves the right to accept the manufacturer's replacement Model number or equipment specified as equal.

G. Equipment verification: Verify sizes of trays, racks, dinnerware and pans prior to fabrication or ordering of equipment.

H. Qualifications: FEC to provide a jobsite supervisor with experience successfully completing two projects of similar size. Supervisor must be able to coordinate with all trades for electrical, plumbing and HVAC requirements.

I. Permits, Licenses and Inspections: Schedule and pay for all permits, inspections and testing required by prevailing agencies and codes related to the installation of Section 11 40 00 equipment. Supply owner and GC with copies of all certificates of compliance from inspections and testing.

1.05 RELATED WORK BY OTHER CONTRACTORS

A. General Contractor (GC)

1. Provide flooring material and base inside and outside of walk-in coolers and freezers manufactured and installed to withstand temperatures below -20º Fahrenheit. Provide base, slab insulation, concrete setting bed and vapor barrier as shown on Section 11 40 00 drawings.

2. Provide concealed wall backing to support all wall mounted equipment as shown on Section 11 40 00 drawings.

3. Install floor troughs and floor pans provided by FEC.

4. Provide all required floor penetrations, wall sleeves, equipment pads and roof curbs for refrigeration systems.

5. Provide all flooring, ceiling finishes and wall finish materials unless indicated on Section 11 40 00 drawings and specifications.

B. Plumbing Contractor (PC)

1. Provide rough-in and final connections to all equipment requiring plumbing services. Flush all lines of contamination prior to connecting all fixtures.

2. Provide all water supply piping, drain lines, drain assemblies, floor drains, valves, traps, tailpieces, pressure reducing valves, shut-off valves, flow control valves, check valves, backflow prevention, etc. that are necessary for the complete installation of Section 11 40 00 equipment unless indicated in Plumbing Schedule as furnished by the FEC.

3. Provide eye wash stations, mop sinks and hose bibbs unless indicated in Plumbing Schedule as furnished by the FEC.

4. Provide gas pressure reducing and regulation valves for pressures above 14” W.C.

5. Provide PVC conduit with wide radius elbows for passage of beverage and refrigeration lines.

6. Provide copper condensate lines for walk-in cooler/freezer. Attach condensate lines securely to the walls of the walk-in cooler/freezer. Trap drain lines on the exterior of walk-in cooler/freezer. Coordinate installation of heat tape for walk-in freezers with electrical contractor.

7. Install all faucets, drains, vacuum breakers, valves, water inlets, traps, filters, PRV’s, gauges, gas valves, gas hoses, flexible water hoses, pressure regulators, etc. furnished by the FEC.

8. Interconnect and assemble all plumbing components, piping and systems of Section 11 40 00 equipment which requires field assembly.

C. Electrical Contractor (EC)

1. Provide all systems and services including wiring to and final connections of all foodservice equipment and components.

2. Provide all receptacles, conduit, controls, starters, disconnects, switches, etc. that are necessary for the complete and proper installation of section 11 40 00 equipment.

3. Provide water proof conduit, electrical boxes and Ground Fault Interrupter receptacles in wet areas.

4. Provide shunt trip breakers and contactors as indicated on Section 11 40 00 drawings. Wire from fire suppression system controls to shunt trip breakers.

5. Install all control circuits for fire suppression systems, exhaust hoods, condensate hoods, refrigeration systems, electrical load systems and waste systems.

6. Install all electrical mechanisms provided by FEC.

7. Whenever possible shall stub-out of walls rather than stub up through floor. Conceal all electrical conduit when possible. No unnecessary exposed wiring permitted. Use polished chrome conduit where exposed.

8. Mount all receptacles horizontally. Provide stainless steel cover plates.

9. Interconnect and assemble all electrical components, exhaust hoods, refrigeration systems and all walk-in cooler/freezer components.

10. All materials and components shall be UL approved and labeled and installed in accordance with NEMA standards.

11. EC and FEC shall verify that the voltage on the job corresponds with the equipment drawings and specifications before ordering any electrical equipment. All equipment shall be grounded.

D. Mechanical Contractor (MC)

1. Provide all systems and services including exhaust ducts, fans, dampers, starters, etc. necessary for the operation of Type I and type II exhaust hoods.

2. Provide rough-in and final connections required for Section 11 40 00 equipment requiring HVAC services.

3. All installation most conform to NFPA 96 and prevailing codes.

1.06 EQUIPMENT WARRANTY

A. General: All equipment to carry one year parts and labor warranty from date of demonstration or owner acceptance by owner or architect. Parts or equipment failure due to material defect or improper installation shall be repaired or replaced at no cost to the owner during this time.

B. Refrigeration Systems: One year refrigeration system parts and labor with an additional four years compressor, condenser and evaporator coil warranty. Refrigerant lost due to a leak in the system or faulty equipment shall be included in warranty.

C. Service: Equipment will be serviced within 24 hours of equipment failure by a factory-trained service agency. Refrigeration system services shall be available 24 hours per day, seven days per week.

1.07 SUBMITTALS

A. General: Submit rough-in drawings, custom fabrication drawings and buyout brochure books within 30 days of contract being awarded. Quantity of submittals to be determined by the architect.

1. All submittals will be provided in PDF format. Drawings will also be accepted in AutoCAD compatible format.

2. Architect or GC will forward electronic documents to Foodservice Consultant for review and approval. Foodservice consultant will return all submittals to architect for revisions to be made by the FEC. FEC to make revisions to submittals until all corrections are made. After all corrections are made to the satisfaction of the Foodservice Consultant and Architect submit final documents in quantity required by the architect.

B. Buyout brochure book: Assemble specification for each piece of foodservice equipment sheets in three-ring binder. Submittal to include numbered cover sheet for each specified item. Indicate accessories and options included with each item. Indicate all utility connections required. Buyout brochure book to be provided in hard copy and PDF format.

C. Drawings: When required by architect drawings to be sent rolled in a tube. Paper size to be minimum 24” x 36”. Drawings to include the following:

1. Layout drawing with equipment list. ¼” = 1’-0” scale.

2. Dimensioned Mechanical, Electrical and Plumbing rough-in drawings indicating duct locations, rough-in heights, sizes, connection types, drains, electrical outlets, switches, etc. ¼” = 1’-0” scale.

3. Shop drawings for all custom fabricated equipment in minimum ¾” = 1’-0” scale. Drawings to indicate Manufacturer and Model for all buyout equipment, metal gauges, types and finishes of all materials used.

D. Approval: Fabrication may start when approved drawings and buyout brochures are received. Document approval shall not relieve FEC of responsibility to comply with Contract Documents unless prior approval has been obtained by Owner or Architect.

E. Samples: Samples of materials shall be submitted to Architect for review and approval at no extra cost.

F. Operations and Maintenance Manuals: Submit PDF copy of operations and maintenance manuals containing all equipment parts lists and operations manuals to Foodservice Consultant for approval. Manuals to include cover sheet indicating project name and location. Cover sheet to include architect contact, foodservice consultant contact and foodservice equipment contractor contact information. Include index indicating all equipment item numbers, manufacturers, serial numbers, responsible service agencies and contact phone numbers. Submit three hard copies in three ring binders to contractor after approval.

1.08 PROJECT CONDITIONS AND COORDINATION

A. Field verify dimensions of foodservice equipment installation areas prior to equipment fabrication.

B. Coordinate installation requirements for HVAC equipment with GC and MC.

C. Coordinate fire suppression system components and installation with EC, MC and GC.

D. Coordinate location and requirements of utility connections with appropriate trades.

E. Coordinate size, location and requirements for concrete bases, floor depressions and insulated floors with GC.

F. Coordinate installation of roof curbs, equipment support, roof and wall penetrations with GC.

PART 2 – PRODUCTS

2.01 GENERAL

A. All equipment and components shall be new and unused.

B. All items will be the current model at the time of delivery.

C. All manufacturer items requiring electrical service shall be UL listed, UL approved and labeled with UL symbol.

D. All faucets shall be by same manufacturer unless specified.

E. All cabinet style refrigerators/freezers shall be by same manufacturer unless specified.

2.02 CUSTOM FABRICATION AND MATERIALS

A. All custom fabricated equipment as described in Item specifications shall be of identical design and finish and shall be fabricated by one manufacturer. All fabricated equipment is to be labeled with NSF symbol.

B. Stainless Steel shall be 18-8 Type 304 #4 finish. Sheets shall be of identical color, finish and appearance. Grain of material shall run in same direction whenever possible.

C. Galvanized steel shall meet ASTM standard A446. Clean, prime and finish with NSF approved grey epoxy-based paint.

D. Edges, corners and welds shall be ground and polished smooth. No sharp edges will be permitted.

E. Unless specified the following metal gauges shall be used:

10 Gauge:	Gusset Plates
12 Gauge:	Hardware reinforcement, channels
14 gauge:	Table tops, sinks, backsplashes, drain boards, slanting rack shelves and shelf brackets
16 gauge:	Under shelves, over shelves, wall shelves, drawer fronts, access panels

18 gauge Cabinet bodies, drawer pans, skirts, closure panels, trim strips.

F. Equipment Edges and Backsplashes: Provide equipment edges and backsplashes shall follow all SMACNA standards unless otherwise noted. Weld and enclose all ends. Cove the intersections of all raised edges and backsplashes ¾". Seal all splashes and turn-ups to wall with NSF approved silver silicone.

G. Sound Dampening: Provide NSF certified 3mm thick sound deadening tape material between table frame and below metal surfaces. NSF approved evenly sprayed-on, 1/8" thick aluminum finish below sinks.

H. Equipment Tops: Reinforce tops with 1"x 4" 12 gauge stainless steel, welded galvanized or painted angle iron hat channels or u-channels. Provide reinforcement lengthwise and at 30" O.C. and at table legs. Fully weld all intersections. No tack welding of table reinforcement allowed.

I. Equipment Legs: Provide 1 5/8" O.D. 16 gauge type 304 stainless steel tubing table legs and frames. Continuously weld cross-bracing. Provide S/S flange secured with S/S screws where cross-rails join cabinet body.

J. Leg sockets: S/S leg sockets with set screws for securing legs. Fully weld leg sockets to channels or socket plates. Legs shall not be placed more than 66" O.C. apart or 30" from front to back.

K. Cabinet body and semi-enclosed worktables: Provide flush welded mullions. All frame work behind cabinet doors shall be S/S. Provide chases and neatly cut holes for passage of utilities.

L. Doors: Provide flush mounted welded double pan doors with continuous S/S pull and concealed lift off hinges. Doors shall be ¾" thick with channel reinforcement and sound dampening core.

Provide Component Hardware #M21-2580 mechanical catches with spring action nylon rollers. Hinged doors are to have heavy-duty lift off hinges and are to be mounted flush with cabinet body.

M. Drawers: Construct using Component Hardware S52 heavy duty slides, 200# capacity per pair. Provide 3-sided housing mounted to S/S cross bracing mounted to underside of table. Drawer front shall be S/S double pan construction with fiberglass sound dampener and continuous S/S pull. Include Component Hardware rubber cushion bumpers. Weld and silicone 16 gauge S/S pan holder in position. Include removable, stamped 18 gauge, 20" x 20" x 5" pan. Drawers must be self-closing.

N. Under shelves: Welded under shelves larger than 21" shall be reinforced using same methods as equipment top. Removable shelves shall be no wider than 21". Grind and polish all edges.
Under shelves in cabinet bodies shall have ends and back turned up 1 ½". Cove intersection minimum ¾". Weld and seal to cabinet body.

O. Over shelves: Table over shelves are to be 14" wide mounted on 14 gauge S/S brackets unless otherwise noted. Shelf brackets shall not exceed 48" O.C. Front of table over shelves shall match leading edge of table. "Splash-mounted" over shelves shall be mounted using welded cantilevered 14 gauge S/S supports. Supports to pass through tight-fitting oval holes. Seal holes using NSF approved silver silicone. Cantilevered supports to be bolted to heavy-duty flanges welded to legs or underside of table as indicated on drawings. Shelving supports spaced maximum 60" O.C.

P. Sinks: Sinks shall be manufactured using 14 gauge S/S. Fully welded one piece construction with ¾" minimum coved corners. Multiple compartment sinks shall contain fully welded double wall construction. Trim strips not allowed. 18 gauge S/S apron shall be provided in front of multiple compartments. Bottom of sink to be pitched to center located drain cup. NSF approved sound dampener required on all sinks.

Q. Drain boards: Pitch all drain boards to sinks.

R. Equipment Brackets: Provide S/S brackets for all rotary lever drains attached to welded studs and chrome acorn nuts. Fully weld all brackets for disposer controls panels to U-channel reinforcement below table as shown on drawings.

S. Fasteners: All fastening devices to be unexposed, wherever possible.. Exposed fasteners shall be counter sunk.

2.03 EXHAUST HOODS

A. Provide fully welded all 18 gauge 304 S/S #4 finish on all exposed surfaces. Corners to be fully welded, ground and polished. Ship duct collar loose. Conceal all wiring. Heat sensor to be installed at each duct collar location to activate exhaust fan when cooking occurs below exhaust hood.
B. Must be designed and installed to comply with all prevailing codes.

C. Lights to be pre-wired to single electrical connection point for connection by EC. Provide NSF and code compliant light fixtures as specified.

D. Trim any spaces or gaps between top of exhaust hoods and finished ceiling with matching S/S trim pieces. Channel mounting of trim required. No exposed fasteners.

E. Hoods to be mounted at 80" AFF.

F. EC to make any required interconnections between hoods, fans, switches and controls.

2.04 COLD STORAGE ROOMS

A. All construction, components and accessories must comply with the Energy Independence and Security Act – 2009. Include all necessary code complying accessories.

B. All prefabricated cold storage rooms shall be manufactured by one manufacturer and installed by factory-supervised installer.

C. Finishes are to be as follows unless otherwise specified.

22 gauge galvalume steel at unexposed walls and ceilings
.040 stucco aluminum at interior walls and exposed walls
.040 smooth aluminum with baked-on white finish at ceiling

D. Interior finished ceiling height shall be 8'-3" unless otherwise specified.

E. Materials

1. Insulation shall be non-burning urethane, foamed in place.

a. Insulation shall be fluorocarbon filled (F-11) 95% closed cell content, nominal density of 2.0 pounds ± 0.1 per cubic foot. Dimensional stability shall be from –45° F. (+7° C.) to 200° F. (93° C.).

b. Insulation shall have a thermal conductivity (K-factor) not to exceed (0.14 B.T.U./hour/square foot) as tested on ASTM C-177, at 75° F. (24° C.) mean temperature and an overall coefficient of heat transfer factor (U) not to exceed 0.029.

c. Classification: Each compartment shall bear a label "Class 1-Insulated Panel" as certified by an independent testing laboratory to have a surface burn spread 25 or less as determined by ASTM E84, UBC No. 8-1, Class A National Fire Protection Association N F P A Number 101, "Life Safety Code".

F. Panel Construction

1. Panels shall consist of precision die formed metal pans with ½" (50 mm) to ¾" (76 mm) flanged perimeter, foamed in place urethane insulation between interior and exterior pans, thoroughly checked for gauge and shall be interchangeable with panels of like size. Metal pans shall be treated on the inside with a preparation coating of bonding agent to ensure a stable adhesion with the chemical bonding capabilities of the insulation.

2. Wall and ceiling panels shall be 4” (100 mm) thick and contain 100% foamed in place insulation and shall not have any internal wood or metal structural members. To ensure tight fitting joints, all panel edges shall have foamed in place urethane tongues and grooves and a flexible vinyl gasket foamed in place on the interior and exterior of all edges.

3. Panels shall be rigidly coupled by a cam action hooked locking device. Locking device shall be foamed in place, maximum 48” (1200 mm) on center. Locking device shall be accessible from the inside to facilitate installation in confined areas and shall be provided with caps to close wrench holes. Joints between panels shall be sealed at interior and exterior edges with a PVC gasket or an odorless nontoxic, synthetic polymerized sealant, to maintain continuity.

4. Wall panels shall have a minimum of three (3) locking devices between each panel, located in the center, lower corner and upper corner.

5. Ceiling panels shall have a minimum of two (2) locking devices between ceiling panel and at wall panels, located at each corner of the wall panel. Ceiling panel joints shall be offset from wall panel joints.

6. All interior vertical corners shall be coved with a ½” (12 mm) radius.

7. Exterior panels, interior partitions, corner panels, ceiling panels and “T” intersection panels shall be matching construction.

G. Wall/Ceiling Support System

1. Ceiling panels shall have a maximum deflection of 1/240 of the span under uniform loading of twenty (20) pounds per square foot. When the ceiling panels require a support system, the Manufacturer shall submit details and structural calculations to an engineer for approval prior to fabrication. A copy of the approved submittal shall be forwarded to Architect and Consultant.

2. An indoor ceiling panel support system, when required, shall be furnished and installed using a hanger wire network attached to hanger brackets, designed to engage with the female lock pins imbedded within the roof panel foam core, spaced 48” on center.

H. Door and Door Frames

1. Door sizes shall be as specified, hinged as indicated on plan. Door shall be able to remain open when opened over 120°.

2. Door shall be flush mounted, in-fitting type with door panel construction to match other panels. Insulation to be same size and type as other panels.

3. Door frames shall be shall consist of vinyl frame with 12 gauge steel frame foamed in place.

4. Door shall be fitted with thermoplastic, magnetic steel core gasket across top and both sides of door. Bottom of door shall be fitted with adjustable, double vinyl wiper gasket. Gasket shall be water, oil, sunlight and fat resistant. When door is in closed position, the magnetic gasket shall form a positive air-tight seal. Door gasket to be easily replaceable.

5. Provide deadbolt locking handle. No exposed fasteners.

6. Provide 16 gauge kick plates or 3/16” diamond tread plate both sides of door to a height of 36” AFF.

7. Provide an anti-condensate heater concealed behind edge of door jam on all sides of frame and below S/S threshold. Heater wires shall be easily accessible for replacement or service.
8. Door shall be adjusted to be self-closing after installation and floor is finished.

9. Provide three hinges on each door.

10. Provide Kason Model 1092 door closer or equal.

11. Provide 12 gauge S/S thresholds at all freezer doors.

I. Components and accessories:

All components and accessories shall be provided with conduit, switches, etc. for easy connection by EC and be concealed within cold room wall prior to panel fabrication. Conduit to extend above ceiling panels for connection of electrical by EC.

J. Light Fixtures and Switches

1. Provide number of light fixtures as indicated on the electrical rough-in plan.

2. LED fixtures shall be 48” long wet/cold locations.

K. Digital Thermometer and Alarm

1. Digital thermometer and alarm shall be furnished for each cold storage room.

2. Provide all-in-one digital walk-in alarm and light management system. Alarm will contain temperature and door open alarms accessible through one panel interface recessed in wall panel. Provide occupancy sensor with timer pre-set to owner’s requirements.

3. When the door does not open into an ambient temperature area, the digital thermometer and alarm shall be factory installed in a wall panel facing an ambient temperature area. Provide name-plate for each thermometer and alarm.

L. Door Fan Switch

1. Door fan switch shall be provided for each low-temperature cold storage room, when door opens into a non-refrigerated area, to shut off evaporator coil fan motors when the door is opened.

2. Door fan switch shall be factory mounted on the door jamb and pre-wired with rigid conduit and wiring within the wall panel to a connection point located on the interior of walk-in near the ceiling. Manufacturer shall provide a 1-1/4” hole in ceiling panel with a loose escutcheon plate. EC to connect to the evaporator coil (s) fan motors.

M. Closure Panels.

Trim any spaces or gaps between top of cold storage rooms and finished ceiling with matching S/S trim pieces. Channel mounting of trim required. No exposed fasteners.

N. Trim

Vertical trim and angles to match cold storage room exterior finish. Trim to be applied with adhesive tape and NSF approved silicone. No exposed fasteners.

O. Utility Penetrations

1. Provide openings in ceiling and wall panels to accommodate all electrical, refrigeration and drain lines.

2. Seal all openings with silicone after lines have been run and before installation of escutcheons.

P. Escutcheons

1. Provide 5” diameter blank stainless steel escutcheons to trim all interior and exposed exterior penetrations.

2. Provide cutting of proper size hole in blanks and panel penetrations

Q. Pressure Relief Vent

1. Pressure relief vent shall be factory installed at each low-temperature cold storage room door.

2. Pressure relief vent shall be electrically heated, 120 volt and have aluminum screen.

R. Corner Guards

Corner guards on the exterior outside corners shall be 3” x 3” x 54” 16 gauge stainless steel secured to wall panels with contact adhesive.

S. Bumper Rails

1. Bumper rails when specified shall be located where indicated on plans.

2. Provide vinyl insert wall protectors. Provide aluminum bumper rail track pre-punched on 12” center for field mounting with S/S screws.

T. Strip Curtain

Provide NSF approved strip curtain. Strip curtain to be easily replaceable.

U. Identification Signs

Provide permanently attached engraved plastic name plates with maximum ¾” high letters identifying each Cold Storage Room and Refrigeration System Compressor. Name plate is to be mounted with adhesive below digital thermometer alarm. A similar name plate with ½” high letters is to be installed on the evaporator coil (s) and at all other items specified with a remote Refrigeration System.

2.05 REFRIGERATION SYSTEMS

A. COPPER TUBING

1. Refrigerant tubing, manufactured by Anaconda, Phelps Dodge, Cerro, Mueller or approved equal, shall be type K (type L - ACR when permitted by local codes) hard drawn, bright, annealed, dehydrated and sealed tubing. Fitting, elbows and tees shall be sweat type wrought copper. All Elbows are to be Long Radius elbows. Under no circumstances are 45-degree elbows to be used on hot gas defrost systems.

2. All direct buried copper piping is to be type “L” soft copper only, rolled out to be straight and insulated with minimum 1” wall insulation for Low temperature suction, Medium temperature suction and all liquid lines. All underground lines are to be buried within a minimum of a 6” bed of Clean Sand Fill Completely Surrounding the Piping. (No rocks of any size are allowed to be near the piping).

B. OVERHEAD PIPING

All overhead piping shall be installed in such a manner as to have relativity easy access in the future for leak checking purpose. Lines above ceiling tile areas are to run in such a way as to be no more than 36” above the ceiling grid line.

C. CONDENSATE DRAIN LINE / DRAIN LINE HEATERS:

1. The Refrigeration Contractor shall furnish and install all self-regulating heat tape on all storage freezer(s), and Coolers that operate below a 33 degree room temperature. Refrigeration Contractor to insulate all heat taped drain lines with ¾” wall insulation.

2. All drain line heat tape is to be self-regulating, 6-watt per foot 120v heat tape, metal covered mesh or wet location heat tape by Frostex or equal will be used. All heat tape is to run on the bottom or down both sides of the pipe and must be secured to the pipe a minimum of every 4”. The sealed off end is to be at the evaporator and must hang out 3”. The evaporator end is to be stripped back and sealed off with Rachem H900 or equal Factory Gel Filled type end cap seal Heat tape is to be connected by the E.C. to a power

source is to be located outside of the box. 36” of extra tape outside of the box for the E.C. to connect. All seal off end caps and electrical connect kits are to be supplied by the Refrigeration Contractor. End caps installed by Refrigeration Contractor. Electrical caps installed by E.C.

D. INSULATION:

1. All Low Temperature Suction Lines will require (1”) Wall Insulation.

2. All Medium Temperature and High Temperature Suction Lines will require (¾”) Wall Insulation.

3. All Direct Buried Underground Piping will require (1”) Wall Insulation on all Suction and Liquid Lines.

4. Suction line insulation shall start at the evaporator coil outlet and run uninterrupted to the suction line service valve (less suction filter) on a single compressor unit and to the compressor rack suction manifold on a parallel compressor rack. Penetrations at cases or W.I. cooler/freezers are to be spray-foamed and caulked on both sides of penetration. Insulation may be slipped on the tubing or split and then sealed with Armstrong #520 adhesive. Butt joints between sections should be compressed a minimum of 3” per every 6’ of insulation. Joints are to be both glued and taped, a minimum of 2” on either side of joints. The contractor will be responsible for repairing separated joints for a period of (one year) after store opening date. Any insulation installed outdoors shall be covered with PVC Jacketing. Liquid and suction lines are not to be insulated together.

E. HANGERS AND SUPPORTS:

1. Piping shall be securely supported and anchored with “Unistrut” Channel and “Hydro-Zorb” or SuperStruct” black (only) cushion inserts and steel clamps. Nylon insert lock nuts only shall be used on the clamps. All piping is to be clamped in only one location per straight run. Each turn in direction requires a set of clamps. Provide 12” long galvanized half-moon sleeves to support pipe/insulation at all hanger locations that are not hydrozorb clamped. These cradles are to be glued to the insulation with armaflex glue covering at least 60% of the cradle (tape is not acceptable to attach metal cradles).

2. Maximum length of a hot or cool gas defrost line set with out or offset is 100’.

3. Maximum length of an off time defrost line set without an offset is 120’.

4. Piping shall be supported at 8’ intervals maximum with horizontal corners supported at not more than (12”) from each edge of the “bend” fitting. Piping for hot gas defrost and heat reclaim lines should be installed with flexible hangers to permit the free expansion and contraction of the tubing. Supports for unclamped/un-insulated lines shall be covered with PVC plastic tubing so as to eliminate direct contact between the tubing and the support. On all hangers where Hydro Zorb clamps are used to support the piping. The R.C. is to tape off the bottom of “unistrut” and foam the area under the clamp. Also, a piece of insulation must be then glued over the top of the clamps. All coils are to be hung with 3/8” galvanized rod. 1 5/8” HD green “unistrut” is to be used on the top of all walk-in coolers, walk-in freezer boxes to support the coils. Unistrut must cross cooler lid joints. All coils of over 400 lbs. will require additional support rods attached to the building structural steel.

F. BRAZING MATERIALS:

1. A brazing alloy with a minimum of 15% silver content (equal to or exceed Silfos) shall be used on all copper to copper fittings, with the exception of relief valve, vent lines and drain lines. Copper to brass fittings shall be brazed with a minimum of 45% silver content alloy (silver solder). All dissimilar metals shall require 45% silver solder.

G. INSTALLATION PROCEDURES

1. All tubing must be kept clean, dry and sealed.

2. The piping shall be laid out and installed to keep the number of fittings at a minimum and the runs as short as possible.

3. Piping shall not run in such a way that might hinder inspection or serviceability of the compressor system.

4. Proper spacing between all line sets to allow for expansion and contraction of lines during gas defrost (minimum 1" spacing).

5. Receiver relief valves on parallel compressor systems shall be piped to the roof. Local codes shall be followed in all other cases (Coordinate with Project Manager before running vent piping).

6. Do not run tubing from one system through a case connected to another system.

7. Refrigeration connections in (Direct Buried) underground locations must be kept to a minimum and all welds must be fully capped with solder.

8. All piping shall be sized by the manufacturer of the equipment. The Refrigeration Contractor shall determine the correct size of all refrigeration piping after verification of job site conditions. Refrigeration Contractor to notify the Manufacturer of any discrepancies. The Manufacturer will make the final determination of sizing of refrigeration piping.

9. Any vertical suction riser shall be trapped at the bottom. Traps are to be either manufactured or double 90-degree elbows and are to be installed the full size of the horizontal run.

10. Any portion of tubing going through brick, rock or concrete shall be properly sealed and protected to avoid pipe and insulation damage.

11. All capillary tubes are to be topped and wire-tied and/or siliconed to avoid vibration breakage.

12. Before making any final piping connections, all lines are to be blown out with high-pressure dry nitrogen to purge the lines of any loose dirt, filings, scale, etc.

H. TESTING AND EVACUATION

1. All refrigeration/heat reclaim and condenser lines are to be pressure tested and leak checked to 200 psi. This pressure must be maintained for 24-hours before attachment to the cases, coils, condensers or racks. After final refrigeration connections are completed, the complete system is to be pressure tested and leak checked at 175 psi.

2. A (Triple) evacuation is to be completed with a two stage vacuum pump and must pull down to 1500 microns on the first evacuation, 600 microns on the second evacuation and 300 Microns or lower on the last evacuation. To break each evacuation the FINAL SYSTEM REFRIGERANT must be used. (Under no circumstance is nitrogen to be used to break an evacuation). (If nitrogen is infused back into the system at any time after evacuations have started the next evacuation is to be considered to be "starting over" at the first evacuation and three additional evacuations must be completed).

3. Final evacuation: The vacuum pump is to be turned off and the system must be capable of rising no higher than the 500-micron level, at a decreasing hourly rate, over a 3 hour period.

I. EQUIPMENT START-UP:

1. Check all compressors for proper oil level and, if necessary, add sufficient oil to bring the level to the center of the crankcase sight glass on all units. Use only the refrigeration oil recommended by the compressor manufacturer. All oil must be delivered to the job in factory sealed, unopened containers.

2. Suitable tags or other means (color coding of compressor heads) should be provided to indicate refrigerant type used in each system.

3. Lubricate any motor or other moving parts with the proper oil or grease as necessary.

4. Remove or loosen shipping retainers under motor compressors. Hold down nuts on spring mounted compressors are not to touch the compressor feet, and are not more than 1/16" above the mounting foot.

5. Check high and low pressure control cut-in and cutout points.

6. Charge until system has sufficient refrigerant for proper operation. Do not overcharge. Do not leave compressor unattended until the system is properly charged with refrigerant and oil.

J. OPERATIONAL CHECKOUT AND CONTROL ADJUSTMENT

1. Thermostatic expansion valves must be checked for proper superheat settings. Feeler bulbs must be in positive contact with the suction line. All valves are to be set per the Manufacturer specifications. If Manufacturer has no specification, use the following guideline:

   a. Low Temperature Valves: 3º to 5º superheat (average)
   b. Medium Temperature Valves: 5º to 6º superheat (average)
   c. High Temperature (A/C): 7º to 8º (average)
   d. EEV Low Temperature: 8º to 10 degrees (average)

2. All valves are to be set using the Pressure/Temperature method. Temperature/Temperature method is Not Acceptable.

2.06 ELECTRICAL REQUIREMENTS

A. Pre-wiring of electrical equipment shall comply with UL, NEMA, NEC and prevailing codes.

B. Equipment requiring electrical connections shall be fabricated by UL listed fabricator.

C. Internal wiring shall be identifiable via tags indicating the item number and electrical requirements. Furnish wiring diagrams. Wiring shall be run in NSF approved rigid conduit. Use chrome where exposed. Wire wet areas in Sealtite EF conduit or equal. Provide raceways for conduit. Final Connections by EC.

D. Exposed junction Boxes for switches and receptacles shall be S/S or cast aluminum Bell boxes and shall be furnished with S/S cover plates. Provide NEMA water-proof boxes in wet areas.

E. Provide all code compliant fluorescent tubes and incandescent bulbs required for foodservice equipment.

2.07 PLUMBING REQUIREMENTS

A. All plumbing components and piping shall be lead free and meet or exceed all prevailing codes.

B. Install piping not less than 6” above finished floor. Whenever possible shall stub-out of walls rather than stub up through floor or using exposed piping. No unnecessary exposed plumbing permitted. No tool marks or visible threads at exposed fittings. Use polished chrome fittings where exposed.

C. Provide pipe openings, chases and/or punch and cut equipment as required to provide access for Plumbing connections and piping. Work performed at the job site shall be of the same quality as similar work in the shop. Provide close fitting clean cut holes for passage. No sharp edges or non-uniform modifications allowed.

D. Indirect waste piping (except from sinks and exhaust hoods) shall be installed in accordance with the local codes. Extend piping to a point of at least 2” (50 mm) above hub drain or floor sink and cut bottom on 45º angle. All indirect waste piping shall be installed to ensure proper drainage. Coordinate piping to drain with equipment and building conditions. Secure indirect waste piping to fixture.

E. Indirect waste piping from ice bins, cold food wells or similar items shall be insulated to prevent condensation.

F. Water inlets shall be located above the positive water level to prevent siphoning of liquids into the water system. Wherever conditions shall require a submerged inlet. Provide a suitable type of check valve and vacuum breaker.

PART 3 - EXECUTION

3.01 DELIVERY, STORAGE AND HANDLING

A. All items shall be delivered, uncrated, assembled and set in place in a safe manner. All items shall be covered at all times, protected and secured until final acceptance. All responsibility shall rest on the contractor for any damage or loss incurred prior to final acceptance.

B. Contractor to schedule deliveries and movements upon the site to prevent delays in other contractor's work and shall coordinate all on site activities with the General Contractor.

C. Deliver foodservice equipment as factory-assembled units with protective crating and covering.

D. Store foodservice equipment in its original crating and protective covering. Store in a dry location.

3.02 FEC INSTALLATION

A. FEC to install all items and materials according to Project Schedule.

B. FEC to furnish all items (brackets, fasteners etc.) required for installation of all specified equipment.

C. Schedule and coordinate installation with GC and appropriate trades as required.

D. Provide supervisor during installation to coordinate and inspect the work of other trades related to the installation of foodservice equipment.

E. Provide all cutting, trimming welding and other modifications required to foodservice equipment.

F. Uncrate, assemble, set-in place and level all equipment for final utility connections.

G. Seal and secure all equipment where required.

H. All wall and ceiling hung items are to be installed and secured by FEC.

I. Fire suppression systems shall be installed, tested, certified and charged by FEC. EC to connect to electrical and alarm systems where necessary. Exposed fire suppression piping is to be chrome plated.

J. FEC to assemble all Cold Storage Rooms. Flooring and cove base are by GC unless otherwise specified.

K. Provide and install complete refrigeration systems fully charged and operational. Provide compressors, condensers, refrigeration rack systems, evaporator coils, vibration eliminators, sight glasses, expansion valves, filters, oil separators, thermostats, defrost time clocks, defrost heaters, controls, solenoids, liquid line driers and refrigeration grade copper piping and fittings.

L. Provide all electrical refrigeration components required for electrical connections. EC to wire to connection points.

M. Install refrigeration components in accordance to manufacturer instructions.

N. Provide electrical heat tape for freezer condensate lines. Heat tape to be installed by EC.

3.03 START-UP AND TESTING

A. Provide trained individual to start-up and test all items to ensure proper installation and operation of foodservice equipment.

B. Test and certify all systems as required.

C. Adjust and calibrate all refrigeration systems, thermostats and temperature readout devices.

D. Arrange for demonstrations and instructions for operations and maintenance of foodservice equipment. Times and dates are to be selected by the owner. Demonstrations may take place over two days.

E. Provide operations and maintenance manuals as directed in Submittals section of Section 11 40 00 specifications.

3.04 CLEANING

A. Remove all packing, crating and debris from site.

B. Remove all protective covering from S/S and other finished surfaces.

C. Clean finished surfaces, touch up as required and remove or refinish damaged or soiled areas, as acceptable to Architect/Consultant. Clean work surfaces free of smudges, dust and debris.

3.05 PROTECTION OF COMPLETED WORK

A. Provide all necessary protective measures to prevent damage to equipment from exposure to other construction activity.

B. Advise GC of procedures and precautions for protection of materials and installed Foodservice equipment from damage by work of other trades.

3.06 MAINTENANCE

A. Provide service inspection six months after start-up.

B. Provide final inspection 30 days prior to the end of warranty periods of equipment. Have all required warranty work completed prior to expiration of warranty.

PART 4 – ITEM SPECIFICATIONS

4.01 ROUGH-IN DRAWINGS

Rough-in drawings have been completed by Capital Foodservice Design. It shall be the responsibility of the Foodservice Equipment Contractor (FEC) to verify all dimensions, plumbing, and electrical services and prevailing codes as they relate to this project and to show any required changes on the documents submitted for approval.

4.02 APPROVED FABRICATORS

Approved fabricators of custom fabricated S/S equipment for this project are.

Best-Way Fabricating, Inc.
603 19th Avenue NE
PO Box 187
St. Joseph, MN 56374
1-800-896-5565

ACS Fabrication
200 West Plato Blvd
St Paul, MN 55107
1-888-429-5924

Two Rivers Enterprises
490 River Street West
Holdingford, MN 56340
320-746-3156

Nationwide Fabrication, Inc.
5311 Niagra Street
Commerce City, CO 80022
1-303-853-0107

Kiefer Corp.
400 Industrial Drive
Random Lake, WI 53075
1-920-994-4332

Institutional Equipment, Inc.
704 Veterans Parkway, Unit B
Bolingbrook, IL 60440-5094
1-630-771-0990

4.03 ALTERNATES AND SUBSTITUTIONS

A. Item specifications are to establish a quality and performance standard. The first manufacturer listed is to be considered prime manufacturer and has been selected to establish a minimum requirement for construction, performance, quality and capacities. Approved alternate manufacturers are listed when available.

B. Approved alternate manufacturers must provide equipment equal to the prime specified manufacturer. Performance, quality, capacity and accessories must be equal to prime specified manufacturer. FEC to coordinate any changes required to electrical, plumbing or HVAC requirements with Architect, Consultant and

appropriate trades. FEC responsible for any cost involved with changes caused by alternate manufacturer selection.

4.04 EQUIPMENT SPECIFICATIONS

ATHLETIC FIELD EQUIPMENT - 114800

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following gymnasium equipment.
   1. Wall Protection Pads.
   2. Fence post and rail protection pads.
   3. Guardrail pads.
   4. Foul ball poles.
   5. Related accessories.

1.2 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrivtive requirements shall govern.
   1. International Association of Athletics feduertations (IAAF)
   2. ASTM International
   3. American Sports Builders Association (ASBA)
   4. Manufacturers Data and Recommended Installation Requirements

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Retain first paragraph below if required. Most of below is normally covered in Product Data if not a customized installation.

B. Shop Drawings: Include materials and finishes, general construction, plans, elevations, sections, details, attachments to other work, and the following:
   1. Wall protection pad layout.
   2. Foul ball poles.

C. Delegated-Design Submittal: For flagpole assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

   1. Include loads, point reactions, and locations for attachment of flagpoles to building's structure.

D. Structural Analysis Data signed and sealed by the qualified professional engineer responsible for their preparation including loads and point reactions for the foul pole foundations.

E. Color samples for selection: for pads and netting.
   1. Pad Fabric: Not less than 12-inches square, with specified treatments applied.

F. Qualification data for professional engineer.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Firm experienced in installation of systems similar in complexity to those required for project.
   1. Acceptable to or licensed by the manufacturer.
   2. Not less than 3 years experience with systems

3. Successfully completed not less than 5 comparable projects using this system.

1.5 PROJECT CONDITIONS

A. Field measurements: verify dimensional sizes of installed items to be protected before beginning fabrication of protection pads and netting.

PART 2 - PRODUCTS

2.1 MANUFACTURERED UNITS

A. Wall Protection Pads with Plywood backing.
1. Size: As indicated on drawings.
2. Backing: APA Rated sheathing, Exterior Exposure, Grade BC, Species Group 1.
a. Thickness 23/32-inch.
3. Core: 3-inch thick open cell polyurethane.
a. Density: 1.5 to 1.7 pounds per cubic foot.
4. Fabric: Flame-retardant 16-ounce per square yard aminated vinyl with 10-mil thick coating.
a. Color: As selected from the manufacturers full range. (match existing)
5. Grommets: No. 3 solid brass.
6. Mounting Hardware:
a. Concrete wall applications; 2-inches by 36-inches x 3/32-inch aluminum clip system.
b. Chain-link Fence Applications; ¼-inch by 2-inches hex head cap screws with T-Nuts and 2-inchs by 36-inches by 3/32-inch aluminum back-up plates.
7. Acceptable Manufacturers:
a. America Athletic, Inc.
b. Porter Athletic Equipment Company.
c. Promats: Model FWP.
d. Comparable products of an approved manufacturer.
e. SportsField Specialties

B. Wall Protection Pads – Sewn Type:
1. Size: As indicated on drawings.
2. Core: 3-inch thick open cell polyurethane.
a. Density: 1.5 to 1.7 pounds per cubic foot.
3. Fabric: Flame retardant 16-ounce per square yard laminated vinyl with 10-mil thick coating.
a. Color: as selected by architect from manufacturers full range.
4. Grommets: No. 3 solid brass.
5. Mounting Hardware:
a. Concrete wall applications; 2-inches by 36-inches x 3/32-inch aluminum clip system.
b. Chain-link fence applications; ¼-inch by 2-inches hex head cap screws with T-nuts and 2-inchs by 36-inches by 3/32 inch aluminum backup plates.
6. Acceptable Manufacturers:
a. America Athletic, Inc.
b. Porter Athletic Equipment Company.
c. Promats: Model FWP.
d. BaseZone Field Wall Padding
e. Comparable products of an approved manufacturer.

C. Fence Post and Top Rail Pads:
1. Size: 6-inch y the maximum possible length.
2. Backing: APA rated Sheathing, Exterior Exposure, Grade BC, Species group 1.

a. Thickness 23/32-inch.
3. Core: 3-inch thick open cell polyurethane.
   a. density: 1.5 – 1.7 pounds per cubic foot.
4. Cover: Flame retardant 16-ounce per square yard laminated vinyl with 10-mil thick coating.
   a. Color: as selected by architect from manufacturers full range.
5. Grommets: No. 3 solid brass spaced 6-inches on center.
6. Ties: nylon type, color to match cover.
7. Acceptable Manufacturers:
   a. America Athletic, Inc.
   b. Porter Athletic Equipment Company.
   c. Promats: Model FWP.
   d. Comparable products of an approved manufacturer.

D. Guard rail Pads:
1. Core: 1-inch thick open cell polyurethane.
   a. density: 1.5 – 1.7 pounds per cubic foot.
2. Cover: Flame retardant 16-ounce per square yard laminated vinyl with 10-mil thick coating.
   a. Color: as selected by architect from manufacturers full range.
3. Grommets: No. 3 solid brass spaced 6-inches on center.
4. Ties: nylon type, color to match cover.
5. Acceptable Manufacturers:
   a. America Athletic, Inc.
   b. Porter Athletic Equipment Company.
   c. Promats: Model FWP.
   d. Comparable products of an approved manufacturer.

E. Foul Ball Poles:
1. Size: 40-feet unless otherwise indicated on the drawings.
   a. Acceptable Manufacturers.
      1. Patterson-Williams Athletic Company; Model1274.
      2. Comparable Products of an approved manufacturer.

2.2 ACCESSORIES

A. Fasteners: Size and type as required for application.
1. Finish: Hot-dipped galvanized.

2.3 FABRICATION

A. Wall Protection Pads:
1. Fabricate pads to sizes indicated on the Drawings.
2. Seal edges and back of plywood backing to match cover.
   a. paint exposed surfaces of plywood to match cover.
3. Adhere core material to backing using waterproof adhesive.
4. Wrap cover around core and extend onto backing not less than 2-inches.
   a. Secure cover to backing every three inches with galvanized steel fasteners.
5. At applications requiring nylon ties provide grommets spaced 1-inches on center.
6. Prvide each pad with three ½-inch diameter weep holes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, including foundation; accurate placement, pattern, orientation of anchor bolts, and other conditions affecting performance of the Work.

B. Verify critical dimensions.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION GENERAL

A. General: Comply with manufacuturer's written installation instructions.

B. Installation units straight, plumb, level and in place with other elements at locations indicated on the Drawings.

C. Install netting at locations indicated on Drawings.

D. Install netting at fence locations using cable ties at each grommet.

END OF SECTION 114800

SECTION 116350

1.GENERAL

1. SCOPE OF WORK

A. Work under this Contract includes all labor, materials, tools, transportation services, supervision, coordination, etc., necessary to complete the supply and installation of a Video Production System, as described in these specifications and illustrated on the associated drawings. The systems shall be called the “Video Production System (VPS)” and the Contractor the “Video Production Contractor”. The systems include the following major items:

1. Video Production Cameras
2. Video Switching systems--routing, production
3. All electrical distribution within each system at each installation point.
4. User Fiber Optic Patching, and distribution.
5. Technical Millwork and Furniture Consoles

B. The Contract also includes:

1. Verification of dimensions and conditions at the job site.
2. Preparation of submittal information.
3. Coordination with other trades.
4. Installation in accordance with the contract documents, manufacturer’s recommendations, and all applicable code requirements.
5. Manufacturer’s commissioning for all major items of equipment.
6. Initial tests and adjustments, written report, and documentation.
7. Instruction of operating personnel; provision of manuals.
8. Maintenance services; warranty.
9. The Contractor is responsible for all subsequent design and engineering not included within the RFP documents. The Contractor is responsible for providing all components necessary for complete and operational system.
10. Any system changes or revisions necessary to make the system conform to the building, walls, electrical services etc, shall be included at time of proposal and installed without claims for additional compensation.

C. The Contract Documents are complementary and are intended to include or imply all items required for the proper execution and completion of the work. Any item of work required by the Specifications or other portion of the Contract Documents, but not shown on the drawings, or shown on the drawings but not required in the Specification, shall be provided by the Contractor without extra charge as if shown or mentioned in both.

2. SYSTEM DESCRIPTION

A. This Video Production systems herein are to be utilized to produce content for stadium LED display and in house TVs. A streaming encoder will be provided to broadcast events as needed. The production suite is located on the main concourse in room 259. with equipment racks and control consoles sharing the space.

B. Video System Operation:

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1. The principal cameras are to be 1080p 59.94 as base bid.
2. It is anticipated that the production switcher will operate at 1080p 59.94.
3. The routing switcher is specified to be 1080p 59.94 operating as base bid.

C. Video Production Contractor will be working in the following major locations:

1. A Video Control Room (259) used to originate programming for the stadium.
2. Various locations around the stadium.

D. A number of video cameras are dedicated to the Video Production System.

1. Each camera may be connected at a JBT in various locations around the stadium.
2. Additional unit costs are requested for potential purchase of additional CCUs, Cameras and Lenses.

E. In addition to the cameras the following equipment is provided for Video Production System use:

1. Production Switcher
2. Character Generator
3. Multi-channel file server used for clip playback and slo motion replay
4. A Video Recorder is provided to:

    a. Make archival video recordings of each production
    b. Playback individual plays in the event of a failure of a file server
    c. Make archival video recordings of a selected individual camera iso angle.
    d. Create “dubs” and duplications of footage for common distribution.

5. KVM systems are used to connect all computerized servers to associated operator stations located within the video production system. This is to be set up in a one-to-one connection topology.

F. Intercom Systems

1. A 2-Wire partyline based intercom system is to be provided for the Video Production system

    a. Multi-channel circuits are connected to a “intercom connectivity panel” panel for ease of configuration.
    a. The Contractor is responsible for coordinating terminations, supplying equipment, and assisting in balancing and configuring the system.

G. IT Networking

1. Project provides a dedicated control network switch for the intercommunication of video production equipment. Devices as shown on drawings connecting to “owner network” shall be configured for dual network use allowing the control network for video production system communication and converged network for internet access.

    a. Contractor to coordinate with owner IT group for network configuration and provide owner specified routing device for uplink of the control network switch.

H. Broadcast Cabling System

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1. The Broadcast Cabling System specification consists of cabling and infrastructure to support In House Production cabling generally originates in JBT's throughout the stadium and terminate in the control room / scoreboard production room 259.
2. SMPTE Hybrid Fiber Network:

    a. The project's camera cabling standard shall be SMPTE hybrid fiber (aka High-Definition cable) to locations shown on the broadcast cabling functional. Notes with regards to this system:
    b. Permanent SMPTE cable to utilize a triple SMPTE cable that can support up to 3 cameras.
    c. Refer to AV drawings for locations and quantities.
    d. Cabling shall utilize "pigtails" at both ends of the cable to accommodate field repair and terminations.
    e. Each cable run shall be fully broken out to 3 circuits - even when only 1 or 2 SMPTE pigtails connections are shown on the broadcast functionals.
    f. Provide dust caps for all fiber breakouts without SMPTE pigtails.

I. Millwork

1. Broadcast millwork will be provided in configurations shown on the floor plans. Take care during installation to prevent scratches and damages to the consoles.

J. The installation of the Video Control Room should be coordinated with the Lighting and Structured Cabling systems (among others).

1. The actual camera, video, and audio cabling from the Video Control Room to the camera locations is provided as tie lines to the camera locations.

3. RESPONSIBILITIES AND RELATED WORK

A. Supply accessories and minor equipment items needed for a complete system, even if not specifically mentioned herein or on the drawings, without claim for additional payment.

B. Notwithstanding any detailed information in the Contract Documents, it is the responsibility of the Video Control Contractor to supply systems in full working order. Notify the Owner's Representative of any discrepancies in part numbers or quantities before bid. Failing to provide such notification, supply items and quantities according to the intent of the Specification and Drawings, without claim for additional payment.

C. Obtain all permits necessary for the execution of any work pertaining to the installation.

D. The drawings included with this specification convey general system concepts. The plans do not show complete and accurate building details. The Contractor is responsible for making field measurements necessary to establish exact locations, relationships and load capacities necessary for the installation of these systems.

E. If a conflict develops between the contract documents and the appropriate codes and is reported to the Owner's Representative prior to proposal opening, the project team will prepare the necessary clarification. Where a conflict is reported after contract award, propose a resolution of the conflict and, upon approval, perform work.

F. All structural support, design, and engineering for installation of all system components.

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G. Power

1. Power shall be provided within the control room above the equipment racks terminated to twist lock receptacles. The contractor shall be responsible for distributing electrical power from the receptacles to the equipment as required.
2. The contractor shall be responsible for connecting appropriate grounds to all equipment in accordance with applicable codes and standards.
3. UPS power shall be provided in the equipment racks and at operator stations to allow a minimum run time of 10 minutes to allow for proper system shutdown and on-air sign off pending an electrical blackout situation.

H. Coordinate work with other trades to avoid causing delays in construction schedule.

I. Paint any POV Camera housing, provided under this contract, to a color selected by Architect & Owner.

4. SUBMITTALS

A. Submit all shop drawings and submittals in accordance with Project Requirements.

B. Shop drawings and submittal data shall contain sufficient information to describe the Work to be performed. Drawings shall be executed at an appropriate scale. Submit all Shop Drawing information at one time.

C. Submittals shall include digital copies with all information, drawings, and reports in .pdf format. PDF documents which include multiple files (e.g. product submittals) shall have a cover sheet and a table of contents with active, clickable links to each subsection.

D. The following outlines expected submittal packages:

1. Project and Submittal schedule shall be submitted within three (3) weeks of award.
2. Product Data

   a. A material list of all equipment to be furnished, arranged in specification order and noted as to which device the equipment represents.
   b. Proposed cable labeling technique.

3. Equipment layout and Millwork details (with console elevations)

   a. Location of all equipment in racks, consoles, or on tables, with dimensions; wire routing and cabling within housings; AC power outlet and terminal strip locations.

4. One Line diagrams for all signals (without cable numbering or patch points)

   a. Wiring diagrams. Complete, detailed wiring diagrams for all systems, based on the contract documents but including cable types, identification and color codes, and detailed wiring of connections, both at equipment and between equipment racks and wiring in conduit.
   b. Schematic drawings of any custom circuitry or equipment modifications, including connector pinouts and component lists.

5. Detail Submittal

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a. Patch panel layouts and designation (labeling) strips.
b. Custom Plates. Provide complete shop drawings on custom fabricated plates or panels. Drawings to include dimensioned locations of components, component types, engraving information and plate material and color.
c. Representative equipment labeling sizes, styles, and numbering.
d. Any structural mounting details (including structural engineers seal as appropriate)
e. Samples as required in various specification paragraphs.

6. User Interface (UI) Submittal.

a. This submittal is to provide sufficient information to indicate that the Contractor has appropriately configured software and user interfaces in accordance with user requests, as well as in common production studio configuration. The submittal can be in PDF, Excel, or as configuration files as appropriate. In some cases this submittal, may need to be incremental, with multiple deliveries. Items covered by this submittal shall include, but not be limited to:
b. Routing Switcher: inputs, outputs, virtual naming, panel configurations
c. Intercom Matrix: Panel configuration, alphanumeric and the like. A “dummy” version of the configuration file is preferred for review.
d. Production Switcher
e. Tally
f. Control System (e.g. Crestron, AMX, etc.) if any.

7. Commissioning Plan and Training Resume Submittal

a. Provide Contractors commissioning plan
b. Provide training schedule
c. Part 3 lists training that is to occur on the system. Provide resumes where required for training on specific device(s) for approval.
d. If Contractor desires to utilize own forces for specified manufacturers commissioning, submit resume and relevant references for approval.
e. Provide sample training attendance sign in sheet

8. Commissioning Completion Submittal.

a. At the conclusion of the commissioning process provide a written submittal indicating the completion of each commissioning task.

9. Training and Event Attendance Submittals:

a. All Operations and Maintenance manuals, as well as as-built drawings must be on site for all sessions of training (drafts are acceptable).
b. Following discussions with Owner and Tenant, formally submit a Training and Event Attendance submittal 4-8 weeks prior to first training. Submittal shall:

1) Include a separate page/entry for every training session.
2) Indicate date, time, and approximate length of training session.
3) Indicate person(s) conducting training.
4) Indicate whether training will be videotaped.
5) Intended curriculum and most appropriate attendees (e.g. engineer, operations, IT, etc.)
6) Include signature and title lines for:

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a) Owner acknowledgement and acceptance of training schedule. Include both an accepted and rejected box. An alternate schedule time should be suggested by the Owner in the event the schedule is rejected.
b) Countersigning by trainer indicating that training actually occurred.
c) All persons attending training. Where attendees do not stay for the entire session, this should be noted on the form and initialed by Owner's representative attending training.
d) Owner's representative attending training at the end of the session shall initial that Training Occurred, Training Materials were provided and left with Owner, training was not interrupted or shortened by equipment or system troubleshooting (If it is, then there should be a line where Owner and Contractor can indicate when make-up training will be provided and how long it should be), Training was generally sufficient for the proposed curriculum.
e) Include Notes section for Owner and Contractor to note any issues during training (areas requiring further development, etc.).

7) Following training occurrence, submit completed training records no later than 5 days following end of training. When training is conducted over a period of weeks, completed training submittals shall be consolidated into a single submittal and submitted every 2 weeks.
8) Event attendance, as specified herein, shall be performed by a staff member associated with the project integration. They shall submit an event attendance report of any issues encountered, resolution or next activities to resolve in a timely fashion.

10. Training Attendance Sign In Submittal

a. Copies of all sign-in sheets from owner training at a maximum of one week after training has occurred.

11. Final Inspection Notification Report.

a. Two copies of a typed, neatly prepared checkout report for each piece of equipment and the entire system shall be prepared and submitted; it shall include:

1) A complete listing of every piece of equipment, the date it was tested and by whom, the results and date re-tested (if failure occurred during any previous tests).
2) The final report shall indicate that every device tested successfully
3) A performance test report indicating that the system meets all of the Contractor testing requirements of Part III.

12. Contract close-out submittals

a. Keep a complete set of drawings on the job, note any changes made during installation, and submit 1 corrected set of reproducible drawings showing Work as installed.
b. Submit the following data for review, prepared as indicated, at least one week prior to acceptance testing (exceptions noted):

1) System Operation and Instructions. Prepare a complete and typical procedure for the operation of the equipment as a system, organized by

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subsystem or activity. This procedure should describe the operation of all system capabilities beginning with system startup and ending with shutdown. Assume the intended reader of the manual to be technically inexperienced and unfamiliar with this facility.

2) Final Documents:

a) A list of all equipment, indicating manufacturer, model, serial number, power consumption, warranty terms if greater than the specified warranty and equipment rack location. Update following acceptance testing, if changed.
b) Manufacturer’s Instruction Manuals for all items of equipment, incorporating or followed by manufacturer's warranty statements.
c) Where manufacturer registration is required, register warranty in Owner’s name, and at an address determined by Owner. Provide copy of registration.
d) For custom circuits or modifications, a description of the purpose, capabilities, and operation of each item.
e) A list of settings of all semi-fixed controls. Update following acceptance testing. (This shall specifically include all computer based software settings, e.g. IP addresses, gateways, drive mapping, backup procedures etc.)
f) Schematic wiring diagrams of the production studio sub-system, based on the as-built documentation, at a reduced scale easy to handle but fully legible.
g) Maintenance Instructions, including Contractor’s maintenance phone number(s) and hours; maintenance schedule; description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.
h) A legend of acronyms and abbreviations must accompany all documentation.
i) Any other pertinent data generated during the Project or required for future service.
j) System Reference Manual: Furnish digital copies as required by Project Requirements.

c. Electronically editable files for all project work:

1) AutoCAD DWG
2) Excel
3) Word
4) PDF is not considered an editable file.

5. QUALITY ASSURANCE

A. Contractor’s Qualifications: Firm experienced in the installation of systems similar in complexity to those required for this project. Specific proposal submission requirements are:

1. Experience with at least three (3) comparable scale sports projects within the last three years.
2. Provide reference information and contact information for each project.
3. In the event sport specific projects are not available, other projects may be considered.

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B. Maintain a fully staffed and equipped service facility. In the event the Contractor is outside a one (1) hour support time for the project, identify local resource(s) to be developed and assigned to support the project during the warranty duration.

C. Contractor authorized to sell all equipment specified within this system.

D. The Contractor shall demonstrate that he has:

1. Adequate plant, equipment bonding and insurance capabilities to complete the work.
2. Adequate staff with commensurate technical experience. Identify the following roles for the project and provide appropriate resumes:

    a. Senior Project Engineer(s).
    b. IT Project Engineer
    c. Project/Site Supervisor (aka lead Contractor).
    d. Project/Off-site project manager.
    e. Purchasing and expediting staff
    f. Vice President/Operator for escalation contact in the event of difficulties
    g. Other staff and their experience that may assist in evaluating the Contractor's proposed deployment team

3. Suitable financial status to meet the obligations of the work.
4. Any installation, labor or electrical subcontractor (this does not include millwork) whose contract value will exceed $10,000.
5. A proposed project schedule with manpower loading diagram (based on a system of this complexity).

    a. Sample submittals are encouraged as part of the proposal submittal. This is including but not limited to:
    b. One-line diagrams
    c. As-built documentation
    d. Photographs of work (showing the rear of equipment racks, not the fronts).
    e. Commissioning procedure(s)
    f. Training documentation
    g. Other information that may assist in evaluating the vendor's past performance.

6. PROJECT CONDITIONS

A. Verify all conditions on the job-site applicable to this work. Notify Owner's Representative in writing of discrepancies, conflicts, or omissions promptly upon discovery.

B. The drawings diagrammatically show cables, conduit, wiring, and arrangements of equipment fitting the space available without interference. If conditions exist at the job site which make it impossible to install work as shown, recommend solutions and/or submit drawings to the Owner's Representative for approval, showing how the work may be installed.

7. ACCEPTANCE TESTING

A. Upon completion of installation and initial tests and adjustments specified in Part 3, acceptance testing shall be performed by the Owners Consultant.

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B. Provide two persons familiar with all aspects of the system to assist the Owners Consultant during acceptance testing.

C. The process of acceptance testing the System may necessitate moving and adjusting certain component parts; perform such adjustments without claim for additional payment.

D. In the event that the system is used prior to final acceptance, attendance in support of system usage shall not be construed as acceptance, or as event attendance.

8. WARRANTY

A. Warrant labor and materials provided under this agreement for one year following the date of the first regular season game, trouble free operation, or final acceptance, whichever is later.

B. System to be free of defects and deficiencies, and to conform to the drawings and specifications as to kind, quality, function, and characteristics; repair or replace defects occurring in labor or materials within the Warranty period without charge. Warrant all replaced products as new.

C. This warranty shall not void specific warranties issued by manufacturers for greater periods of time. Nor shall it void any rights guaranteed to the Owner by law.

D. Within the warranty period, answer service calls within 8 hours, and correct the problem within twenty-four hours.

E. Register all manufacturers' warranties (e.g. software, computers, etc.) in Owner's name.

9. SPECIFIED PRODUCTS AND MANUFACTURERS

A. Model numbers and manufacturers included in this specification are listed as a standard of quality. Regardless of the length or completeness of the descriptive paragraph herein, each device shall meet all of its published manufacturer's specifications. Verify performance as required. Where two or more acceptable products are listed, the Contractor may use either at his option.

B. Other qualified manufacturers will be considered subject to approval of complete technical data, samples, and results of independent testing laboratory tests of proposed equipment, submitted in accordance with project requirements.

C. If proposed system includes equipment other than specified model numbers, submit a list of major items and their quantities, with a one-line schematic diagram for review.

D. Include a list of previously installed projects using proposed equipment that are similar in nature to specified system.

E. If product is discontinued or made obsolete due to continuing product development, replace it with manufacturers' equivalent at time of installation at no additional cost.

F. If product is unavailable by project completion due to supply chain issues, replace it with alternate manufacturers' equivalent at time of installation at no additional cost.

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10. OPTIONS SHOULD REFLECT THE NET COST (ADD OR DEDUCT) FOR THE OPTION AND ALL IMPACTED ELEMENTS. IN THE EVENT SUPPLIER CANNOT QUOTE A SPECIFIC PRODUCT; LIST NA ON BID FORM.

A. Option 11 63 50-A. Clip Player Replacement Option. Provide incremental cost to replace low, base bid Slow Motion solution

1. Option 11 63 50-A1. Newtek Clip Player

a. Supply Acceptable Newtek 3Play based solution in lieu of base (low) bid configuration

2. Option 11 63 50–A2. Ross Clip Player

a. Supply Acceptable Ross based solution in lieu of base (low) bid configuration

3. Option 11 63 50-A3. Variant Systems Slow Motion Option

a. Supply Acceptable Variant Systems Slow Motion Option based solution in lieu of base (low) bid configuration

B. Option 11 63 50-B. Camera Replacement Option. Provide incremental cost to replace low, base bid Camera

1. Option 11 63 50-B1. Hitachi Camera Solution

a. Supply acceptable Hitachi Solution in lieu of base (low) bid configuration

2. Option 11 63 50 – B2. Ikegami Camera Solution

a. Supply acceptable Ikegami Solution in lieu of base (low) bid configuration

3. Option 11 63 50-B3 Sony Camera Solution

a. Supply acceptable Sony Solution in lieu of base (low) bid configuration

C. Option 11 63 50-C. Closed Caption Encoder Option. Provide cost to provide one (1) Type 1 CCE and associated equipment

11. UNIT COSTS SHOULD REFLECT THE NET COST (ADD OR DEDUCT) FOR THE UNIT COST AND ALL IMPACTED ELEMENTS. IN THE EVENT SUPPLIER CANNOT QUOTE A SPECIFIC PRODUCT; LIST NA ON BID FORM.

A. Unit Cost 11 63 50-A. Unit Cost to add/deduct Cameras

1. Unit Cost 11 63 50-A1 Unit Costs to add/deduct one (1) Type 1 Camera, CCU, and associated support equipment.
2. Unit Cost 11 63 50-A2 Unit Costs to add/deduct one (1) Type 1 POV, and associated support equipment.

B. Unit Cost 11 63 50-B. Unit Cost to add/deduct Slow Motion

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1. Unit Cost 11 63 50-B1 Unit Cost to add/deduct four (4) channels of 1080p60 record and two (2) channels of 1080p60 playout and associated equipment (SLO MO_1)

C. Unit Cost 11 63 50-C. Unit Costs to add/deduct one (1) Type 1 Comp ($COMP_1$)

1. Unit Costs to add/deduct one (1) Type 1 Wireless Intercom Belt pack (ICOM WR_1)

D. Unit Cost 11 63 50 – D. Provide incremental cost to add/deduct one (1) Type 1 SDI to NDI Converter ($NDITX_1$) and associated support equipment.

E. Unit Costs 11 63 50-E. Extended support options. Annual support costs shall be following the warranty period. They shall be exercised 30 days before the expiration of the warranty or preceding annual support period whichever is later. Note: base bid shall include 1st year of support as base bid. In the event that vendor provides support for 2nd, 3rd or other years at no cost, then indicate annual costs and at which month and year they begin.

1. Unit Costs 11 63 50-E1. Provide sum of annual costs for all software and hardware support for full Production Switcher Systems specified as Base Bid. Annual costs shall be for ten years following expiration of the project warranty period. Note: if base bid product is significantly HIGHER than alternate products, a note to the order of magnitude would be appreciated.
2. Unit Costs 11 63 50-E2. Provide sum of annual costs for all software and hardware support for all type 1 CGs (CG_1). Annual costs shall be for seven years following expiration of the project warranty period. Note: if base bid product is significantly HIGHER than alternate products, a note to the order of magnitude would be appreciated.
3. Unit Costs 11 63 50-E3. Provide sum of annual costs for all software and hardware support for all Slow Motion and Clip Players in base bid. Annual costs shall be for seven years following expiration of the project warranty period. Note: if base bid product is significantly HIGHER than alternate products, a note to the order of magnitude would be appreciated.

2.PRODUCTS

1. GENERAL

A. All equipment and materials shall carry original manufacturer’s warranty. B-stock or floor demonstration equipment is allowed and encouraged for all equipment, other than video and audio monitors and patch panels. Given the construction cycle NAB or IBC or intervening trade shows may be accounted for. Take care during installation to prevent scratches, dents, chips, etc.

B. Regardless of the length or completeness of the descriptive paragraph herein, each device shall meet all of its published manufacturer’s specifications. Verify performance as required. Where two or more acceptable products are listed, the Contractor may use either at his option.

C. Provide engraved lamicoid labels at the front and rear of all signal processing equipment mounted in racks. Mount labels on the equipment and attach in a neat, plumb, and permanent manner. Embossed labels will not be accepted. Provide engraved labels at the rear only of equipment mounted in furniture consoles.

D. Custom rack panels shall be 1/8" thick aluminum, standard rack sizes, brushed black anodized finish unless otherwise noted. (Brush in direction of aluminum grain only.) Custom connector

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plate (speaker, microphone, etc.) finishes shall be selected from manufacturer's full range of standard finishes. Plastic plates will not be accepted, even if they are building standard in other areas.

E. All engraving shall be 1/8" high block sans serif characters unless noted otherwise. On dark panels or push buttons, letters shall be white; on stainless steel or brushed natural aluminum plates, or light-colored push buttons, letters shall be black.

F. In accordance with IEC-268 standard, all XLR connectors shall be wired pin 2 hot (high), pin 3 low, and pin 1 screen (shield).

G. All patch panels shall be wired so signal "sources" (outputs from devices) appear on the upper row of a row pair; all "loads" (inputs to devices) appear on the lower row of a row pair. All patch panel designation strips shall utilize alphanumeric and descriptive labels. The jack positions in each horizontal row shall be numbered sequentially from left to right. The horizontal jack rows shall be lettered sequentially from top to bottom. The alphanumeric identification of each jack shall be included on the functional block drawings.

2. CAMERAS

A. Camera, Camera Control Unit and Accessories

b. Hitachi Solution:

1) Type 1 Camera (CAM1)

a) Portable 2/3", 3 Chip Camera
b) SMPTE Hybrid Fiber Transmission System
c) Acceptable Product

(1) Hitachi Z-HD5500UH with

(a) Hitachi CA-H550U-S5 Camera Adapter
(b) Hitachi TA-Z3 Tripod Adapter

a. Type 1 Viewfinder (VF_1)

1) Acceptable Product

a) Hitachi VF-PBM307 with

(1) Hitachi AT-500
(2) Hitachi VC-90A
(3) Hitachi VF-L20D

2) Quantity: 1 per camera

b. Type 1 Camera Control Unit (CCU_1)

1) Acceptable product

a) Hitachi CU-HD550U

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c. Type 1 Remote Control Panel (RCP_1)

1) Mounted in Desk
2) Acceptable Product

a) Hitachi RU-1500JY with

d. Type 1 Microphone (MIC_1)

1) Acceptable Product

a) Sony ECM-674 with

(1) Hitachi MH-1000

2) Quantity: 1 Per Camera

2. Ikegami Solution

a. Type 1 Camera (CAM_1)

1) Portable 2/3”, 3 Chip Camera
2) SMPTE Hybrid Fiber Transmission System
3) Acceptable Product

(1) Ikegami HDK-99 Camera Head with

(a) Ikegami FA-97A SMPTE Lemo Version Adapter
(c) Ikegami T-430

b. Type 1 Viewfinder (VF_1)

1) Acceptable Product

(1) Ikegami VF701A/K
(2) Ikegami HVF701D-003
(3) Ikegami VFL201A

2) Quantity: 1 per camera

c. Type 1 Camera Control Unit (CCU_1)

1) Acceptable product

(1) Ikegami BSX-100H Lemo Version with

(a) Ikegami RMBS89-001
(d) Note: QTY (1) RMBS89-001 per (2) type 1 CCU

d. Type 1 Remote Control Panel (RCP_1)

1) Mounted in Desk
2) Acceptable Product

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a) Ikgami OCP-300 with

e. Type 1 Microphone (MIC_1)

1) Acceptable Product

a) Sony ECM-674 with

(1) Rycote 037340

2) Quantity: 1 Per Camera

3. Sony Solution:

a. Type 1 Camera (CAM_1)

1) Acceptable Product

a) Sony HXC-FB80HL with

(1) Sony VCT-14

b. Type 1 Viewfinder (VF_1)

1) Acceptable Product

a) Sony HDVF-L770 with

2) Quantity: 1 per camera

c. Type 1 Camera Control Unit (CCU_1)

1) Acceptable product

a) Sony HXCU-FB80L

d. Type 1 Remote Control Panel (RCP_1)

1) Mounted in Desk
2) Acceptable Product

a) Sony RCP-1000

e. Type 1 Microphone (MIC_1)

1) Acceptable Product

a) Sony ECM-674 with

(1) Sony CAC-12

2) Quantity: 1 Per Camera

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B. Type 1 Camera Lens and Support Package ($LENS_1$)

1. Type 1 Lens Configuration

a. Canon Solution:

1) Canon KJ20x8.2B IRSD with

a) Canon MS-15M Servo System
b) Canon Lens Filter

b. Fujinon Solution:

1) Fujinon XA20SX8.5BERM with

a) Tiffen W82DIGULTCLR
b) Fujinon MS-01

2. Type 1 Tripod and Support Package

2) Libec Solution

a) Libec RS-450DM with

(1) Libec PH-6B

3) Sachtler Solution

a) Sachtler 2513 System with

(1) Sachtler 3270 Telescopic Pan Handle

4) Vinten Solution

a) Vinten VB250-CP2M Tripod System with

(1) Vinten 3219-91 Telescopic Pan Bar with Clamp

3. Rain Slicker

a. M.T.O. Unlimited Shooterslickers S10 Rain/Shoot with

1) M.T.O Unlimited Shooterslicker S7 Overnight Elephant Bags

2. Case

a. Custom Castered Case sized to accommodate Camera and lens while connected as well as ancillary viewfinders, tripod adaptor plates, microphone holders, intercom headsets, 5 meter cable, etc.
b. Manufacturers with potential solutions

1) Viking
2) As Approved

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b. Coordinate case detail with owner. Provide multiple case solutions per owner request as required.

3. PRODUCTION SWITCHER

A. Baseline Production Switcher Requirements that may not be included in part numbers listed below

1. 16 Video Inputs
2. 4 Video Outputs
3. 2 ME Control Panel
4. 3 fully featured mix-effect buses
5. Tally management interface
6. Configure for remote control of LED Content System and to enable transitions and playout.
7. Redundant power for switcher frame.
8. Production Switcher Commissioning: see commissioning section.
9. H.264 Streaming

B. Acceptable Newtek Solution

1. Type 1 Production Switcher (PS_1)

a. Newtek TriCaster TC1 Pro (FG-003245-R001)

2. 2ME Control Panel (PS_2)

a. Newtek Small Control Panel (FG-001589-R001)

4. ROUTING SWITCHER

B. Type 1 Routing Switcher (RS1)

1. Performance Requirements

a. Unit shall provide routing of multiple signals and signal types

1) 525, 625, 1080i 50, 1080i 59.94, 720P 50, 720P 60, 1080P 24, 1080PSF 24, 1080PSF 23.98, 1080p50 A, 1080p60 A.

b. Sized as shown on drawings with ability to expand 100x100 as well as additional monitoring outputs required to serve the (MIV) shown. Please note that the physical frame and size is the ultimate requirement, expansion is expected to be accommodated with the addition of additional input, output and cross point cards.
c. Unit shall be sized to accommodate a specified system with an additional 10% for future use.
d. Equip with redundant power supplies
e. Equip with redundant router control
f. Switches shall be free from visible artifacts on destination devices without introduction of unnecessary delay.

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g. Multiplex 16 channels of audio on each video input/output (note: coordinate outputs that do not require mux with routing switcher I/O schedule).

1) Full mono breakaway audio routing support.
2) Seamless integration between demultiplexed and discrete audio.

h. Switching shall be controlled by a broadcast standard routing switcher control system.
i. Configure Routing Switcher to interface to all shading joysticks (RCP1) This can be accomplished at RS, RS BPS, or RS XY as capable.
j. Provide Web services Video Routing Solution. System to allow users to browse to a specific web address to route local video monitors and device IO. Setup for user profiles to simplify routing and setup at user stations.
k. Acceptable Products

1) Ross Dashboard (Quantity: 1)
2) Evertz MAGNUM-Router-VCP-WEB. (Quantity: 2)
3) As Approved

l. Provide all appropriate Routing Switcher Control Hardware Software required for proper operation. System shall:

1) Be interfaced to a tally interface system to allow transfer of alphanumeric switcher information to/from:
2) Production Switcher
3) Multi-image Display System
4) Be interfaced to the production switcher to allow transfer of alphanumeric information as well as remote switching.
5) Allow control panels to intercommunicate. In the event that Ethernet protocol is used for the communication and it requires a separate physical network, then this supplier shall provide the network hardware required.

C. Acceptable Products

1. Evertz Solution

a. EQX10-FR with
b. EQX-FC (QTY: 2)
c. EQX-PS-FR-B
d. EQX-PS (QTY: 4)
e. EQX-10-XPTG180x288 (QTY: 2)
f. EQX-IP16AD-3G-2TDM (QTY: As Required)
g. EQX-OP16AE-3G-2TDM (QTY: As Required)
h. EQX-OP16AE-FK-HSS (QTY: As Required)
i. EMX6-FR+6PS with
j. EMX-FC (QTY: 2)
k. EMR-ADMX-16x16a (QTY: 2)
l. EMR-108-MADI (QTY:2)
m. Multi-Image Viewers (MIV)

1) Frame

a) Acceptable Product

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(1) Evertz EMX6-FR-1000W with redundant power supply and frame controller (EMX-FC)

b) Type 1 Multi-Image Viewer (MIV1)

(1) 32 sources with two (2) distinct; separately programmable outputs.
(2) Quantity: 3
(3) Acceptable Product

(a) Evertz 3067VIPX-HW-A+32x4+SM with appropriate rear plate and XLINK cable

c) Configuration Software:

(1) Acceptable Product

(a) Evertz Magnum-Multiviewer.

2. Ross Solution

a. Ross Ultrix-FR5 configured with

1) Ross Ultrix-HDB-IO-A (QTY: As Required)
2) Ross Ultriscape MV License (QTY: 3)
3) Ross SFP-MADI-Coax (QTY: 2)
4) Ross SFP-HDB-IO-3G (QTY: As Required)
5) Ross ULTIPOWER
6) Ross ULTRIPOWER-PS (QTY: 2)
7) Ross ULTRICOOL
8) Ross ULTRICOOL-PS
9) Ross Ultrix-Term Kit1855A (QTY: 5)

3. As Approved

D. Routing System Button Control Panel (RSBPS1)

1. Use Routing System Button Control Panel with same manufacture as routing switcher.
2. Evertz Solution

a. Evertz CP-1040E

3. Ross Solution

a. Ross RCP-QE36

4. As Approved

5. VIDEO MONITORS AND ACCESSORIES

A. Type 1 Color Video Monitor ($CPXM_1$)

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1. 22” monitor DVI inputs
2. Acceptable product:

    a. Lenovo ThinkVision T23D-10 Monitor
    b. NEC E221N-BK Monitor

3. As Approved

B. Type 2 Color Video Monitor ($CPXM_2$)

1. 22” monitor DVI inputs
2. 3G-SDI Input
3. Acceptable product:

    a. Lenovo ThinkVision T23D-10 Monitor with

        1) Type 1 HDMI ($HDMI_1$)

    b. NEC E221N-BK Monitor

        1) Type 1 HDMI ($HDMI_1$)

4. As Approved

C. Type 3 Color Video Monitor ($CPXM_3$)

1. 49” monitor HDMI inputs
2. Acceptable product:

    a. LG 49UH5 Monitor with

        1) Chief TS525TU

    b. Samsung QE50T Monitor with

        1) Chief TS525TU

    c. Sony FWD-49X80 Monitor with

        1) Chief TS525TU

D. Type 4 Color Video Monitor ($CPXM_4$)

1. 17” Monitor
2. VESA Mountable
3. 3G HDSDI Input
4. HDMI Input
5. Acceptable Products

    a. Ikegami HLM-1760WR
    b. Sony LMD-A170

E. Type 5 Color Video Monitor ($CPXM_5$)

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1. Touch screen monitor
2. Acceptable product:

    a. Asus VT229H
    b. Planar PCT2265
    c. Viewsonic TD2230
    d. As Approved

F. Type 6 Color Video Monitor ($CPXM_6$)

1. 17.3” Rackmount Monitor
2. 3G HDSDI Input
3. HDMI Input
4. Acceptable Products

    a. Delvcam DELV-3GHD-17RM
    b. FeelWorld P173-9HSD-RM

G. Type 7 Color Picture Monitor ($CPXM_7$)

1. 27” HDR IPS Mini LED Professional Monitor
2. Dolby Vision, HLG & HDR-10 Support
3. VESA Mountable
4. HDMI Input
5. Display Port Input
6. Acceptable Product

    a. Asus ProArt PA27UCX-K
    b. Eizo CG279X-BK

H. Type 8 Color Video Monitor ($CPXM_8$)

1. 49” Monitor
2. Portable Cart
3. Acceptable product:

    a. LG 49UH5 Monitor with

        1) Chief LPAUB

    b. Samsung QE50T Monitor with

        1) Chief LPAUB

    c. Sony FWD-49X80 Monitor with

        1) Chief LPAUB

6. TEST AND MEASUREMENT

A. Test and Sync Generator

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1. Provide Sync to all devices
2. Bring any and all unused signals to patch
3. Type 1 Sync Generator ($TEST_1$) with integral test generator; digital black, and two independently adjustable black burst outputs:

    a. Acceptable Product

        1) Ensemble Designs Bright Eye BE57 with

            a) Ensemble Designs BERKMT-RR

        2) Other Acceptable Manufacturers: Evertz, Ross

B. Waveform/Vectorscope (WVS_1)

1. Two independent displays
2. Waveform Monitor
3. Vector Scope
4. (1) 3G HDSDI Input per Display
5. Input Loop Out
6. Acceptable Product

    a. Blackmagic Design SmartScope DUO HDL-SMTWSCOPEDUO4K2
    b. Other Vendors with Acceptable Solutions

        1) Leader, Tektronix

7. CHARACTER GENERATOR

E. Type 1 Character Generator (CG1)

1. 1 output channels consisting of (1) fill output and (1) key output as a combined NDI stream
2. Provide ability to ingest external data from scoring system and multiple XML and external HTTP data sources
1. Provide video output hardware based on chosen production switcher.
3. Provide manufacture baseball starter graphics package
4. Acceptable Product:

    a. AJT Solution

        1) AJT LiveServer GFX SDI

    b. Ross Solution

        1) Ross Video XSTS-0001 (Quantity: 1 per unit) with

            a) Ross Video XST-DLQ – Datalinq (Quantity: 1 per unit)
            b) Ross Video XPN-1RU-M8- Chassis (Quantity: 1 per unit)

8. SLOW MOTION AND CLIPS PLAYER

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A. Type 1 Slow Motion (SLO MO_1), and Type 1 Slow Motion Remote Control Panel (SCP_1)

1. 6 channels
2. Ability to build, review, select clips or recorded angles at the same time
3. Melt creation without external server
4. Clip naming and management
5. Playlist creation
6. Network file import/export
7. "Hot Key" camera angle playback
8. Multiple file formation
9. Multi-image viewing
10. At least 60 hours of storage at 100 Mbits per channel recording
11. Acceptable Products:

a. Newtek Solution

1) Newtek 3Play 3P1 with

a) Newtek 3tb Expansion Drive

2) 3Play Control Surface (SCP_1)

b. Ross Solution

1) Abeka Mira-PR-AVC-6-02
2) Abekas Mira-IR-CS (SCP_1)

c. Variant Systems Solution

1) Variant VSG-ENV-4+2+LPSMB with

a) Variant VSG-ENV-DIPA-PER-LICE

(1) Note: Package includes compatible touch screen. Delete (1) Type 1 CPXM

2) Variant VSG-ENV-PANEL-TB-USB (SCP_1)

9. VIDEO RECORDING EQUIPMENT

A. Type 1 Video Disk Recorder (VDR_1)

1. Acceptable products

a. AJA KiPro Go with

1) AJA KPU-SHELF
2) SanDisk SDCZ880-256G-A46 (QTY: 2)

b. Blackmagic Design HYPERD/STM with

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1) Comprehensive PWC-BK-6
2) Blackmagic Design CONVNTRM/YA/RSH
3) Sandisk SDSDXPK-032G-ANCIN (QTY: 2)

10. DISTRIBUTION GEAR AND SIGNAL PROCESSING FRAMES AND POWER SUPPLIES

A. Frame with cooling fan, network card with 1 power supply ($FRAME_1$)

1. Open Gear

a. AJA OG-X-FR
b. Ross Video OG3-FR-CN

2. Other Vendors with Acceptable Solutions

a. Evertz
b. Imagine Communications

B. Redundant Power Supply:

1. Mounts in selected Distribution Gear Card Frame
2. QTY: 1 Per Frame
3. Acceptable product:

a. AJA OG-X-PS
b. Ross PS OG3.

4. Other Vendors with Acceptable Solutions

a. Evertz
b. Imagine Communications

C. Type 1 Serial Equalizing Amplifier (SDA_1)

1. 1 x 4 General distribution amplifier.
2. Mounts in selected Distribution Gear Card Frame.

a. Open Gear

1) Dual channel solution

a) AJA OG-3GDA-2x4
b) Ross Video SRA-8802-R2S

(1) NOTE USE ROSS SRA-8802 WITH ROSS R2S-8802 WHERE APPROPRIATE

2) Quad Channel solution

a) Ross Video QRA-8808-R2H

b. Cobalt meeting these performance requirements.

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3. Other Vendors with Acceptable Solutions

    a. Evertz
    b. Imagine Communications

D. Type 1 Up/Down/Cross-Convertor (UDC_1):

1. Mounts in selected distribution gear card frame
2. SDI Video Input
3. SDI Video Output
4. Converts between SD, HD and 3G Formats
5. Acceptable Product

    a. AJA OG-UDC
    b. Blackmagic Design CONVOPENGUDC
    c. Other Vendors with acceptable solutions

        1) Evertz
        2) Imagine Communications

E. Type 1 Analog Video Distribution Amplifier (VDA_1):

1. Mounts in selected Distribution Gear Card Frame.
2. Acceptable product:

    a. Cobalt 9910DA-AV with

        1) Cobalt RM20-9910-AV-B

    b. Ross Video UDA-8705A-R2

3. Other Vendors with Acceptable Solutions

    a. Evertz
    b. Imagine Communications

F. Type 1 SDI to Audio Disembedder ($DEBED_1$)

1. Mounts in selected Distribution Gear Card Frame
2. Stereo Analog audio disembedding
3. 3G-HDSDI Input

    a. AJA 3G-AMA
    b. Ross Video DMX-8259-4C-R2C
    c. Other Vendors with acceptable solutions

        1) Cobalt
        2) Evertz
        3) Imagine Communications

G. Type 1 Audio to SDI Embedder (EMBED1)

1. Mounts in selected Distribution Gear Card Frame

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2. Stereo analog audio embedding
3. 3G-HDSDI Input
4. 3G-HDSDI Output
5. Acceptable Product

    a. AJA 3G-AMA
    b. Ross Video MUX-8258-4C-R2C
    c. Other Vendors with acceptable solutions

        1) Cobalt
        2) Evertz
        3) Imagine Communications

H. Type 1 Analog Audio Distribution Amplifier (ADA_1)

1. Mounts in selected Distribution Gear Card Frame
2. Stereo Analog audio Distribution Amplifier
3. 2x4
4. Acceptable Product

    a. Cobalt 9241 with

        1) Cobalt RM20-9241-B

    b. Ross Video ADA-8405-C-R2C

5. Other Vendors with Acceptable Solutions

    a. Evertz
    b. Imagine Communications

I. Type 1 Scan Converter ($SCALER_1$):

1. Mounts in selected Distribution Gear Card Frame
2. HDMI Input
3. 3G SDI Output
4. Acceptable Product:

    a. Apantac OG-US-4000-SET-1
    b. AJA OG-ROI-HDMI

5. Other Vendors with Acceptable Solutions

    a. Evertz
    b. Imagine Communications

J. Type 2 Scan Converter ($SCALER_2$):

1. Mounts in selected Distribution Gear Card Frame
2. DVI Input
3. 3G SDI Output
4. Acceptable Product:

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a. Apantac OG-US-3500-SET-1
b. AJA OG-ROI-DVI

5. Other Vendors with Acceptable Solutions

a. Evertz
b. Imagine Communications

K. Type 1 HDMI converter ($HDMI_1$)

1. Acceptable products:

a. AJA Hi5-PLUS with appropriate power supply
b. Black Box VSC-SDI-HDMI
c. Decimator DD-HX

2. Quantity: As required plus two (2)

L. Type 1 SDI to NDI Converter ($NDI\ TX_1$)

1. (4) 3G HDSDI Input
2. (4) NDI Stream Output
3. Acceptable Product

a. BirdDog BD4KQUAD with

1) Middle Atlantic U1V

b. NewTek Spark Plus FG-002903-R001 with

1) Middle Atlantic U1V

a) Note: This is a single channel solution

M. Type 1 NDI to SDI Converter ($NDI\ RX_1$)

1. (4) 3G HDSDI Output
2. (4) NDI Stream Input
3. Acceptable Product

a. BirdDog BD4KQUAD with

1) Middle Atlantic U1V

b. NewTek FG-002903-R001 with

1) Middle Atlantic U1V

a) Note: This is a single channel solution

N. Closed Caption Encoder and Decoder (CCE_1).

1. EEG Solution

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a. EEG HD1492. (Quantity: 1; single path units)
b. EEG DE1285. (Quantity: 1; single path units) with

2) EEG-CCD-49 IP output license

2. Evertz Solution

a. Evertz 7825CCE-AUD-3G+3RU. (Quantity: 1, single path units)

11. AUDIO, MIXER, TIMECODE

A. Type 1 Audio Mixer ($MIXER_1$)

1. Allen & Heath SQ-6 with

a. Allen & Heath SQ Dante Card

2. Yamaha TF-5 with

a. NY64-D

3. As Approved

F. Type 1 Dante Interface (DANTE1)

1. Simultaneous 64x64 I/O
2. Coaxial and Optical MADI Inputs
3. Dual Ethernet Connectivity
4. Acceptable Product

a. AuviTran AVBx3 with

1) AuviTran AxC-Dante
2) AuviTran AxC-MADI/SFP

b. Ferrofish Verto MX
c. Focusrite Pro RedNet D64R
d. Joseph Electronics Dante XBMD-1

G. Type 2 Dante Interface (DANTE2)

1. Simultaneous 16x16 I/O
2. 16 Line Level Analog inputs
3. 16 Line Level Analog Outputs
4. Dual Ethernet Connectivity
5. Acceptable Product

a. AuviTran AVBx3 with

1) AuviTran AxC-Dante
2) AuviTran AxC-AS16M
3) AuviTran AxC-AX16O

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b. Focusrite Pro RedNet D16R
c. Joseph Electronics Dante PMC-2
d. Studio Tech Model 5412-02

H. Dante Network Bridge (DANTE BRIDGE1)

1. Allows linking of 64 audio channels with variable sample rates
2. Bidirectional
3. Acceptable Product

a. AuviTran AVBx3 with

1) AuviTran AxC-Dante (QTY: 2)

b. Studio Tech Model 5482-02

B. Type 1 Speaker ($SPKR_1$)

1. Acceptable Product:

a. Genelec 8010A with

1) Genelec 8010-410W

b. JBL 305P MKII with

1) Rockville RHSB8

a) Note: Provide (1) for every (2) Type 1 speakers

c. As Approved

C. Type 1 Audio Monitor ($AMON_1$)

1. Monitors up to 8 Embedded Audio Channels
2. (2) SDI Inputs
3. Built in Preview Screen
4. Acceptable Product

a. Wholer AMP1-8

D. Type 2 Audio Monitor ($AMON_2$)

1. Monitors up to 8 Embedded Audio Channels
2. (1) SDI Inputs
3. (1) Stereo Analog Input
4. Built in Preview Screen
5. Acceptable Product

a. Marshall Electronics AR-DM51-B

1.2 TV TALENT SUPPORT EQUIPMENT

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A. TV Talent Booth TX Unit (TALENT TX1)

1. (2) 3G SDI Inputs
2. (2) 3G SDI Outputs
3. (4) 1Gb PoE Ports
4. Optical transmission over (1) single mode fiber
5. Rackmount Kit
6. Power Supply
7. Acceptable Product

a. Multidyne VB Box V10-3867-22-SXX4B-ST with

1) Multidyne RU for VB10

B. TV Talent Booth RX Unit (TALENT RX1)

1. (2) 3G SDI Inputs
2. (2) 3G SDI Outputs
3. (4) 1Gb PoE Ports
4. Optical transmission over (1) single mode fiber
5. Rackmount Kit
6. Power Supply
7. Acceptable Product

a. Multidyne VB Box V10-3867-22-SXX4A-ST with

1) Multidyne RU for VB10

C. Talent Support Interface Box

1. Bidirectional DANTE audio support
2. Digital audio and direct-microphone outputs
3. One main and one talkback output channel
4. 2-channel headphone output
5. Quantity: 3
6. Acceptable Product

a. Studio Tech Model 204

D. Talent Support Monitor

1. 21.5” 1080P HD Resolution
2. HD-SDI Input
3. Quantity: 2
4. Acceptable Product

a. CAME-TV CTV-2105
b. Feelworld LUT215
c. Ikegami ULE-217-HDR
d. Joseph Electronics JE210-HDR

E. Talent Announcer Headset

1. Combined headset & boom microphone

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2. XLR Microphone Connector
3. ¼" TRS Headphone connector
4. Quantity: 4
5. Acceptable Product

    a. Sennheiser HMD 300 XQ-2

F. Talent Support Cable Kit

1. 25' Ethercon

    a. Quantity: 3
    b. Acceptable Product

        1) Clark X-CN423CS6-25-NE86
        2) Joseph Electronics JVD2412-NEBB-25
        3) Pro Co C2701-25F

G. 100' Ethercon

1. Quantity: 3
2. Acceptable Product

    a. Clark X-CN423CS6-100-NE86
    b. Joseph Electronics JVD2412-NEBB-100
    c. Pro Co C2701-100F

H. 25' BNC Cable

1. Quantity: 3
2. Acceptable Product

    a. Clark X-CD7506-BLACK-25
    b. Joseph Electronics JVC1694A(BLACK)KBB-25

I. 100' BNC Cable

1. Quantity: 3
2. Acceptable Product

    a. Clark X-CD7506-BLACK-100
    b. Gepco GVC11-BLACK-100
    c. Joseph Electronics JVC1694A(BLACK)KBB-100

J. 200' Tactical Single Mode Fiberoptic Cabling Reel

1. Quantity: 2
2. Acceptable Product

    a. Clarwire X-CWFBTSM6-200-STST with
    b. Hannay AVF-14

K. Type 1 Mobile Equipment Rack (MRACK1)

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1. 14 Rack Units
2. Caster Base
3. Touring Style Case
4. Acceptable Product

    a. Gator Case G-Tour 14U CAST with

        1) Middle Atlantic Products PD-915R

    b. Odyssey FZS14W with

        1) Middle Atlantic Products PD-915R

12. INTERCOM

A. Intercom Master Station (ICOM MS_1):

1. Performance Specification
2. 4 Independent Channels
3. Visual and audible call signaling
4. Program feeds to both channels
5. Remote Mic Kill
6. Stage Announce
7. Built-in Speaker
8. 10 Switch Source Assignment Panel
9. Acceptable Product

    a. Clearcom SB-704
    b. Other Vendors with Acceptable Solutions

        1) RTS

B. Type 1 Intercom Interface (ICOM IF_1)

1. Converts single channel clear com to 4-wire IO
2. (4) Individual Circuits
3. Built in Test Jack
4. Individual Interface transmit receive and null controls
5. Acceptable Product

    a. Clearcom IF4W4
    b. Other Vendors with Acceptable Solutions

        1) RTS
        2) Studio Technologies

C. Type 1 Intercom Beltpack

1. 2-Wire Single Channel
2. Quantity: 5
3. Acceptable Product

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a. Clearcom RS-701
b. Other Vendors with Acceptable Solutions

1) RTS

D. Type 1 IFB Talent Receiver

1. 2-Wire Single channel
2. Quantity: 4
3. Acceptable Product

a. Clearcom TR-50 with

1) Clearcom TS-1

b. Other Vendors with Acceptable Solutions

1) RTS

E. Intercom Signal Splitter

1. XLR-3 Input
2. (7) XLR-3 Outputs
3. Quantity: As Required
4. Acceptable Product

a. Telex TW-7W - F.01U.118.832

F. Intercom Stations

1. Use same manufacturer as selected for Master Station. Note: coordinate sex of headset connector to correlate with headsets and camera connections:

a. Type 1 ICOM Station ($ICOM_1$)

1) Clearcom RM 702
2) Other Vendors with Acceptable Solutions

a) RTS

b. Type 2 ICOM Station ($ICOM_2$)

1) Clearcom RM 704
2) Other Vendors with Acceptable Solutions

a) RTS

c. Type 2 ICOM Station ($ICOM_3$)

1) Clearcom KB-702GM with

a) Clearcom V-BOX

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2) Other Vendors with Acceptable Solutions

a) RTS

G. Headsets: PROVIDE APPROPRIATE XLR CONNECTOR AT THE END OF EACH UNIT.

1. Lightweight

a. Clearcom CC-28x4
b. Quantity: 8

1) Other Vendors with Acceptable Solutions

a) RTS

2. Single Muff

a. Quantity: 5
b. Acceptable Product

1) Clearcom CC-300-X4
2) Other Vendors with Acceptable Solutions

a) RTS

c. Note: coordinate sex of headset connector to correlate with wireless beltpacks and camera connections

3. Single Muff Camera Headsets

a. Quantity: 4
b. Acceptable Product

1) Clearcom CC-300-XX
2) Other Vendors with Acceptable Solutions

a) RTS

c. Note: coordinate sex of headset connector to correlate with camera connections.

H. Headphone.

1. SONY MDR-7506. (Quantity: 1)

13. MISCELLANEOUS EQUIPMENT REQUIREMENTS

A. Equipment Rack to be frame and panel type constructed of 16-gauge cold-rolled steel. Racks to have locking rear door mounted on the frame (not the rails). Empty mounting panel spaces to be filled with blank or vent panels, in a finish to match rack. Provide end panels and top panels as required. Provide shelving as required for equipment mounting within racks. Provide rack supports as required. Provide seven rack keys of each type. Rack color to be gloss or flat black.

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Include extra set of mounting rails in each rack for rear support of panels or equipment. Verify exact rack space required.

1. Racks to be
    a. Racks
        1) Middle Atlantic BGR-4538 with
            a) Middle Atlantic FWD-BGR-RR45
    b. Rack Tops
        1) Middle Atlantic BGR-552FT-FC. (Quantity: 1 per rack)
    c. Side Panels at ends of racks (Only need where exposed; at walls; leave exposed)
        1) Middle Atlantic
    d. Rack Base
        1) Quantity: 1 Per Rack
        2) Acceptable Product
            a) Middle Atlantic BS
2. Support Equipment
    a. Rear Doors:
        1) Middle Atlantic Split Vented Door
    b. Blank Panels
        1) Middle Atlantic EB Series Flanged Blanks
    c. Vent Panels
    d. Rack screws
        1) Middle Atlantic HS
    e. Power distribution
        1) Middle Atlantic PDT series on both sides of rack; Separate circuit breaker feeds to each side for redundancy.
    f. Rear Rack light
        1) Quantity: 1 Per Rack
        2) Acceptable Product
            a) Middle Atlantic LT-GN-PL

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g. Front Rack Light

1) Quantity: 1 Per Rack
2) Acceptable Product

a) Middle Atlantic LT-CABULT-SINGLE

h. Rack Shelves:

1) Heavy Duty pull out shelf.

a) Middle Atlantic SS

2) General shelf standard

a) Middle Atlantic RSH with escutcheon.

i. Hinged Access Panels as noted on the rack elevations

1) Middle Atlantic AP-X (where is X is 2, 4 or 6)

j. Horizontal Cable Management (for CAT5/6 cable management) as noted on the rack elevations

1) Middle Atlantic HHCM-1
2) Middle Atlantic HHCM-2

k. Additional cable management:

1) Middle Atlantic BR-1/BR-2 Cable Brush Grommet Panels
2) Middle Atlantic LPB

B. Cable tray is to be provided above equipment racks to facilitate interrack cabling. Cable tray is to be ceiling mounted six (6) inches above the rack top.

1. 4in by 12in Basket Tray

a. Acceptable Product

1) Legrand Cablofil
2) Approved Equal

C. Wire Mold is to be provided underneath counters to facilitate cabling to the operation positions throughout the control room. Where possible, wire mold is to run directly to racks in lieu of conduit to under counter locations. Wiremold is to be sized to a 40% fill ratio or larger, based on install cabling.

1. Wiremold

a. Acceptable Product

1) Legrand Wiremold Series
2) Approved Equal

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D. Video Tally connections are to be provided to indicate when a particular source is “on-air”. Connections shall be provided between the video switcher and:

1. Camera control units

E. Patch Panels:

1. Identification strips to be printed labels of different color for each major connector grouping. Use a combination of colored fonts on white background and black fonts on colored backgrounds.
2. Video and AES (unbalanced) patch panel with normal through patch jacks.

a. Acceptable Products

1) Bittree B64H-2MWTHD. (Quantity: As required with 10% excess capacity)
2) Equivalent products from AVP are also acceptable

3. Audio Patch Panels—

a. Non-terminated inputs to be shorted through normalling contacts on rear panel.
b. Provide one punch down tool and one replacement tip.
c. Acceptable product:

1) Bittree B96DC-HNSSH/E3 M2OU7B
2) Equivalent products from AVP and ADC are also acceptable

a) Provide additional panels for termination of existing, external cabling; terminations at patch panels by video production system Contractor.

4. Fiber Optic Patch Panels (SMFO PANEL)

a. Enclosure

1) Corning CCH-02U
2) Quantity: As Required

b. Adapter Plates

1) Corning CCH
2) Quantity: As Required

5. Camera Jack Panel

a. Triax/SMPTE Plug/Jack Panel:

1) Panel is to be a modular system type to provide flexibility between triax and SMPTE connectors.
2) Connectors are to electrically isolated from the panel.

a) SMPTE hybrid connectors: Field = Canare FCS015A-FR, Video Rack = Canare FCS015A-MR

3) Modules are to be nonconductive plastic.

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a) Acceptable product:

(1) Gepco Modular Frame HMPF with HMP-S SMPTE module
(2) Clark Modular Frame MPS-O with MP-S SMPTE module

6. General Purpose Interface contact closures available on the DVE, Still Store, Character Generator, Editor, and any other devices shall be brought to a patch panel (normals out) for wiring purposes.
7. CAT6. (Quantity: As required)

F. Patch Cables:

1. Video Patch Cables. Standard Video Patch Cords; each length in a different color

a. Bittree is basis of Design; Provide compatible products from others:

1) 2' in length

a) Bittree VPCM240X-75 . (Quantity: 8)

2) 3' in length.

a) Bittree VPCM360X-75. (Quantity: 8)

3) 4' in length.

a) Bittree VPCM480X-75. (Quantity: 6)

4) 6' patch to male BNC

a) Bittree VPCM240X-7572. (Quantity: 3)

5) Midsize Plug to BNC Patch Cord

a) Bittree VPBM2400-75 (Quantity: 3)

6) Conversion adapter

a) Bittree ADMW12. (Quantity: 2)

7) Equivalent products from AVP and ADC are also acceptable

2. Audio Patch cables

a. Bittree is basis of design
b. Acceptable Product

1) Bittree BPC2405-110. (Quantity: 15)
2) Equivalent products from AVP and ADC are also acceptable

3. TT to Female XLR Adapter Cable

a. Bittree BPCXF4807-110. (Quantity: 4)

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4. TT To Male XLR Adapter Cable

    a. Bittree BPCXM4804-110. (Quantity: 4)

5. Patch Cord Holder OPTIONS:

    a. Pomona 4408. (Quantity: 1), or
    b. Trompeter CH50. (Quantity: 1), or

6. Impact Insertion Tool With spare Tip

    a. Bittree PT1LA (Quantity: 1)

G. Camera, Video and Audio Cables:

1. Camera (SMPTE)

    a. Length: 10 foot--to be used for CCU patch.

        1) Acceptable Product

            a) Gepco GHF92A-0-10-PS.
            b) Clark X-HFCTP-10-MF
            c) Joseph Electronics JSCBLDN(BLUE)PUWFUW-10
            d) MultiDyne MC-SH0010-SIPSIR-MDC

        2) Quantity: 6

    b. Length: 50 foot.

        1) Acceptable Product

            a) Gepco GHF92A-0-50-PS.
            b) Clark X-HFCTP-50-F
            c) Joseph Electronics JSCBLDN(BLUE)PUWFUW-50
            d) MultiDyne MC-SH0050-SIPSIR-MDC

        2) Quantity: 4

    c. Length: 100 foot.

        1) Acceptable Product

            a) Gepco GHF92A-0-100-PS
            b) Clark X-HFCTP-100-MF
            c) Joseph Electronics JSCBLDN(BLUE)PUWFUW-100
            d) MultiDyne MC-SH0100-SIPSIR-MDC

        2) Quantity: 2

2. Video Cables:

    a. Assembly:

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1) Clark X-CD7506-BLUE-##
2) Gepco GVC11-BLUE-##
3) Joseph Electronics JVC1694A(BLUE)KBB-##

b. Quantity: and Lengths:

1) 10 feet (Quantity: 5)
2) 25 feet (Quantity: 5)
3) 50 feet (Quantity: 2)
4) 100 feet (Quantity: 4)

3. Audio Cables:

a. Assembly:

1) Clark
2) Gepco GMC-5-BLUE-xx-MF-NBG
3) Joseph Electronics JAC1192A(BLUE)XMBXFB-##

b. Quantity: and Lengths:

1) 10 feet (Quantity: 5)
2) 25 feet (Quantity: 10)
3) 50 feet (Quantity: 2)
4) 100 feet (Quantity: 4)

H. For all devices with detachable power cord, provide a “shortened” cable to connect directly to power strip without “bundling”; this power cable is preferred in a color other than black. Provide Owner 15 of the original length power cables.

I. ST Cleaning Tool:

1. Acceptable product to include the following:

a. One click cleaner:

1) Clark FOC-CK-OC (Qty 2)

b. Two Swab Pak (one wet, one dry):

1) Clark FOC-CS (Qty. 5)

c. SMPTE Cable Cleaner

1) LEMO WST.KI.125.34

d. Universal cleaning sticks:

1) Clark FOC-CK-CSP (Qty 1)

J. Cable, connectors and miscellaneous hardware

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1. Video (under 100') and AES-U Cable. Precision video cable, PVC jacketed. Solid center conductor. Color: cable to be ordered in 6 colors (other than black) for each separate cabling system:

    a. Gepco VDM-230
    b. Clark CD7559F
    c. Belden 1855

2. INTRA- ROOM Video. Precision video cable, PVC jacketed. Solid center conductor. Color: cable to be ordered in 6 colors (other than black) for each separate cabling system:

    a. Gepco VSD-2001
    b. Clark CD7559F
    c. Belden 1694A

3. CABLE FOR ANY RUNS OUTSIDE OF MAIN EQUIPMENT ROOM. Precision video cable, PVC jacketed. Solid center conductor. Color: cable to be ordered in 6 colors (other than black) for each separate cabling system.

    a. Gepco VHD7000
    b. Clark CD7511DBR
    c. Belden 7855A

4. AES Audio Cable

    a. Belden 1800B
    b. Clark 801

5. Analog Audio Cable

    a. Belden 9451
    b. Clark SPA22GS

6. Antenna Cabling

    a. Belden 7733A
    b. Clark RF50LL

7. Category Cabling

    a. Riser

        1) Belden 2412
        2) Clark CN423C6

    b. Plenum

        1) Belden 2413
        2) Clark CN423C6P

8. Display Port Cable

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a. Extron DisplayPort Ultra

9. DVI Cable

a. Extron DVID SL Ultra

10. HDMI Cable

a. Extron HDMI Ultra

11. HDMI to Display Port Cable

a. Legrand Cables to Go 54326

12. Intercom Cabling

a. For use with 2-wire intercom systems
b. Permanent Short Runs Under 500’

1) Acceptable Product

a) Belden 8762

c. Permanent Long Runs Greater than 500’

1) Acceptable Product

a) Belden 8760

d. For Portable Cables

1) Acceptable Product

a) Belden 8412

e. Other Vendors with Acceptable Solutions

1) Clark Wire
2) Gepco

13. USB Cables

a. Legrand Cables to Go USB Series
b. Triplite U0 Series

K. Connectors

1. XLR type connectors shall incorporate metal shells and bodies and employ a non-hydroscopic dielectric. Panel connectors to be removable from panel front for solder and repair work. Male and Female panel connectors to fit in the same cutout.

a. XLR connectors: Neutrik.

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2. F Connector:

    a. Provide commercial style gold plated connector with integral sleeve for F6 Series, F11 Series, and F59 Headend cable.
    b. Provide seal ring in all moisture intensive environments.
    c. Install with manufacturer recommended compression tool.
    d. Provide weatherized boots and seal covers for all antenna connections.
    e. Verify connector cable type, size and construction with manufacturer.
    f. Acceptable product:

        1) Gilbert Engineering GF-US-6Q series, GF-US-11Q, and GF-US-59Q series respectively.
        2) Gilbert Engineering Seal ring: G-SR-1/2.

3. BNC Bulkhead Connections to utilize gold plated center contacts, insulated from panel feed-through connection:

    a. Kings

4. BNC cable connections to utilize gold plated center contact, dual crimp connections:

    a. Kings

L. Uninterrupted Power Supplies

1. Rack Mount UPS Systems (Quantity: 4)

    a. Hardware Performance Requirements

        1) 1500 VA minimum
        2) Rack mountable
        3) Removable batteries
        4) Support for load expansion
        5) Support for remote monitoring

    b. Vendors with acceptable solutions:

        1) APC
        2) Liebert
        3) Middle Atlantic Products
        4) Vertiv

14. MILLWORK

A. Furniture Console:

1. Console shall be constructed to house audio, video, control and other equipment as shown on drawings. Console shall be constructed by expert craftsman in a fully qualified cabinet shop regularly in business for technical millwork furniture.
2. The term “console” includes actual consoles housing equipment for work while seated; console desks housing little or no equipment; and other millwork or furniture housing monitors, timing or cueing devices, etc.

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3. All shelves, counters and edges to be designed to support 250 pound point load at edge of counter in addition to equipment mounted in or on shelf.
4. Equipment rack frames with drilled and tapped mounting holes shall be included as shown on drawings (reference EIA standards). Unused rack space shall be filled with black blank panels, brushed anodized aluminum.
5. AC power distribution and other requirements shall be as in Part 3; for routing between sections of cabinet, metal conduit and/or wireway shall be used for shielding and protection of circuits or as required by applicable codes. Power distribution must be hardwired into the millwork; pre-fabricated whips and related may not comply with regional expectations.
6. Cabling access is required at each and every counter location. Preferred cabling system is a slot or reveal in the millwork that allows user a great deal of flexibility in locating cabling. Where slot exists in a flat millwork piece, then slot should be equipped with a brush cover or other suitable filler material that allows cables to be easily connected and dressed through openings (e.g. www.mockett.com; brush wire manager series).

    a. Circular grommets are not allowed
    b. A slot or cable reveal at the intersection of counter with vertical "rack" elements is preferred wherever possible.

7. Certain equipment shall be mounted into the millwork (e.g. console mount intercom stations, camera control shading joysticks, etc.); do not cut into millwork, until on site and user can evaluate operating configuration.
8. Seismic bracing and bases for millwork as required.
9. Field verify all site conditions prior to final shop drawing submittal to Owner’s Representative.
10. Steel Components

    a. Steel components shall be 11g. or 3/16” cold rolled (type B), laser cut, de-burred and press break formed for strength and accuracy. Powder coating finish is polyester/epoxy oven baked with Airstatic process.

11. Aluminum Extrusion

    a. Aluminum extrusion to be 6061 with clear anodizing. Slot for attachment of standard, custom and client supplied components. Steel components to be factory placed for speed of on-site assemble and accuracy.

12. Wood Components

    a. Wood components to meet AWI Premium Grade Standards, construction to include solid woods, multiply plywood sheet, medium density fiber board and high density/high quality particle board. All components to be permanently plant assembled with screws, glue and staples. Black Melamine surfaces to cover equipment bay interiors and there are no exposed raw wood surfaces.

13. Millwork Locations to be Provided:

    a. Freestanding millwork

        1) Rear monitor Track;
        2) Turret, shelf, or recessed monitor configuration on an individual bay basis
        3) Front and rear access lower equipment bays
        4) Fully articulating monitor support arms

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5) Integral cable management
6) Locations

a) Control C208D

(1) TD Counter

7) Basis of Design:

a) Forecast Masterail
b) Forecast FC-AA0313 Articulating Monitor Arm mounts

8) Other Acceptable Suppliers:

a) Beck.tv
b) Laguna Designs
c) Lund Halsey
d) Middle Atlantic Products
e) Time Base Consoles

15. UTILITY COMPUTERS

A. Type 1 Computer ($COMP_1$)

1. Acceptable Product

a. BSI RMS1107 with

1) Intel i5-10400
2) ASRock Z590
3) 8GB DDR4 RAM
4) 1TB SATA SSD
5) Microsoft Windows 10 Pro
6) 24” Sliding Rails
300W Power Supply
7) TPM Module

b. Superlogics SL-1U-H81SLV-GC with

1) Intel i5-4570S
2) 8GB DDR3 1600 RAM
3) 1TB SSD
4) Microsoft Windows 10 Pro
5) 26” Adjustable Slide Rails

16. NETWORK SWITCH

A. Type 1 Network Switch ($SWITCH_1$)

1. Coordinate network switch with owner for converged network uplink
2. (48) 1Gb/S Ports

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3. (2) 10Gb/S SFP+ Ports
4. Layer 3 Networking
5. Managed
6. POE+
7. Acceptable Product

    a. Cisco Catalyst 9300
    b. Netgear GSM4352PA
    c. Ubiquity USW-Pro-48-POE

8. Other Vendors with Acceptable Solutions

    a. HP
    b. Juniper

17. KEYBOARD, VIDEO, MOUSE EXTENDERS

A. Type 1 Computer Interface (EXT_1) & Type 1 Computer Receiver (EXR_1)

1. Single Head Display Port or HDMI
2. USB 2.0
3. Acceptable Product

    a. Adder XD641P-DP-US
    b. Blackbox KVXLCH-100

B. Type 2 Computer Interface (EXT_2) & Type 2 Computer Receiver (EXR_2)

1. Dual Head Display Port or HDMI
2. USB 2.0
3. Acceptable Product

    a. Adder XD642P-DP-US
    b. Blackbox KVXLCHDP-200

C. Type 1 USB 2.0 Extension (USB TX_1) (USB RX_1)

1. Extends USB2.0 USB over Category Cable
2. 328’ Max Cable Distance
3. Acceptable Product

    a. Blackbox IC408A-R2
    b. Crestron USB-EXT-2 KIT
    c. Extron USB Extender Plus T (60-1471-12) with

        1) Extron USB Extender Plus R (60-1471-13)

D. Type 1 Mouse ($MOUSE_1$)

1. Acceptable Products:

    a. Microsoft P58-00061

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b. As Approved

2. Quantity: As Required plus 1

E. Type 2 Mouse ($MOUSE_2$)

1. Acceptable product

a. Logitech G502

F. Type 1 Keyboard ($KEYBOARD_1$)

1. Acceptable Products

a. Microsoft ANB-00001
b. As Approved

2. Quantity: As Required plus 1

G. Type 2 Keyboard ($KEYBOARD_2$)

1. Mini keyboard & trackpad combo
2. Acceptable Product

a. E-SDS KB1011

H. Type 3 Keyboard ($KEYBOARD_3$)

1. Rack Mount sliding Keyboard
2. Acceptable Products

a. Middle Atlantic RM-KB

I. Type 4 Keyboard ($KEYBOARD_4$)

1. Provide dedicated wired keyboard for graphics station
2. Acceptable Product

a. Logitech G413
c. As Approved

18. BROADCAST CABLING

A. SMPTE Hybrid Cable:

1. Cable to be provided with Appropriate NEC rating.

a. Riser Rated Three Channel HD (SMPTE) Camera Cable:

1) For general use where allowed by code.
2) High-Definition Television (HDTV) hybrid fiber optic camera cable.
3) Cable to provide copper and fiber connectivity for 3 channel SMPTE lines.

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4) Acceptable Product:

a) Belden 7824R
b) Clark HFC3R
c) OCC CX021HBAB9GR
d) Shattuc SCOP .3FCAMR

b. Plenum Rated Three Channel HD (SMPTE) Camera Cable:

1) For use within plenum spaces or as required by Code.
2) High-Definition Television (HDTV) hybrid fiber optic camera cable.
3) Cable to provide copper and fiber connectivity for 3 channel SMPTE lines.
4) Acceptable Product:

a) Belden 7824P
b) Clark HFC3P
c) OCC CX021HBAB9YP
d) Shattuc: SCOP.3FCAMP

B. Precision SDI Cable:

1. Riser Rated Digital Coax Cable:

a. For general use where allowed by code.
b. Type: RG-6U coax cable.
c. Solid center conductor.
d. Acceptable product:

1) Belden 1694a
2) Clark CD7506DBR

2. Plenum rated Digital Coax Cable for use only within plenum spaces or as required by Code:

a. For use within plenum spaces or as required by Code.
b. Type: RG-6U coax cable.
c. Solid center conductor.
d. Acceptable product:

1) Belden 1695A
2) Clark CD7506P

C. Analog Audio Cables:

1. Neatly dress unused pairs in rear of junction box or rack.

a. Riser Rated Audio Cable 6 pair:

1) For general use where allowed by Code.
2) Provide multi-pair shielded cable. Use six-pair cabling where six pairs is scheduled.
3) Provide two six pairs for DT-12 cabling.
4) Each pair of insulated conductors to be individually jacketed with foil shield with drain wire and two jacketed conductors.
5) Conductors to be 22 AWG stranded tinned copper.

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6) Acceptable product:

a) Belden 1816R
b) Clark 706
c) Shattuc SCA.2206

b. Plenum Rated Audio Cable 6 pair:

1) For use within plenum spaces or as required by Code.
2) Provide multi-pair shielded cable. Use six-pair cabling where six pair is scheduled.
3) Each pair of insulated conductors to be individually jacketed with foil shield with drain wire and two jacketed conductors.
4) Conductors to be 22 AWG stranded tinned copper.
5) Acceptable product:

a) Belden 1816P
b) Clark 706P

c. Riser Rated Audio Cable 4 pair:

1) For general use where allowed by Code.
2) Provide multi-pair shielded cable. Use four-pair cabling where four pairs is scheduled.
3) Each pair of insulated conductors to be individually jacketed with foil shield with drain wire and two jacketed conductors.
4) Conductors to be 22 AWG stranded tinned copper.
5) Acceptable product:

a) Belden 1815R
b) Clark 704
c) Shattuc: SCA.2204

d. Plenum Rated Audio Cable 4 pair:

1) For use within plenum spaces or as required by Code
2) Provide multi-pair shielded cable. Use four-pair cabling where four pair is scheduled.
3) Each pair of insulated conductors to be individually jacketed with foil shield with drain wire and two jacketed conductors.
4) Conductors to be 22 AWG stranded tinned copper.
5) Acceptable product:

a) Belden 1815P
b) Clark 22EPS4P (heat shrink each pair)
c) Shattuc: SCA.2204ISP (heat shrink each pair)

e. Riser Rated Audio Cable 2 pair:

1) For general use where allowed by Code.
2) Provide multi-pair shielded cable. Use two-pair cabling where two pairs is scheduled.
3) Each pair of insulated conductors to be individually jacketed with foil shield with drain wire and two jacketed conductors.

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4) Conductors to be 22 AWG stranded tinned copper.
5) Acceptable product:

a) Belden 1814R
b) Clark RS22G2
c) Shattuc SCA.2202

f. Plenum Rated Audio Cable 2 pair:

1) For use within plenum spaces or as required by Code
2) Provide multi-pair shielded cable. Use two-pair cabling where two pairs is scheduled.
3) Each pair of insulated conductors to be individually jacketed with foil shield with drain wire and two jacketed conductors.
4) Conductors to be 22 AWG stranded tinned copper.
5) Acceptable product:
6) Belden 9451DP
7) Clark RS22G2P
8) Shattuc SCA.2202ISP

g. Analog Audio Cable single pair (Inner Rack Wiring):

1) Provide for inner rack wiring.
2) PVC outer jacket.
3) Conductors to be 22 AWG stranded tinned copper.
4) Acceptable product:

a) Belden 9451
b) Clark SPA22GS
c) Shattuc: SCA.2201

D. Connectors

1. XLR-3M

a. Connector type: XLR.
b. Gender: Male.
c. Style: Panel mount.
d. Acceptable Product

1) Neutrik NC3MDL-B-1

2. XLR-3F

a. Connector type: XLR.
b. Gender: Female.
c. Style: Panel mount.
d. Acceptable Product

1) Neutrik NC3FDL-B-1

3. BNC Bulkhead Connector

a. Connector type: 75-ohm BNC.

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b. Gender: Female.
c. Style: Bulkhead Jack.
d. Acceptable Product

1) Canare BCJ-JRK with IU-7/16 isolation bushing
2) Kings 2029-17-9
3) Neutik NBB75FI
4) Trompeter UBJ-28

4. RF-45 Panel Mount

a. Connector type: 8 conductor RJ series data.
b. Data Rate: CAT 6 compliant, up to 10 GBit/s.
c. Gender: Female.
d. Style: Panel mount.
e. Acceptable Product

1) Neutrik NE8 series

E. Panels

1. Blank Panels:

a. Type: Flanged.
b. Material: 16-gauge aluminum.
c. Finish: Black brushed anodized.
d. Acceptable product:

1) Belden PNL Series
2) Middle Atlantic BL series
3) Clark RP-A Series

2. Coax Panels:

a. Type; Flanged panel
b. Material: Brush anodized aluminum panel, equal to Middle Atlantic BL series.
c. Panel adapter: Kings 2029-17-9
d. Acceptable product:

1) Belden/Gepco Custom
2) Clark Wire and Cable Custom
3) Approved Whirlwind Custom

F. Triax/SMPTE Plug/Jack Panel:

1. Panel is to be a modular system type to provide flexibility between triax and SMPTE connectors.
2. Connectors are to be electrically isolated from the panel via nonconductive plastic modules.
3. Canare Field SMPTE hybrid connectors: Canare FCS015A-FR.
4. Clark Field SMPTE hybrid connectors: Field = Clark X-HFC-FXW-ST-A6-1.5m.
5. Canare Rack Interconnect SMPTE hybrid connectors: FCS015A-MR.
6. Clark Rack Interconnect SMPTE hybrid connectors: Clark X-HFC-EDW-ST-A6-1.5m.
7. Acceptable product:

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a. Studio Panel:

1) Panel to have a 45-degree angle.

a) Clark Modular Frame RP-MPA-I with MP-S SMPTE module. MP-B blank module

b. Rack panel:

1) Clark Modular Frame RP-MPA-O with MP-S SMPTE module. MP-B blank module
2) OCC RC2U (Contact: Charlie Nehls 972 509-1500)

G. SMPTE Hybrid Components:

1. SMPTE Splice Box ($SPLICE_1$):

a. Provide splice box to be securely mounted in the back of JBT box or triax/SMPTE panel.
b. Splice box to provide for fusion splicing and fiber management.
c. Nylon style connector for terminating copper lines.
d. Coordinate below pigtails with splice box or enclosure.
e. Acceptable product:

1) Canare FCE-4
2) Canare FCE-6 (where two triple cables terminate)
3) Clark HFC-SB4
4) OCC RC2U for SMPTE (Contact: Charlie Nehls 972 509-1500)

H. Plug SMPTE Connector and Pigtails:

1. Provide SMPTE socket connector with 1-meter cable to terminate to above splice box.
2. Provide with dust cap tethered to angled panel.
3. Provide isolation plate for electrical isolation if required (depending on configuration).
4. Provide 3 spare pigtails of each type.
5. Acceptable product:

a. Canare FCS015A-MR with dust cap
b. Clark X-HFC-EDW-ST-A6-1.5
c. Lemo MDT (coordinate pigtail connectors with splice box)
d. OCC SMPTE Socket – OCA-LMFR1SCP006-5050 LEMO, (Canare Connector also available) (Contact: Charlie Nehls 972 509-1500)

I. Socket SMPTE Connector and Pigtail:

1. Provide connector with isolation plate and tethered dust cap.
2. Provide quantity of pigtails in accordance with cable schedule.
3. Provide Owner with three spare cables.
4. Acceptable product:

a. Canare FCS015A-FR with IU-FCF-SET and dust cap
b. Clark X-HFC-FXW-ST-A6-1.5
c. Lemo ECU (coordinate pigtail connectors with splice box)

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d. OCC SMPTE Plug - OCA-LFFR1SCPP006-5050 LEMO, (Canare connectors also available) (Contact: Charlie Nehls 972 509-1500)

19. BROADCAST ENCLOSURES

A. Broadcast Connection Enclosure (JBT)

1. Acceptable Product:

a. Bulloch Fabrication (refer to JBT device description on AV00-00)
b. Other vendors with acceptable solutions

1) American Midwest Power
2) Joseph Electronics

20. DEMONSTRATION, TRAINING, AND EVENT ATTENDANCE

A. Manufacturer's trainers or manufacturer's authorized or approved trainers to provide operations and service training on the following major equipment

1. Production Switcher (all levels)

a. Submit resume on trainer on this device for approval.
b. 8 hours onsite in no more than 4 hours per session.
c. Provide an experienced switcher TD to program macros, custom controls, DVE moves, etc. for first events. This will include consultation on: creative content, programming of content, interfacing to file servers, etc.
d. Switcher TD is specifically to be experienced in broadcast production
e. Curriculum:

1) Internal timing adjustments
2) Normal switcher operations
3) Use of aux busses with DVE
4) Programming switcher effects memory
5) Software configuration for:
6) DVE
7) Editor
8) GPIs
9) Automation System
10) Routing Switcher
11) Camera/robotic interfaces,
12) Other interfaced devices

f. Trainer's Daily reports shall be emailed to those being trained, the Owner's representative, the manufacturer's training department, the systems Contractor and the GC/CM as appropriate. The reports should include information required as part of the submittal; as well as detailed information on setup and operational training specific to the project installation. The Daily reports should be cumulative and edited as appropriate during the training duration.

2. Slo Mo / Clips training

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a. 8 hours onsite in no more than 4 hours per session.
b. Training shall be separate from commissioning. Plan on original trainer to be present at first designated sporting event.
c. Trainer's Daily reports shall be emailed to those being trained, the Owner's representative, the manufacturer's training department, the systems Contractor and the GC/CM as appropriate. The reports should include information required as part of the submittal; as well as detailed information on setup and operational training specific to the project installation. The Daily reports should be cumulative and edited as appropriate during the training duration.
d. If manufacturer's training is not available, Contractor is to substitute own forces for training hour requirements.

5. Graphics/Character Generator implementation specialist (20 hours).

a. Submit resume on implementation specialist on this device for approval.
b. Provide an experienced CG Owner to assist in development and implementation of CG templates. This will include consultation on: creative content, programming of content, interfacing to graphic and statistical systems, etc.
c. CG implementation is specifically to be experienced in game entertainment production (not just broadcast production), preferably in a sporting facility with unique aspect ratio displays.
d. CG Owner is specifically to be experienced with database interfacing to Daktronics DakStats, Statvision, Optasport RTD and summary database or other scoring systems (e.g. MLBAM XML; Scorepad, Status Pro, etc.).
e. It is expected that some of this involvement and time will be in advance to actual on site time and work.
f. It is expected that trainer will need to attend one (1) game as well as the day before the opener (which shall not count towards 20 hours of the training above).
g. No more than 8 hours of this time shall be as traditional CG training; the bulk of the time shall be in assistance of building templates, transitions, 3D effects, clip playout and the like.
h. Trainer's Daily reports shall be emailed to those being trained, the Owner's representative, the manufacturer's training department, the systems Contractor and the GC/CM as appropriate. The reports should include information required as part of the submittal; as well as detailed information on setup and operational training specific to the project installation. The Daily reports should be cumulative and edited as appropriate during the training duration.

B. Approach

1. Manufacturer's training should be assumed to take place on the project site, unless agreed to by the Owner.
2. Training should be scheduled to be non-overlapping, unless agreed to by the Owner.
3. Actual training schedule shall be by agreement with Owner. Do not assume that training will occur over 8 hour days. It is more likely that training will be scheduled in 2-4 hour increments; perhaps over a period of weeks (or even months).
4. In the event that a portion of the training time is occupied in troubleshooting the equipment installation, commissioning the equipment, then the training time shall be extended an equal amount of time.
5. The following is a general idea of the training "curriculum":

a. A general familiarization of the architecture of the device.
b. An explanation of how the device interfaces to the rest of the Video Production System (including data connections; timing requirements and the like).

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c. General training on operating the device.
d. Specific training on device operation (e.g. on the CG, entering statistics; how to access data retrieval sources; how to create repeatable formats and layouts).
e. Saving information; backing information up.
f. Basic troubleshooting
g. Specific troubleshooting (this information may be conveyed to personnel other than the device's "Owners").
h. How to upgrade software; precautions taken while doing (e.g. backing-up existing software).

C. Provide not less than 20 hours of "systems operation and maintenance" instruction to Owner designated personnel on the use and operation of the System.

1. A minimum of three separate sessions, by an instructor fully knowledgeable and qualified in system operation. The System Reference Manuals should be complete and on site at the time of this instruction.

D. Event Attendance

1. Video Production System

a. In addition to training and warranty requirements, this Contractor shall provide event support services to facilitate troubleshooting and effect repair of the specified systems during critical events.

1) Be present on event day from at least 4 hours prior to start, until the time released by the Owner.
2) During these events perform such tasks (e.g. assistance with timing, patching, routing, shading, troubleshooting cabling problems, etc.) as requested by user.
3) Event support personnel shall be a project engineer associated with the original system design, configuration and engineering.
4) During warranty, provide these services for 5 events as designated by Owner
5) Schedule 2 days with team before expiration of the system warranty to review systems and equipment operation.

3.EXECUTION

1. GENERAL

A. All equipment and materials shall be new. Take care during installation to prevent scratches, dents, chips, etc.

B. Mount equipment and enclosures plumb and square. Permanently installed equipment to be firmly and safely held in place. Design equipment supports to support loads imposed with a safety factor of at least three. Seismic bracing shall be installed on appropriate equipment where local codes require such installation.

C. Cover edges of cable pass-through holes in chassis, racks, boxes, etc., with rubber grommets or Brady GRNY nylon grommetting.

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2. AC POWER AND GROUNDING

A. Coordinate and make final connection of power and ground wiring to racks. Hard wire power wiring directly to internal AC receptacles to ensure uninterrupted operation.

B. Install 3-conductor, isolated ground outlets in each rack. Provide a minimum of two spare outlets in each rack. Label each outlet as to which AC circuit is feeding it and provide the same information in the circuit breaker panel. Majority off the device powering should be “dual corded” for redundant distribution.

C. Install a copper ground buss bar top to bottom in each rack, insulated from the rack. Ground equipment chassis not having a three wire power cord to these busses using nuts, bolts and lock washers with No. 12 wire. Connect ground wire from each AC outlet in rack to this buss bar. Connect each rack buss bar to main ground wire in local power panel with properly sized insulated cable.

D. For all devices with detachable power cord, provide a “shortened” cable to connect directly to power strip without “bundling”; this power cable is preferred in a color other than black. Provide Owner 15 of the original length power cables.

3. EQUIPMENT RACKS, EQUIPMENT HOUSINGS AND CONSOLES

A. Mount equipment in racks and consoles and fully wire and test before delivery to job site. If field conditions prevent prior assembly of racks, notify Owner’s Representative in writing that racks will be fabricated on site and the reasons for the change.

B. Provide adequate whisper type ventilation.

C. Looking at the rack from the rear, locate AC power wiring on the left; line level audio, video, and RF wiring on the right. Panels or equipment mounted on the rear rack rails shall not block access to any front mounted components.

D. Where power supplies exist on both sides of the rack provide second power strip on the right (excepting patch panel racks).

E. Provide blank panels to fill unused panel space within the equipment rack / housing / Console.

4. SYSTEM WIRING

A. Take precautions to prevent and guard against electromagnetic and electrostatic hum. For line level audio signals, float cable shields at the output of source device. Shields not connected to be folded back over cable jacket and covered with heat-shrink tubing. Do not cut off unused shields.

B. Exercise care in wiring; damaged cables or equipment will not be accepted. Isolate cables of different signals or different levels; and separate, organize, and route to restrict channel crosstalk or feedback oscillation in any amplifier section. Keep wiring separated into groups for microphone level circuits, line level circuits, loudspeaker circuits, and power circuits.

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C. Make joints and connections with rosin-core solder or with mechanical connectors approved by the Architect's Consultant; where spade lugs are used, crimp properly with ratchet type tool. Spade lugs mounted on 22 gauge or smaller cable to be soldered after crimping.

D. Execute wiring in strict adherence to standard professional practice.

E. Neatly lace vertical and horizontal wiring inside rack with lacing bars. Horizontal wiring in rack to be neatly tied in manageable bundles with cable lengths cut to minimize excess cable slack but still allow for service and testing. Provide horizontal support bars if cable bundles sag. Neatly bundle excess AC power cable from rack mounted equipment with velcro cable ties; where short power cables are not available. Rack wiring to be bundled with velcro cable ties or hoop distribution system. Electrical tape and adhesive backed cable tie anchors are not acceptable.

F. Provide adequate service loops so that equipment mounted on rack slides may be pulled fully out, to their locked position without straining cable.

G. All mini-BNC, mini-DIN and RCA/phono connections shall be made directly to the cable in question; whips and adapters are not acceptable.

H. Wiring and connections shall be completely visible and labeled in rack. Termination resistors shall be 1% tolerance; fully visible and not concealed within equipment or connectors.

I. Custom rack panels shall be 1/8" thick aluminum, standard rack sizes, brushed black anodized finish unless otherwise noted. (Brush in direction of aluminum grain only.) Custom connector plate (speaker, microphone, etc.) finishes shall be selected from manufacturer's full range of standard finishes. Plastic plates will not be accepted, even if building standard in other areas.

1. All engraving shall be 1/8" block sans serif characters unless noted otherwise. On dark panels or push buttons, letters shall be white; on stainless steel or brushed natural aluminum plates, or light-colored push buttons, letters shall be black.

J. All patch panels shall be wired so signal "sources" (outputs from devices) appear on the upper row of a row pair; all "loads" (inputs to devices) appear on the lower row of a row pair. All patch panel designation strips shall utilize alphanumeric and descriptive labels. The jack positions in each horizontal row shall be numbered sequentially from left to right. The horizontal jack rows shall be lettered sequentially from top to bottom. The alphanumeric identification of each jack shall be included on the functional block drawings.

K. General Equipment and Cable Labeling:

1. Provide engraved lamicoid labels on the front and rear of active equipment mounted in racks. Mount labels in a neat, plumb and permanent manner. Embossed labels are not acceptable. Equipment labels to have at least three lines of engraving with the first line listing the general name of the device, i.e., COMB GENERATOR, or RF SWITCHER. The second line to include the schematic reference of the device, i.e., COMB GEN, or RF SWITCH. The bottom line to indicate what other devices or areas this equipment controls, i.e., FEEDS SPLITTER or MONITOR/RECEIVER.
2. Provide an engraved label over each user-operated control that describes the function or purpose of the control. Label size to be adjusted to fit available space.
3. Engraved labels to have 1/8" high characters minimum. Labels to be black with white characters except where indicated.
4. Cables and wiring to be logically, legibly and permanently labeled for easy identification. Labels on cables to be adhesive strip type covered with clear heat-shrink tubing. Factory

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stamped heat shrink tubing may be used in lieu of the adhesive strip style label. Hand-written or self-laminating type labels are not acceptable.

5. Wiring designations to be an alpha-numeric code that is unique for each cable. Locate the cable designation at the start and end of each cable run and within 3" of the point of termination or connection. For cable runs that have intermediate splice points, the cable shall have the same designation throughout with an additional suffix to indicate each segment of the run. Cable labels shall identify source and destination codes on each label. Actual cable designation assignments to be determined by Contractor. Add cable designation codes to system schematic drawings included with Project Record Drawings.
6. Label each terminal strip with a unique identification code in addition to a numerical label for each terminal. Show terminal strip codes on system schematic drawings included with Project Record Drawings.
7. Provide adhesive labels on the rear of equipment where cables attach to indicate the designation of the cable connected at that point.
8. Provide labels at both ends of equipment power cables with the general name of the device they are powering listed.
9. Provide adhesive labels on the top and bottom of DC power supplies with the general name of the device they are powering.
10. Provide adhesive labels below each outlet on all power strips indicting which device is being powered.

L. Device labeling shall consist of two types: functional drawing reference and operational naming convention. Device physical labeling shall apply to functional drawings and physical labels on devices, operational naming convention shall allow user to provide flexible labeling between devices and their function (e.g. camera naming/numbering, file server labels).

M. Installation of Cable and Wiring

1. Install cable in a manner to adhere to manufacturer’s specifications for maximum cable pulling tension, minimum bend radius, and rigging calculations and restrictions.
2. Provide appropriate support at all horizontal-to-vertical transitions in order to keep the weight of the cable from degrading at the point of transition.
3. Provide splice free wiring and cabling from origination to destination.
4. Make joints and connections with rosin-core solder or with mechanical connectors approved by the Owner’s Representative; where spade lugs are used, crimp properly with ratchet type tool.
5. Take precaution to prevent and guard against electromagnetic and electrostatic hum. For line-level audio signal, float cable shield at the output of source device. Shield not connected to be folded back over cable jacket and covered with heat-shrink tubing. Do not cut off unused shield.
6. Isolate cables and wires of different signals or different levels; and separate, organize, and route to restrict channel crosstalk or feedback oscillation in any amplifier section in compliance with ASDI article 12.3.
7. Cover edges of cable and wire pass-through holes in chassis, housings, boxes, etc., with rubber grommets or Brady GRNY nylon grommetting.
8. Install cable so that a radius bend of no less than ten times the cables OD is maintained.

N. Housing Cabling and Wiring

1. Provide 1’-6” minimum service loop within junction boxes to enable plates to be removed from the junction box and serviced.
2. Install cable and wire neatly tied in manageable bundles with cable lengths cut to minimize excess cable slack but still allow for service and testing. Provide horizontal support bars if cable bundles sag.

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3. Cables should be dressed to permit individual plates and panels to be removed, without disturbing adjacent plates or panels.
4. Neatly bundle excess AC power cable from housing mounted equipment with plastic cable ties.
5. Provide plastic cable ties or lacing twine to bundle cabling and wiring. Electrical tape and adhesive backed cable tie anchors are not acceptable.
6. Install with connections completely visible and labeled.

5. CONTRACTOR TESTS AND ADJUSTMENTS

A. Verify the following before beginning actual tests and adjustments on the system:

1. All products are installed in proper and safe manner according to manufacturer's instructions.
2. Insulation and shrink tubing are present where required.
3. All Dust, debris, solder splatter, etc. is removed.
4. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
5. All labeling has been provided.
6. Temporary facilities and utilities have been properly disconnected, removed and disposed of off-site.
7. All products are neat, clean and unmarred and parts securely attached.
8. All broken work, including glass, raised flooring and supports, ceiling tiles and supports, walls, doors, etc. have been replaced or properly repaired, and debris cleaned up and discarded.
9. All extra materials, portable equipment and spares shall be delivered and stored at the premises as directed.

B. Prior to energizing the System verify and perform the following tests and adjustments in compliance with applicable EIA standards. Record the results of each test in the Project Record Manual.

1. Electronic devices are properly grounded.
2. Test each AC power receptacle with a circuit checker for proper hot, neutral and ground connections.
3. Powered devices have AC power from the proper circuit.
4. Measure and record the DC resistance between the technical ground in any equipment rack or console and the main building ground. Resistance should be 0.15 ohms or less.

C. Preparation for Acceptance, prior to final inspection:

1. Verify each individual component is operating properly
2. Verify each individual component's performance meets the manufacturer's published performance for this unit.
3. Verify proper operation from controlling devices to controlled devices.
4. Verify proper adjustment, balance and alignment of equipment for optimum quality and to meet the manufacturer's published specifications.
5. Establish and mark normal settings for each level control, and appropriately record these settings within the "System Operation and Maintenance Manual."
6. Verify that all communications and networking services are installed and in proper working condition (Ethernet, IP addressing)
7. Other tests on equipment or systems as deemed appropriate, such as, but not limited to:

   a. Cameras

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1) Verify Camera power on
2) Verify all indicators on Camera reflect no short circuit or open circuit conditions
3) Verify Pan-Tilt arms function smoothly
4) Verify Focus control is connected and working
5) Verify Zoom control is connected and working
6) Verify Camera Head is balanced in front, back and center
7) Verify Intercom headset is working
8) Verify Return Video is functional
9) Verify the Video mode is set proper mode (HD/SD)
10) Verify Aspect Ratio is set to proper mode (16:9/4:3)

b. Camera Base Stations:

1) Verify all SMPTE connectors from base stations to cameras fit snugly into each other and are secure.
2) Verify that there is no interruption in SMPTE cable by checking communication link indicator between camera and base station is OK.
3) Verify On-Air/Tally and ISO indicators function as per manufacturer's specifications.
4) Verify cable lengths do not exceed standard maximum recommended lengths for respective cable.

c. CCUs/OCPs

1) Verify relevant cameras are assigned and connected to respective CCU/OCP.
2) Verify assigned IP addresses and subnet mask are configured correctly
3) Verify iris control sensitivity, mode, range and center is setup and joystick is calibrated
4) Verify shading control is turned on
5) Verify White Balance is set and parameters stored.
6) Verify control of camera iris

d. Video Production Switcher

1) Verify assigned IP address and subnet mask is configured correctly
2) Verify all sources are defined, labeled and routed accurately
3) Verify all output assignments are accurate and labeled (program vs. preview)
4) Verify all external devices (DDRs, VTRs, etc) are routed accurately
5) Verify source to button mapping and labeling is to end user preferences

e. Monitors

1) Verify all camera preview cameras have picture from assigned cameras and are labeled as such
2) Verify program and preview monitors have the correct picture routed to them from production switcher
3) Verify DDRs, VTRs monitors have picture
4) Verify aspect ratio is set to 16:9 for native HD signal
5) Verify monitors are calibrated and color matched

f. Cable Testing

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1) Cable testing is used to verify that the cable meets the manufacturer's specifications after installation and termination of the cable.
2) The cable testing data provides a reference for troubleshooting future problems with the cable plant.
3) SMPTE Hybrid Cable

    a) Provide a Method of Procedure (MOP) for testing:

        (1) Provide information of the test equipment (manufacture and model #) used for tests. Date of last calibration if applicable.
        (2) Provide a detail description of the test performed for each cable system. Provide functional diagram (if it provides information that is difficult to describe) of test setup with description of test cables used (including lengths if applicable for TDR and OTDR tests). THE MOP should be available to field personnel to perform testing. The MOP to be used to verify test setup and testing during check out.
        (3) Refer to Close Out Documentation in Part 1 of this specification for close out documentation.

    b) Fiber Testing

        (1) Perform visual optic inspection to verify connectors are properly polished and free of defects such as direct, scratches and polishing defects before performing data measurements.
        (2) SMPTE cable to be tested at the splice box before pigtails are installed to verify cable and terminations at the splice box is correct. Provide final testing with splice boxes and pigtails installed. Include all 3 channels for triple SMPTE cable, even if they are not initially terminated with pigtails.
        (3) Perform bi-directional field testing of each terminated strand of fiber optic cable listed in this Section for length, loss and polarity. Field testing equipment must include both an optical loss test set (OLTS) and optical time domain reflectometer (OTDR). Testing measurements are required to meet transmission performances listed in ANSI/TIA-568.3-D/4.2/Table 1 at both 850 nm and 1300 nm for multimode fiber, and both 1310 nm and 1550 nm for single-mode fiber. The shortest pulse width should be used to provide maximum resolution for OTDR tests.
        (4) Submit cable certification reports of the following field-testing measurement methods:

            (a) Attenuation
            (b) Length
            (c) Polarity
            (d) OTDR traces

        (5) Cable certification reports must bear the location/room number and cable identifier for each cable tested. Test results/reports in electronic copies by closet must be delivered to the Project Manager according to the submittal procedures.

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(6) Deliver an electronic file containing all individual test records and the software required to display and print the test records using a typical personal computer (PC).

(a) Deliver test results in raw data and in PDF format on a memory stick or DVD.

4) Copper Cable Tests:

a) Provide a Method of Procedure (MOP) for testing:

(1) Provide information of the test equipment (manufacture and model #) used for tests. Date of last calibration if applicable.
(2) Provide a detail description of the test performed for each cable system. Provide functional diagram (if it provides information that is difficult to describe) of test setup with description of test cables used (including lengths if applicable for TDR and OTDR tests). THE MOP should be available to field personnel to perform testing. The MOP to be used to verify test setup and testing during check out.
(3) Refer to Close Out Documentation in Part 1 of this specification for close out documentation.
(4) Hi-Pot testing

(a) Riser rated cable – 2500-volt DC
(b) Plenum rated cable – 1600-volt DC

5) Video Coax

a) Low Power Tests: Utilize a Gepco TT-22 with Triax to BNC adapters or equal for test units. Document any issues and action to correct as part of the final report.
b) High Power Test: After low power test, perform a high voltage wiring and cabling test with a megohmeter (Megger®) to test for the following:

(1) Center conductor to shield isolation: Test using appropriate DC voltage for a period of not more than 2 seconds and look for high capacitance in the cable. Set the sensitivity for over-current to 50% setting.
(2) Plenum cable requires a lower voltage.

c) TDR tests:

(1) Perform Time Domain Reflectometer (TDR) tests on coax cable to test for cable irregularities and length.
(2) Perform TDR test on the inner conductor and shield. Provide test data in graph form as part of the as built documentation provided to owner.

d) Or Return Loss (RL) Tests:

(1) Provide a dual port network analyzer with VSWR bridge and impedance matching transformers.

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(2) Sweep cables from 5MHz to 270MHz.
(3) Repair cables that do not meet manufacturer's Return Loss (RL). Typical return loss readings for RG-6 digital coax.
(4) Return Loss for frequencies from 5MHz to 270MHz to be a Minimum of 21dB.

(a) Provide test data in graph form as part of the as built documentation provided to owner. Provide manufacture's stated Return Loss as part of the documentation.

e) Sweep Tests:

(1) Sweep using a spectrum analyzer with an internal generator. Provide a coax jumper cable to loop test signal from tracking generator back to analyzer.
(2) Sweep cables up to a minimum of 270MHz. Record the coax loss at 100MHz, 270MHz and 500MHz.

6) Audio Cables

a) Test XLR's where they are hard split.
b) Test conductors and shield for shorts to building ground.
c) Test for shorts between conductors and shield.
d) Test that cable is wired to industry standard pin 2 high, pin 3 low and pin 1 screen (shield).

7) Test Results

a) Provide an Excel spreadsheet with the following tables
b) Cable # (should be final as built cable #).
c) From Location
d) From Location panel # port #
e) To Location
f) To Location panel # and port #
g) Cable manufacture and model #.
h) Notes: Record any issues and fixes during the testing.
i) Cable length from TDR:
j) HI-POT test between center pin and inner shield
k) HI-POT notes from any issues and remedy to fix issue.
l) TDR reference test number for TDR data file.
m) Submit graphs of TDR tests for review by the consultant.
n) Note any cable failures and the fixes to bring cable into spec

D. Commissioning. Commissioning shall be performed by a combination of the Contractor, the manufacturer or a separate commissioning agent retained by the Contractor. The following identifies some, but not all, of the commissioning tasks expected of the commissioning team. This list is not intended to be comprehensive and should be considered a general guideline for the Contractor without a defined commissioning process statement.

1. Cameras and tripods.

a. Setup camera in accordance with Manufacturer's procedure
b. Balance camera and lens on tripod

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c. Confirm presence and proper operation of:

1) Lens controllers
2) Tripod feet, spreaders
3) All cases and carts
4) Rain slicker(s), if any
5) Viewfinders and attachments
6) Batteries and battery chargers
7) Specified microphones
8) Specified wireless hardware
9) Specified camera lighting

d. Set lens back-focus
e. Exercise full zoom/focus control on lens
f. Confirm Remote control panel properly interacts with camera
g. Confirm tallies function as expected at each CCU and Camera. Provide/plan on green and red tally.
h. Confirm Intercom connections are balanced and functional; including CCU front panel connections
i. Confirm program audio connections are properly functioning
j. Confirm return video functions as appropriate

2. Time Code

a. Confirm time code is set to appropriate clock and offset for team/league requirements
b. Confirm time code is distributed to all devices with time code inputs (including file servers, tape machines, multi-viewers, etc.)
c. Confirm time code records properly at all devices
d. Confirm time code does not cross talk into audio or video circuits

3. Computers, Networking, IP and Data

a. Coordinate IP address for any equipment supplied herein.

1) Program Gateways
2) Program subnets
3) Coordinate subnets and V-lans with other systems including, but not limited to AV, scoring and video displays, and league statistics.

b. Coordinate firewall and routing configuration if needed between production studio system and house system
c. Set all clocks, software and hardware, to listen to local or network NTP server.
d. If appropriate create auto-logon scripts
e. Establish logical share names, including, but not limited to, AV, scoring and video displays, and league statistics.
f. Set startup process to include logging into appropriate services and servers (e.g. establish SQL connection between Character Generator and data service)
g. Establish a defined back up process and train user
h. Install all relevant software including, but not limited to:

1) Clients preference for browser(s)
2) Word processing, spreadsheet, presentation and general office software
3) Adobe Acrobat

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4) Software used to control, monitor and troubleshoot any hardware provided herein
5) Creative/Graphic suites as appropriate

i. Ghost all boot and configuration hard drives after setup and acceptance, but before the users begin training.
j. Ghost all boot and configuration hard drives 1 month after acceptance.
k. Connect all data interlinked devices (e.g. CGs, protocol translators, robotic cameras, etc) with their sources using appropriate control routing switcher, patches, distribution devices and the like, Confirm

1) Baud rate, programming speed
2) Desired operations are functional and reliable
3) Interconnection with other systems including, but not limited to, AV, scoring and video displays, and league statistics.

l. Rack and UPS sensors (SENSOR).

1) Setup all rack and room temperature, humidity and moisture sensors with appropriate alarming, notification, and SNMP alarms. .
2) Setup all UPS alarms with appropriate alarming, notification, and SNMP alarms

4. KVM Systems

a. Label all source and destinations with meaningful labels (e.g. COMP 15-01 is not acceptable; C15-01; Riedel Director is).
b. Coordinate labeling to include the registered device name, MAC address and IP Address.
c. Determine the extent that certain users should be locked out (e.g. not all users should have access to CG keyboard).

5. Intercom

a. Setup each station with labels as coordinated with the Owner.
b. Test each user station to every other station.
c. Stress test the system under event standards so that users are located at each station and attempt to communicate as they would for the event.
d. Setup all wireless communication so that talk/listen is available throughout the covered area. Test with high ambient noise conditions.
e. Balance all users, user station, and intercom sources.
f. Null all party line circuits
g. Test Audio Monitoring Paths using the intercom system; verify appropriate gain structure, adjust as required.

6. Audio Phase and Stereo imaging.

a. Check audio phase from each device to each destination, through routing switcher and direct patch. Correct any anomalies.
b. Check Left/Right pairing from each device to each destination, through routing switcher and direct patch. Correct any anomalies.
c. Set audio levels through each device to each destination, through routing switcher and direct patch for unity gain. Adjust interfacing devices to accommodate level differences that occur. Correct any anomalies.

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d. Use appropriate test tapes and signals and tones to verify playback level of file servers, tape machines and any device with audio playback capability.

7. SMATV, IPTV, Broadcast cabling and Sound System interconnections.

   a. Check audio phase from each device to each destination, through routing switcher and direct patch. Correct any anomalies.
   b. Check Left/Right pairing from each device to each destination, through routing switcher and direct patch. Correct any anomalies.
   c. Set audio levels through each device to each destination, through routing switcher and direct patch for unity gain. Adjust interfacing devices to accommodate level differences that occur. Correct any anomalies.

8. Coordinate proper naming and labeling between video and audio sources and destinations that originate elsewhere including, but not limited to Sound, Broadcast, MATV, IPTV, Video Display and LED Scoring devices which may be related work. This shall include but not be limited to: common device labels and nomenclature at each end, rack numbering, all routing interfaces.

   a. After cables are landed and coordinate verify proper connection with each supplier.
   b. Confirm that physical labels correspond to drawing labels and most importantly any alphanumeric control system labels (e.g. Tuner 1 should also be called SAT RX 5 and DIRECTV 7)

9. Production and Routing switcher configurations to Owner/Owner preferences this shall include, but not be limited to:

   a. All equipment settings
   b. Configurations
   c. Software setup
   d. All hardware, button, and software labeling on devices into groups as requested by Owner/Owner.
   e. Routing switcher programming including real and virtual naming configurations, salvo setup and programming and the like.
   f. Audio Routing

      1) Provide appropriate virtual labels for audio sources; building mono, left right pairs as directed by the Owner for recording multiple audio sources and/or routing to external locations.
      2) Set gain between exterior ties and the routing system
      3) Verify gain of feeds to and from the PA system, adjust as necessary
      4) Configure MADI routing paths to exterior devices, if MADI interface is present.
      5) Assist user in setting up routing to VCRs and File servers for appropriate game and non-game audio configurations.

   g. Proper Alphanumeric transfer of sources to destinations including under-monitor tally designations, tally and between production and routing switchers. This shall include, but not be limited to:

      1) Multi-viewers
      2) In-monitor tally/under monitor displays whether connected via router or direct to auxiliary bus

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h. Salvos

1) Establish pre-game and game salvos for all video and audio sources and destinations.
2) Modify salvos after all event attendance.
3) Archive each salvo.

i. Interfaces to other devices for proper operation (e.g. machine and file server control from the production switcher, through a control routing layer, to the end devices).
j. Tally programming
k. GPI and/or switcher peripheral setup and control of:

1) Character Generator(s)
2) File server(s)
3) Video Display Processors (which are likely supplied by others)
4) Routing Switcher
5) Audio playback devices
6) Audio Mixers
7) Cameras and robotics

l. Setup and configure all protocol converters that may be used between devices including but not limited to:

1) Different switching systems
2) Scoring and Video Display systems controllers

10. Video Routing and Multi-image viewing

a. Using a SMPTE pathological pattern test each check video path from each device to each destination, through routing switcher and direct patch. Correct any anomalies.
b. With user, determine initial multi-image viewer configuration and layout.
c. Assign both functional drawing reference and operational naming convention.
d. Video board processors
e. Setup of video processing returns

11. Distribution Gear and Signal Processing. Setup all software remote interface and operation software including but not limited to:

a. Device labeling corresponding to drawings as well as functional use
b. Signal path processing and/or interconnection paths as allowable
c. Set alarm and notifications screens as allowed.

12. Closed Captioning

a. Setup video and audio routing into and out of the device.
b. Coordinate connection of the captioning steno machine to the encoder
c. Set priority on encoder based upon user preference (e.g. local steno override or is ignored).
d. Coordinate addressing inputs/outputs from the decoder to scoring and video display.
e. Setup intercom station to receive a headset only on the 2nd output of the intercom station

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f. Setup listening mix

13. Record all software settings and creating appropriate back up records (paper and electronic as appropriate).
14. Confirm all equipment, loose or fixed, is on site. Provide written list and confirmation of such. Note that this list may be the same as the serial number list required for closeout submittals.
15. SMFO Cables

    a. List each fiber strand separately with description and cable number. Include the measured length of the cable using OTDR and power attenuation.

6. TEST EQUIPMENT

A. Provide the following equipment on site for final acceptance testing. Test equipment to be available for the entire period through final system acceptance. Prior to start of testing, provide a list to the Owner's Representative of test equipment make and model numbers that will be used.

1. Dual-trace oscilloscope: 100 MHz bandwidth, 1 mV/cm sensitivity, TV trigger.
2. Multimeter: Measurement range, DC to 20,000 Hz, 100 mV to 300 V, 10 ma to 10A.
3. Television signal generator: Tektronix
4. 75 ohm, 1 percent terminators, connection adapters, test cabling, etc., as required.
5. Fiber Optic Cable Test Kit: Optical Wavelength Laboratories KIT-WT-WSVSDST.
6. Provide two portable VHF or UHF business band radios for use during acceptance testing. Radios should have a transmission range sufficient to cover entire project. Radios to include rechargeable batteries and recharger along with "holster" for wearing on belt. Radios to be available for duration of testing process, including any follow-up visits required prior to final acceptance.

7. ACCEPTANCE

A. Upon completion of installation and initial tests and report specified in Part 3, acceptance testing shall be performed by the Architect's Consultant.

B. Acceptance testing will include operation of each major system and any other components deemed necessary. Contractor will assist in this testing and provide any test equipment required specified herein. Contractor shall provide at least 1 technician available for the entire testing period (day and night), to assist in tests, adjustments, and final modifications. Tools and material required to make any necessary repairs, corrections, or adjustments shall be furnished by the Contractor. Testing process is estimated to take a minimum of 3 days.

C. The following procedures will be performed on each System:

1. Video Signal: From all source inputs (for cameras, character generators, video tape units, etc.) through all VDAs, processors, switchers, etc., to all signal destinations. Verification of correct signal timing for each source, via each path will be made using standard test patterns. Each processing device will be checked such that the signal passes through the device in the no processing mode such that unity luminance, chrominance, and signal timing and phasing conditions are achieved.
2. Control functions shall be checked for proper operation, from controlling devices to controlled devices.

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3. The audio fidelity test shall consist of driving the system with pink noise and measuring the response in each 1/3 octave band from 40 to 16,000 Hz. Octave, 1/3 octave, or notch filters as specified shall be used to adjust the response as necessary to fit the requirements of the space.
4. Adjust, balance, and align equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for each level control and record these settings, in the "System Operation and Maintenance Manual."
5. Installed and loose equipment will be inventoried for correct quantity.
6. Any other test on any piece of equipment or system deemed appropriate.

D. In the event the need for further adjustment or work becomes evident during equalization and/or acceptance testing, the Contractor will continue his work until the system is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications, the Contractor will pay for additional time and expenses of the Architect's Consultant.

E. The Architect's Consultant's fees and costs involved in acceptance testing are not the responsibility of the Video Control Contractor, except as described in Part 3 of this specification.

F. In the event that the Video Production System is used prior to final acceptance, attendance in support of that usage shall not be construed as acceptance, or as event attendance.

END OF SECTION 116350

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SECTION 116350

1.GENERAL

1. SCOPE OF WORK

A. Work under this Contract includes all labor, materials, tools, transportation services, supervision, coordination, etc., necessary to complete the supply and installation of a Video Production System, as described in these specifications and illustrated on the associated drawings. The systems shall be called the “Video Production System (VPS)” and the Contractor the “Video Production Contractor”. The systems include the following major items:

1. Video Production Cameras
2. Video Switching systems--routing, production
3. All electrical distribution within each system at each installation point.
4. User Fiber Optic Patching, and distribution.
5. Technical Millwork and Furniture Consoles

B. The Contract also includes:

1. Verification of dimensions and conditions at the job site.
2. Preparation of submittal information.
3. Coordination with other trades.
4. Installation in accordance with the contract documents, manufacturer’s recommendations, and all applicable code requirements.
5. Manufacturer’s commissioning for all major items of equipment.
6. Initial tests and adjustments, written report, and documentation.
7. Instruction of operating personnel; provision of manuals.
8. Maintenance services; warranty.
9. The Contractor is responsible for all subsequent design and engineering not included within the RFP documents. The Contractor is responsible for providing all components necessary for complete and operational system.
10. Any system changes or revisions necessary to make the system conform to the building, walls, electrical services etc, shall be included at time of proposal and installed without claims for additional compensation.

C. The Contract Documents are complementary and are intended to include or imply all items required for the proper execution and completion of the work. Any item of work required by the Specifications or other portion of the Contract Documents, but not shown on the drawings, or shown on the drawings but not required in the Specification, shall be provided by the Contractor without extra charge as if shown or mentioned in both.

2. SYSTEM DESCRIPTION

A. This Video Production systems herein are to be utilized to produce content for stadium LED display and in house TVs. A streaming encoder will be provided to broadcast events as needed. The production suite is located on the main concourse in room 259. with equipment racks and control consoles sharing the space.

B. Video System Operation:

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1. The principal cameras are to be 1080p 59.94 as base bid.
2. It is anticipated that the production switcher will operate at 1080p 59.94.
3. The routing switcher is specified to be 1080p 59.94 operating as base bid.

C. Video Production Contractor will be working in the following major locations:

1. A Video Control Room (259) used to originate programming for the stadium.
2. Various locations around the stadium.

D. A number of video cameras are dedicated to the Video Production System.

1. Each camera may be connected at a JBT in various locations around the stadium.
2. Additional unit costs are requested for potential purchase of additional CCUs, Cameras and Lenses.

E. In addition to the cameras the following equipment is provided for Video Production System use:

1. Production Switcher
2. Character Generator
3. Multi-channel file server used for clip playback and slo motion replay
4. A Video Recorder is provided to:

    a. Make archival video recordings of each production
    b. Playback individual plays in the event of a failure of a file server
    c. Make archival video recordings of a selected individual camera iso angle.
    d. Create “dubs” and duplications of footage for common distribution.

5. KVM systems are used to connect all computerized servers to associated operator stations located within the video production system. This is to be set up in a one-to-one connection topology.

F. Intercom Systems

1. A 2-Wire partyline based intercom system is to be provided for the Video Production system

    a. Multi-channel circuits are connected to a “intercom connectivity panel” panel for ease of configuration.
    a. The Contractor is responsible for coordinating terminations, supplying equipment, and assisting in balancing and configuring the system.

G. IT Networking

1. Project provides a dedicated control network switch for the intercommunication of video production equipment. Devices as shown on drawings connecting to “owner network” shall be configured for dual network use allowing the control network for video production system communication and converged network for internet access.

    a. Contractor to coordinate with owner IT group for network configuration and provide owner specified routing device for uplink of the control network switch.

H. Broadcast Cabling System

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1. The Broadcast Cabling System specification consists of cabling and infrastructure to support In House Production cabling generally originates in JBT's throughout the stadium and terminate in the control room / scoreboard production room 259.
2. SMPTE Hybrid Fiber Network:

    a. The project's camera cabling standard shall be SMPTE hybrid fiber (aka High-Definition cable) to locations shown on the broadcast cabling functional. Notes with regards to this system:
    b. Permanent SMPTE cable to utilize a triple SMPTE cable that can support up to 3 cameras.
    c. Refer to AV drawings for locations and quantities.
    d. Cabling shall utilize "pigtails" at both ends of the cable to accommodate field repair and terminations.
    e. Each cable run shall be fully broken out to 3 circuits - even when only 1 or 2 SMPTE pigtails connections are shown on the broadcast functionals.
    f. Provide dust caps for all fiber breakouts without SMPTE pigtails.

I. Millwork

1. Broadcast millwork will be provided in configurations shown on the floor plans. Take care during installation to prevent scratches and damages to the consoles.

J. The installation of the Video Control Room should be coordinated with the Lighting and Structured Cabling systems (among others).

1. The actual camera, video, and audio cabling from the Video Control Room to the camera locations is provided as tie lines to the camera locations.

3. RESPONSIBILITIES AND RELATED WORK

A. Supply accessories and minor equipment items needed for a complete system, even if not specifically mentioned herein or on the drawings, without claim for additional payment.

B. Notwithstanding any detailed information in the Contract Documents, it is the responsibility of the Video Control Contractor to supply systems in full working order. Notify the Owner's Representative of any discrepancies in part numbers or quantities before bid. Failing to provide such notification, supply items and quantities according to the intent of the Specification and Drawings, without claim for additional payment.

C. Obtain all permits necessary for the execution of any work pertaining to the installation.

D. The drawings included with this specification convey general system concepts. The plans do not show complete and accurate building details. The Contractor is responsible for making field measurements necessary to establish exact locations, relationships and load capacities necessary for the installation of these systems.

E. If a conflict develops between the contract documents and the appropriate codes and is reported to the Owner's Representative prior to proposal opening, the project team will prepare the necessary clarification. Where a conflict is reported after contract award, propose a resolution of the conflict and, upon approval, perform work.

F. All structural support, design, and engineering for installation of all system components.

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G. Power

1. Power shall be provided within the control room above the equipment racks terminated to twist lock receptacles. The contractor shall be responsible for distributing electrical power from the receptacles to the equipment as required.
2. The contractor shall be responsible for connecting appropriate grounds to all equipment in accordance with applicable codes and standards.
3. UPS power shall be provided in the equipment racks and at operator stations to allow a minimum run time of 10 minutes to allow for proper system shutdown and on-air sign off pending an electrical blackout situation.

H. Coordinate work with other trades to avoid causing delays in construction schedule.

I. Paint any POV Camera housing, provided under this contract, to a color selected by Architect & Owner.

4. SUBMITTALS

A. Submit all shop drawings and submittals in accordance with Project Requirements.

B. Shop drawings and submittal data shall contain sufficient information to describe the Work to be performed. Drawings shall be executed at an appropriate scale. Submit all Shop Drawing information at one time.

C. Submittals shall include digital copies with all information, drawings, and reports in .pdf format. PDF documents which include multiple files (e.g. product submittals) shall have a cover sheet and a table of contents with active, clickable links to each subsection.

D. The following outlines expected submittal packages:

1. Project and Submittal schedule shall be submitted within three (3) weeks of award.
2. Product Data

   a. A material list of all equipment to be furnished, arranged in specification order and noted as to which device the equipment represents.
   b. Proposed cable labeling technique.

3. Equipment layout and Millwork details (with console elevations)

   a. Location of all equipment in racks, consoles, or on tables, with dimensions; wire routing and cabling within housings; AC power outlet and terminal strip locations.

4. One Line diagrams for all signals (without cable numbering or patch points)

   a. Wiring diagrams. Complete, detailed wiring diagrams for all systems, based on the contract documents but including cable types, identification and color codes, and detailed wiring of connections, both at equipment and between equipment racks and wiring in conduit.
   b. Schematic drawings of any custom circuitry or equipment modifications, including connector pinouts and component lists.

5. Detail Submittal

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a. Patch panel layouts and designation (labeling) strips.
b. Custom Plates. Provide complete shop drawings on custom fabricated plates or panels. Drawings to include dimensioned locations of components, component types, engraving information and plate material and color.
c. Representative equipment labeling sizes, styles, and numbering.
d. Any structural mounting details (including structural engineers seal as appropriate)
e. Samples as required in various specification paragraphs.

6. User Interface (UI) Submittal.

a. This submittal is to provide sufficient information to indicate that the Contractor has appropriately configured software and user interfaces in accordance with user requests, as well as in common production studio configuration. The submittal can be in PDF, Excel, or as configuration files as appropriate. In some cases this submittal, may need to be incremental, with multiple deliveries. Items covered by this submittal shall include, but not be limited to:
b. Routing Switcher: inputs, outputs, virtual naming, panel configurations
c. Intercom Matrix: Panel configuration, alphanumeric and the like. A “dummy” version of the configuration file is preferred for review.
d. Production Switcher
e. Tally
f. Control System (e.g. Crestron, AMX, etc.) if any.

7. Commissioning Plan and Training Resume Submittal

a. Provide Contractors commissioning plan
b. Provide training schedule
c. Part 3 lists training that is to occur on the system. Provide resumes where required for training on specific device(s) for approval.
d. If Contractor desires to utilize own forces for specified manufacturers commissioning, submit resume and relevant references for approval.
e. Provide sample training attendance sign in sheet

8. Commissioning Completion Submittal.

a. At the conclusion of the commissioning process provide a written submittal indicating the completion of each commissioning task.

9. Training and Event Attendance Submittals:

a. All Operations and Maintenance manuals, as well as as-built drawings must be on site for all sessions of training (drafts are acceptable).
b. Following discussions with Owner and Tenant, formally submit a Training and Event Attendance submittal 4-8 weeks prior to first training. Submittal shall:

1) Include a separate page/entry for every training session.
2) Indicate date, time, and approximate length of training session.
3) Indicate person(s) conducting training.
4) Indicate whether training will be videotaped.
5) Intended curriculum and most appropriate attendees (e.g. engineer, operations, IT, etc.)
6) Include signature and title lines for:

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a) Owner acknowledgement and acceptance of training schedule. Include both an accepted and rejected box. An alternate schedule time should be suggested by the Owner in the event the schedule is rejected.
b) Countersigning by trainer indicating that training actually occurred.
c) All persons attending training. Where attendees do not stay for the entire session, this should be noted on the form and initialed by Owner's representative attending training.
d) Owner's representative attending training at the end of the session shall initial that Training Occurred, Training Materials were provided and left with Owner, training was not interrupted or shortened by equipment or system troubleshooting (If it is, then there should be a line where Owner and Contractor can indicate when make-up training will be provided and how long it should be), Training was generally sufficient for the proposed curriculum.
e) Include Notes section for Owner and Contractor to note any issues during training (areas requiring further development, etc.).

7) Following training occurrence, submit completed training records no later than 5 days following end of training. When training is conducted over a period of weeks, completed training submittals shall be consolidated into a single submittal and submitted every 2 weeks.
8) Event attendance, as specified herein, shall be performed by a staff member associated with the project integration. They shall submit an event attendance report of any issues encountered, resolution or next activities to resolve in a timely fashion.

10. Training Attendance Sign In Submittal

a. Copies of all sign-in sheets from owner training at a maximum of one week after training has occurred.

11. Final Inspection Notification Report.

a. Two copies of a typed, neatly prepared checkout report for each piece of equipment and the entire system shall be prepared and submitted; it shall include:

1) A complete listing of every piece of equipment, the date it was tested and by whom, the results and date re-tested (if failure occurred during any previous tests).
2) The final report shall indicate that every device tested successfully
3) A performance test report indicating that the system meets all of the Contractor testing requirements of Part III.

12. Contract close-out submittals

a. Keep a complete set of drawings on the job, note any changes made during installation, and submit 1 corrected set of reproducible drawings showing Work as installed.
b. Submit the following data for review, prepared as indicated, at least one week prior to acceptance testing (exceptions noted):

1) System Operation and Instructions. Prepare a complete and typical procedure for the operation of the equipment as a system, organized by

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subsystem or activity. This procedure should describe the operation of all system capabilities beginning with system startup and ending with shutdown. Assume the intended reader of the manual to be technically inexperienced and unfamiliar with this facility.

2) Final Documents:

a) A list of all equipment, indicating manufacturer, model, serial number, power consumption, warranty terms if greater than the specified warranty and equipment rack location. Update following acceptance testing, if changed.
b) Manufacturer’s Instruction Manuals for all items of equipment, incorporating or followed by manufacturer's warranty statements.
c) Where manufacturer registration is required, register warranty in Owner’s name, and at an address determined by Owner. Provide copy of registration.
d) For custom circuits or modifications, a description of the purpose, capabilities, and operation of each item.
e) A list of settings of all semi-fixed controls. Update following acceptance testing. (This shall specifically include all computer based software settings, e.g. IP addresses, gateways, drive mapping, backup procedures etc.)
f) Schematic wiring diagrams of the production studio sub-system, based on the as-built documentation, at a reduced scale easy to handle but fully legible.
g) Maintenance Instructions, including Contractor’s maintenance phone number(s) and hours; maintenance schedule; description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.
h) A legend of acronyms and abbreviations must accompany all documentation.
i) Any other pertinent data generated during the Project or required for future service.
j) System Reference Manual: Furnish digital copies as required by Project Requirements.

c. Electronically editable files for all project work:

1) AutoCAD DWG
2) Excel
3) Word
4) PDF is not considered an editable file.

5. QUALITY ASSURANCE

A. Contractor’s Qualifications: Firm experienced in the installation of systems similar in complexity to those required for this project. Specific proposal submission requirements are:

1. Experience with at least three (3) comparable scale sports projects within the last three years.
2. Provide reference information and contact information for each project.
3. In the event sport specific projects are not available, other projects may be considered.

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B. Maintain a fully staffed and equipped service facility. In the event the Contractor is outside a one (1) hour support time for the project, identify local resource(s) to be developed and assigned to support the project during the warranty duration.

C. Contractor authorized to sell all equipment specified within this system.

D. The Contractor shall demonstrate that he has:

1. Adequate plant, equipment bonding and insurance capabilities to complete the work.
2. Adequate staff with commensurate technical experience. Identify the following roles for the project and provide appropriate resumes:

    a. Senior Project Engineer(s).
    b. IT Project Engineer
    c. Project/Site Supervisor (aka lead Contractor).
    d. Project/Off-site project manager.
    e. Purchasing and expediting staff
    f. Vice President/Operator for escalation contact in the event of difficulties
    g. Other staff and their experience that may assist in evaluating the Contractor's proposed deployment team

3. Suitable financial status to meet the obligations of the work.
4. Any installation, labor or electrical subcontractor (this does not include millwork) whose contract value will exceed $10,000.
5. A proposed project schedule with manpower loading diagram (based on a system of this complexity).

    a. Sample submittals are encouraged as part of the proposal submittal. This is including but not limited to:
    b. One-line diagrams
    c. As-built documentation
    d. Photographs of work (showing the rear of equipment racks, not the fronts).
    e. Commissioning procedure(s)
    f. Training documentation
    g. Other information that may assist in evaluating the vendor's past performance.

6. PROJECT CONDITIONS

A. Verify all conditions on the job-site applicable to this work. Notify Owner's Representative in writing of discrepancies, conflicts, or omissions promptly upon discovery.

B. The drawings diagrammatically show cables, conduit, wiring, and arrangements of equipment fitting the space available without interference. If conditions exist at the job site which make it impossible to install work as shown, recommend solutions and/or submit drawings to the Owner's Representative for approval, showing how the work may be installed.

7. ACCEPTANCE TESTING

A. Upon completion of installation and initial tests and adjustments specified in Part 3, acceptance testing shall be performed by the Owners Consultant.

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B. Provide two persons familiar with all aspects of the system to assist the Owners Consultant during acceptance testing.

C. The process of acceptance testing the System may necessitate moving and adjusting certain component parts; perform such adjustments without claim for additional payment.

D. In the event that the system is used prior to final acceptance, attendance in support of system usage shall not be construed as acceptance, or as event attendance.

8. WARRANTY

A. Warrant labor and materials provided under this agreement for one year following the date of the first regular season game, trouble free operation, or final acceptance, whichever is later.

B. System to be free of defects and deficiencies, and to conform to the drawings and specifications as to kind, quality, function, and characteristics; repair or replace defects occurring in labor or materials within the Warranty period without charge. Warrant all replaced products as new.

C. This warranty shall not void specific warranties issued by manufacturers for greater periods of time. Nor shall it void any rights guaranteed to the Owner by law.

D. Within the warranty period, answer service calls within 8 hours, and correct the problem within twenty-four hours.

E. Register all manufacturers' warranties (e.g. software, computers, etc.) in Owner's name.

9. SPECIFIED PRODUCTS AND MANUFACTURERS

A. Model numbers and manufacturers included in this specification are listed as a standard of quality. Regardless of the length or completeness of the descriptive paragraph herein, each device shall meet all of its published manufacturer's specifications. Verify performance as required. Where two or more acceptable products are listed, the Contractor may use either at his option.

B. Other qualified manufacturers will be considered subject to approval of complete technical data, samples, and results of independent testing laboratory tests of proposed equipment, submitted in accordance with project requirements.

C. If proposed system includes equipment other than specified model numbers, submit a list of major items and their quantities, with a one-line schematic diagram for review.

D. Include a list of previously installed projects using proposed equipment that are similar in nature to specified system.

E. If product is discontinued or made obsolete due to continuing product development, replace it with manufacturers' equivalent at time of installation at no additional cost.

F. If product is unavailable by project completion due to supply chain issues, replace it with alternate manufacturers' equivalent at time of installation at no additional cost.

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10. OPTIONS SHOULD REFLECT THE NET COST (ADD OR DEDUCT) FOR THE OPTION AND ALL IMPACTED ELEMENTS. IN THE EVENT SUPPLIER CANNOT QUOTE A SPECIFIC PRODUCT; LIST NA ON BID FORM.

A. Option 11 63 50-A. Clip Player Replacement Option. Provide incremental cost to replace low, base bid Slow Motion solution

1. Option 11 63 50-A1. Newtek Clip Player

a. Supply Acceptable Newtek 3Play based solution in lieu of base (low) bid configuration

2. Option 11 63 50–A2. Ross Clip Player

a. Supply Acceptable Ross based solution in lieu of base (low) bid configuration

3. Option 11 63 50-A3. Variant Systems Slow Motion Option

a. Supply Acceptable Variant Systems Slow Motion Option based solution in lieu of base (low) bid configuration

B. Option 11 63 50-B. Camera Replacement Option. Provide incremental cost to replace low, base bid Camera

1. Option 11 63 50-B1. Hitachi Camera Solution

a. Supply acceptable Hitachi Solution in lieu of base (low) bid configuration

2. Option 11 63 50 – B2. Ikegami Camera Solution

a. Supply acceptable Ikegami Solution in lieu of base (low) bid configuration

3. Option 11 63 50-B3 Sony Camera Solution

a. Supply acceptable Sony Solution in lieu of base (low) bid configuration

C. Option 11 63 50-C. Closed Caption Encoder Option. Provide cost to provide one (1) Type 1 CCE and associated equipment

11. UNIT COSTS SHOULD REFLECT THE NET COST (ADD OR DEDUCT) FOR THE UNIT COST AND ALL IMPACTED ELEMENTS. IN THE EVENT SUPPLIER CANNOT QUOTE A SPECIFIC PRODUCT; LIST NA ON BID FORM.

A. Unit Cost 11 63 50-A. Unit Cost to add/deduct Cameras

1. Unit Cost 11 63 50-A1 Unit Costs to add/deduct one (1) Type 1 Camera, CCU, and associated support equipment.
2. Unit Cost 11 63 50-A2 Unit Costs to add/deduct one (1) Type 1 POV, and associated support equipment.

B. Unit Cost 11 63 50-B. Unit Cost to add/deduct Slow Motion

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1. Unit Cost 11 63 50-B1 Unit Cost to add/deduct four (4) channels of 1080p60 record and two (2) channels of 1080p60 playout and associated equipment (SLO MO_1)

C. Unit Cost 11 63 50-C. Unit Costs to add/deduct one (1) Type 1 Comp ($COMP_1$)

1. Unit Costs to add/deduct one (1) Type 1 Wireless Intercom Belt pack (ICOM WR_1)

D. Unit Cost 11 63 50 – D. Provide incremental cost to add/deduct one (1) Type 1 SDI to NDI Converter ($NDITX_1$) and associated support equipment.

E. Unit Costs 11 63 50-E. Extended support options. Annual support costs shall be following the warranty period. They shall be exercised 30 days before the expiration of the warranty or preceding annual support period whichever is later. Note: base bid shall include 1st year of support as base bid. In the event that vendor provides support for 2nd, 3rd or other years at no cost, then indicate annual costs and at which month and year they begin.

1. Unit Costs 11 63 50-E1. Provide sum of annual costs for all software and hardware support for full Production Switcher Systems specified as Base Bid. Annual costs shall be for ten years following expiration of the project warranty period. Note: if base bid product is significantly HIGHER than alternate products, a note to the order of magnitude would be appreciated.
2. Unit Costs 11 63 50-E2. Provide sum of annual costs for all software and hardware support for all type 1 CGs (CG_1). Annual costs shall be for seven years following expiration of the project warranty period. Note: if base bid product is significantly HIGHER than alternate products, a note to the order of magnitude would be appreciated.
3. Unit Costs 11 63 50-E3. Provide sum of annual costs for all software and hardware support for all Slow Motion and Clip Players in base bid. Annual costs shall be for seven years following expiration of the project warranty period. Note: if base bid product is significantly HIGHER than alternate products, a note to the order of magnitude would be appreciated.

2.PRODUCTS

1. GENERAL

A. All equipment and materials shall carry original manufacturer's warranty. B-stock or floor demonstration equipment is allowed and encouraged for all equipment, other than video and audio monitors and patch panels. Given the construction cycle NAB or IBC or intervening trade shows may be accounted for. Take care during installation to prevent scratches, dents, chips, etc.

B. Regardless of the length or completeness of the descriptive paragraph herein, each device shall meet all of its published manufacturer's specifications. Verify performance as required. Where two or more acceptable products are listed, the Contractor may use either at his option.

C. Provide engraved lamicoid labels at the front and rear of all signal processing equipment mounted in racks. Mount labels on the equipment and attach in a neat, plumb, and permanent manner. Embossed labels will not be accepted. Provide engraved labels at the rear only of equipment mounted in furniture consoles.

D. Custom rack panels shall be 1/8" thick aluminum, standard rack sizes, brushed black anodized finish unless otherwise noted. (Brush in direction of aluminum grain only.) Custom connector

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plate (speaker, microphone, etc.) finishes shall be selected from manufacturer's full range of standard finishes. Plastic plates will not be accepted, even if they are building standard in other areas.

E. All engraving shall be 1/8" high block sans serif characters unless noted otherwise. On dark panels or push buttons, letters shall be white; on stainless steel or brushed natural aluminum plates, or light-colored push buttons, letters shall be black.

F. In accordance with IEC-268 standard, all XLR connectors shall be wired pin 2 hot (high), pin 3 low, and pin 1 screen (shield).

G. All patch panels shall be wired so signal "sources" (outputs from devices) appear on the upper row of a row pair; all "loads" (inputs to devices) appear on the lower row of a row pair. All patch panel designation strips shall utilize alphanumeric and descriptive labels. The jack positions in each horizontal row shall be numbered sequentially from left to right. The horizontal jack rows shall be lettered sequentially from top to bottom. The alphanumeric identification of each jack shall be included on the functional block drawings.

2. CAMERAS

A. Camera, Camera Control Unit and Accessories

b. Hitachi Solution:

1) Type 1 Camera (CAM1)

a) Portable 2/3", 3 Chip Camera
b) SMPTE Hybrid Fiber Transmission System
c) Acceptable Product

(1) Hitachi Z-HD5500UH with

(a) Hitachi CA-H550U-S5 Camera Adapter
(b) Hitachi TA-Z3 Tripod Adapter

a. Type 1 Viewfinder (VF_1)

1) Acceptable Product

a) Hitachi VF-PBM307 with

(1) Hitachi AT-500
(2) Hitachi VC-90A
(3) Hitachi VF-L20D

2) Quantity: 1 per camera

b. Type 1 Camera Control Unit (CCU_1)

1) Acceptable product

a) Hitachi CU-HD550U

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c. Type 1 Remote Control Panel (RCP_1)

1) Mounted in Desk
2) Acceptable Product

a) Hitachi RU-1500JY with

d. Type 1 Microphone (MIC_1)

1) Acceptable Product

a) Sony ECM-674 with

(1) Hitachi MH-1000

2) Quantity: 1 Per Camera

2. Ikegami Solution

a. Type 1 Camera (CAM_1)

1) Portable 2/3”, 3 Chip Camera
2) SMPTE Hybrid Fiber Transmission System
3) Acceptable Product

(1) Ikegami HDK-99 Camera Head with

(a) Ikegami FA-97A SMPTE Lemo Version Adapter
(c) Ikegami T-430

b. Type 1 Viewfinder (VF_1)

1) Acceptable Product

(1) Ikegami VF701A/K
(2) Ikegami HVF701D-003
(3) Ikegami VFL201A

2) Quantity: 1 per camera

c. Type 1 Camera Control Unit (CCU_1)

1) Acceptable product

(1) Ikegami BSX-100H Lemo Version with

(a) Ikegami RMBS89-001
(d) Note: QTY (1) RMBS89-001 per (2) type 1 CCU

d. Type 1 Remote Control Panel (RCP_1)

1) Mounted in Desk
2) Acceptable Product

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a) Ikgami OCP-300 with

e. Type 1 Microphone (MIC_1)

1) Acceptable Product

a) Sony ECM-674 with

(1) Rycote 037340

2) Quantity: 1 Per Camera

3. Sony Solution:

a. Type 1 Camera (CAM_1)

1) Acceptable Product

a) Sony HXC-FB80HL with

(1) Sony VCT-14

b. Type 1 Viewfinder (VF_1)

1) Acceptable Product

a) Sony HDVF-L770 with

2) Quantity: 1 per camera

c. Type 1 Camera Control Unit (CCU_1)

1) Acceptable product

a) Sony HXCU-FB80L

d. Type 1 Remote Control Panel (RCP_1)

1) Mounted in Desk
2) Acceptable Product

a) Sony RCP-1000

e. Type 1 Microphone (MIC_1)

1) Acceptable Product

a) Sony ECM-674 with

(1) Sony CAC-12

2) Quantity: 1 Per Camera

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B. Type 1 Camera Lens and Support Package ($LENS_1$)

1. Type 1 Lens Configuration

a. Canon Solution:

1) Canon KJ20x8.2B IRSD with

a) Canon MS-15M Servo System
b) Canon Lens Filter

b. Fujinon Solution:

1) Fujinon XA20SX8.5BERM with

a) Tiffen W82DIGULTCLR
b) Fujinon MS-01

2. Type 1 Tripod and Support Package

2) Libec Solution

a) Libec RS-450DM with

(1) Libec PH-6B

3) Sachtler Solution

a) Sachtler 2513 System with

(1) Sachtler 3270 Telescopic Pan Handle

4) Vinten Solution

a) Vinten VB250-CP2M Tripod System with

(1) Vinten 3219-91 Telescopic Pan Bar with Clamp

3. Rain Slicker

a. M.T.O. Unlimited Shooterslickers S10 Rain/Shoot with

1) M.T.O Unlimited Shooterslicker S7 Overnight Elephant Bags

2. Case

a. Custom Castered Case sized to accommodate Camera and lens while connected as well as ancillary viewfinders, tripod adaptor plates, microphone holders, intercom headsets, 5 meter cable, etc.
b. Manufacturers with potential solutions

1) Viking
2) As Approved

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b. Coordinate case detail with owner. Provide multiple case solutions per owner request as required.

3. PRODUCTION SWITCHER

A. Baseline Production Switcher Requirements that may not be included in part numbers listed below

1. 16 Video Inputs
2. 4 Video Outputs
3. 2 ME Control Panel
4. 3 fully featured mix-effect buses
5. Tally management interface
6. Configure for remote control of LED Content System and to enable transitions and playout.
7. Redundant power for switcher frame.
8. Production Switcher Commissioning: see commissioning section.
9. H.264 Streaming

B. Acceptable Newtek Solution

1. Type 1 Production Switcher (PS_1)

a. Newtek TriCaster TC1 Pro (FG-003245-R001)

2. 2ME Control Panel (PS_2)

a. Newtek Small Control Panel (FG-001589-R001)

4. ROUTING SWITCHER

B. Type 1 Routing Switcher (RS1)

1. Performance Requirements

a. Unit shall provide routing of multiple signals and signal types

1) 525, 625, 1080i 50, 1080i 59.94, 720P 50, 720P 60, 1080P 24, 1080PSF 24, 1080PSF 23.98, 1080p50 A, 1080p60 A.

b. Sized as shown on drawings with ability to expand 100x100 as well as additional monitoring outputs required to serve the (MIV) shown. Please note that the physical frame and size is the ultimate requirement, expansion is expected to be accommodated with the addition of additional input, output and cross point cards.
c. Unit shall be sized to accommodate a specified system with an additional 10% for future use.
d. Equip with redundant power supplies
e. Equip with redundant router control
f. Switches shall be free from visible artifacts on destination devices without introduction of unnecessary delay.

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g. Multiplex 16 channels of audio on each video input/output (note: coordinate outputs that do not require mux with routing switcher I/O schedule).

1) Full mono breakaway audio routing support.
2) Seamless integration between demultiplexed and discrete audio.

h. Switching shall be controlled by a broadcast standard routing switcher control system.
i. Configure Routing Switcher to interface to all shading joysticks (RCP1) This can be accomplished at RS, RS BPS, or RS XY as capable.
j. Provide Web services Video Routing Solution. System to allow users to browse to a specific web address to route local video monitors and device IO. Setup for user profiles to simplify routing and setup at user stations.
k. Acceptable Products

1) Ross Dashboard (Quantity: 1)
2) Evertz MAGNUM-Router-VCP-WEB. (Quantity: 2)
3) As Approved

l. Provide all appropriate Routing Switcher Control Hardware Software required for proper operation. System shall:

1) Be interfaced to a tally interface system to allow transfer of alphanumeric switcher information to/from:
2) Production Switcher
3) Multi-image Display System
4) Be interfaced to the production switcher to allow transfer of alphanumeric information as well as remote switching.
5) Allow control panels to intercommunicate. In the event that Ethernet protocol is used for the communication and it requires a separate physical network, then this supplier shall provide the network hardware required.

C. Acceptable Products

1. Evertz Solution

a. EQX10-FR with
b. EQX-FC (QTY: 2)
c. EQX-PS-FR-B
d. EQX-PS (QTY: 4)
e. EQX-10-XPTG180x288 (QTY: 2)
f. EQX-IP16AD-3G-2TDM (QTY: As Required)
g. EQX-OP16AE-3G-2TDM (QTY: As Required)
h. EQX-OP16AE-FK-HSS (QTY: As Required)
i. EMX6-FR+6PS with
j. EMX-FC (QTY: 2)
k. EMR-ADMX-16x16a (QTY: 2)
l. EMR-108-MADI (QTY:2)
m. Multi-Image Viewers (MIV)

1) Frame

a) Acceptable Product

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(1) Evertz EMX6-FR-1000W with redundant power supply and frame controller (EMX-FC)

b) Type 1 Multi-Image Viewer (MIV1)

(1) 32 sources with two (2) distinct; separately programmable outputs.
(2) Quantity: 3
(3) Acceptable Product

(a) Evertz 3067VIPX-HW-A+32x4+SM with appropriate rear plate and XLINK cable

c) Configuration Software:

(1) Acceptable Product

(a) Evertz Magnum-Multiviewer.

2. Ross Solution

a. Ross Ultrix-FR5 configured with

1) Ross Ultrix-HDB-IO-A (QTY: As Required)
2) Ross Ultriscape MV License (QTY: 3)
3) Ross SFP-MADI-Coax (QTY: 2)
4) Ross SFP-HDB-IO-3G (QTY: As Required)
5) Ross ULTIPOWER
6) Ross ULTRIPOWER-PS (QTY: 2)
7) Ross ULTRICOOL
8) Ross ULTRICOOL-PS
9) Ross Ultrix-Term Kit1855A (QTY: 5)

3. As Approved

D. Routing System Button Control Panel (RSBPS1)

1. Use Routing System Button Control Panel with same manufacture as routing switcher.
2. Evertz Solution

a. Evertz CP-1040E

3. Ross Solution

a. Ross RCP-QE36

4. As Approved

5. VIDEO MONITORS AND ACCESSORIES

A. Type 1 Color Video Monitor ($CPXM_1$)

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1. 22” monitor DVI inputs
2. Acceptable product:

    a. Lenovo ThinkVision T23D-10 Monitor
    b. NEC E221N-BK Monitor

3. As Approved

B. Type 2 Color Video Monitor ($CPXM_2$)

1. 22” monitor DVI inputs
2. 3G-SDI Input
3. Acceptable product:

    a. Lenovo ThinkVision T23D-10 Monitor with

        1) Type 1 HDMI ($HDMI_1$)

    b. NEC E221N-BK Monitor

        1) Type 1 HDMI ($HDMI_1$)

4. As Approved

C. Type 3 Color Video Monitor ($CPXM_3$)

1. 49” monitor HDMI inputs
2. Acceptable product:

    a. LG 49UH5 Monitor with

        1) Chief TS525TU

    b. Samsung QE50T Monitor with

        1) Chief TS525TU

    c. Sony FWD-49X80 Monitor with

        1) Chief TS525TU

D. Type 4 Color Video Monitor ($CPXM_4$)

1. 17” Monitor
2. VESA Mountable
3. 3G HDSDI Input
4. HDMI Input
5. Acceptable Products

    a. Ikegami HLM-1760WR
    b. Sony LMD-A170

E. Type 5 Color Video Monitor ($CPXM_5$)

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1. Touch screen monitor
2. Acceptable product:

    a. Asus VT229H
    b. Planar PCT2265
    c. Viewsonic TD2230
    d. As Approved

F. Type 6 Color Video Monitor ($CPXM_6$)

1. 17.3” Rackmount Monitor
2. 3G HDSDI Input
3. HDMI Input
4. Acceptable Products

    a. Delvcam DELV-3GHD-17RM
    b. FeelWorld P173-9HSD-RM

G. Type 7 Color Picture Monitor ($CPXM_7$)

1. 27” HDR IPS Mini LED Professional Monitor
2. Dolby Vision, HLG & HDR-10 Support
3. VESA Mountable
4. HDMI Input
5. Display Port Input
6. Acceptable Product

    a. Asus ProArt PA27UCX-K
    b. Eizo CG279X-BK

H. Type 8 Color Video Monitor ($CPXM_8$)

1. 49” Monitor
2. Portable Cart
3. Acceptable product:

    a. LG 49UH5 Monitor with

        1) Chief LPAUB

    b. Samsung QE50T Monitor with

        1) Chief LPAUB

    c. Sony FWD-49X80 Monitor with

        1) Chief LPAUB

6. TEST AND MEASUREMENT

A. Test and Sync Generator

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1. Provide Sync to all devices
2. Bring any and all unused signals to patch
3. Type 1 Sync Generator ($TEST_1$) with integral test generator; digital black, and two independently adjustable black burst outputs:

    a. Acceptable Product

        1) Ensemble Designs Bright Eye BE57 with

            a) Ensemble Designs BERKMT-RR

        2) Other Acceptable Manufacturers: Evertz, Ross

B. Waveform/Vectorscope (WVS_1)

1. Two independent displays
2. Waveform Monitor
3. Vector Scope
4. (1) 3G HDSDI Input per Display
5. Input Loop Out
6. Acceptable Product

    a. Blackmagic Design SmartScope DUO HDL-SMTWSCOPEDUO4K2
    b. Other Vendors with Acceptable Solutions

        1) Leader, Tektronix

7. CHARACTER GENERATOR

E. Type 1 Character Generator (CG1)

1. 1 output channels consisting of (1) fill output and (1) key output as a combined NDI stream
2. Provide ability to ingest external data from scoring system and multiple XML and external HTTP data sources
1. Provide video output hardware based on chosen production switcher.
3. Provide manufacture baseball starter graphics package
4. Acceptable Product:

    a. AJT Solution

        1) AJT LiveServer GFX SDI

    b. Ross Solution

        1) Ross Video XSTS-0001 (Quantity: 1 per unit) with

            a) Ross Video XST-DLQ – Datalinq (Quantity: 1 per unit)
            b) Ross Video XPN-1RU-M8- Chassis (Quantity: 1 per unit)

8. SLOW MOTION AND CLIPS PLAYER

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A. Type 1 Slow Motion (SLO MO_1), and Type 1 Slow Motion Remote Control Panel (SCP_1)

1. 6 channels
2. Ability to build, review, select clips or recorded angles at the same time
3. Melt creation without external server
4. Clip naming and management
5. Playlist creation
6. Network file import/export
7. "Hot Key" camera angle playback
8. Multiple file formation
9. Multi-image viewing
10. At least 60 hours of storage at 100 Mbits per channel recording
11. Acceptable Products:

a. Newtek Solution

1) Newtek 3Play 3P1 with

a) Newtek 3tb Expansion Drive

2) 3Play Control Surface (SCP_1)

b. Ross Solution

1) Abeka Mira-PR-AVC-6-02
2) Abekas Mira-IR-CS (SCP_1)

c. Variant Systems Solution

1) Variant VSG-ENV-4+2+LPSMB with

a) Variant VSG-ENV-DIPA-PER-LICE

(1) Note: Package includes compatible touch screen. Delete (1) Type 1 CPXM

2) Variant VSG-ENV-PANEL-TB-USB (SCP_1)

9. VIDEO RECORDING EQUIPMENT

A. Type 1 Video Disk Recorder (VDR_1)

1. Acceptable products

a. AJA KiPro Go with

1) AJA KPU-SHELF
2) SanDisk SDCZ880-256G-A46 (QTY: 2)

b. Blackmagic Design HYPERD/STM with

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1) Comprehensive PWC-BK-6
2) Blackmagic Design CONVNTRM/YA/RSH
3) Sandisk SDSDXPK-032G-ANCIN (QTY: 2)

10. DISTRIBUTION GEAR AND SIGNAL PROCESSING FRAMES AND POWER SUPPLIES

A. Frame with cooling fan, network card with 1 power supply ($FRAME_1$)

1. Open Gear

a. AJA OG-X-FR
b. Ross Video OG3-FR-CN

2. Other Vendors with Acceptable Solutions

a. Evertz
b. Imagine Communications

B. Redundant Power Supply:

1. Mounts in selected Distribution Gear Card Frame
2. QTY: 1 Per Frame
3. Acceptable product:

a. AJA OG-X-PS
b. Ross PS OG3.

4. Other Vendors with Acceptable Solutions

a. Evertz
b. Imagine Communications

C. Type 1 Serial Equalizing Amplifier (SDA_1)

1. 1 x 4 General distribution amplifier.
2. Mounts in selected Distribution Gear Card Frame.

a. Open Gear

1) Dual channel solution

a) AJA OG-3GDA-2x4
b) Ross Video SRA-8802-R2S

(1) NOTE USE ROSS SRA-8802 WITH ROSS R2S-8802 WHERE APPROPRIATE

2) Quad Channel solution

a) Ross Video QRA-8808-R2H

b. Cobalt meeting these performance requirements.

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3. Other Vendors with Acceptable Solutions

    a. Evertz
    b. Imagine Communications

D. Type 1 Up/Down/Cross-Convertor (UDC_1):

1. Mounts in selected distribution gear card frame
2. SDI Video Input
3. SDI Video Output
4. Converts between SD, HD and 3G Formats
5. Acceptable Product

    a. AJA OG-UDC
    b. Blackmagic Design CONVOPENGUDC
    c. Other Vendors with acceptable solutions

        1) Evertz
        2) Imagine Communications

E. Type 1 Analog Video Distribution Amplifier (VDA_1):

1. Mounts in selected Distribution Gear Card Frame.
2. Acceptable product:

    a. Cobalt 9910DA-AV with

        1) Cobalt RM20-9910-AV-B

    b. Ross Video UDA-8705A-R2

3. Other Vendors with Acceptable Solutions

    a. Evertz
    b. Imagine Communications

F. Type 1 SDI to Audio Disembedder ($DEBED_1$)

1. Mounts in selected Distribution Gear Card Frame
2. Stereo Analog audio disembedding
3. 3G-HDSDI Input

    a. AJA 3G-AMA
    b. Ross Video DMX-8259-4C-R2C
    c. Other Vendors with acceptable solutions

        1) Cobalt
        2) Evertz
        3) Imagine Communications

G. Type 1 Audio to SDI Embedder (EMBED1)

1. Mounts in selected Distribution Gear Card Frame

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2. Stereo analog audio embedding
3. 3G-HDSDI Input
4. 3G-HDSDI Output
5. Acceptable Product

    a. AJA 3G-AMA
    b. Ross Video MUX-8258-4C-R2C
    c. Other Vendors with acceptable solutions

        1) Cobalt
        2) Evertz
        3) Imagine Communications

H. Type 1 Analog Audio Distribution Amplifier (ADA_1)

1. Mounts in selected Distribution Gear Card Frame
2. Stereo Analog audio Distribution Amplifier
3. 2x4
4. Acceptable Product

    a. Cobalt 9241 with

        1) Cobalt RM20-9241-B

    b. Ross Video ADA-8405-C-R2C

5. Other Vendors with Acceptable Solutions

    a. Evertz
    b. Imagine Communications

I. Type 1 Scan Converter ($SCALER_1$):

1. Mounts in selected Distribution Gear Card Frame
2. HDMI Input
3. 3G SDI Output
4. Acceptable Product:

    a. Apantac OG-US-4000-SET-1
    b. AJA OG-ROI-HDMI

5. Other Vendors with Acceptable Solutions

    a. Evertz
    b. Imagine Communications

J. Type 2 Scan Converter ($SCALER_2$):

1. Mounts in selected Distribution Gear Card Frame
2. DVI Input
3. 3G SDI Output
4. Acceptable Product:

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a. Apantac OG-US-3500-SET-1
b. AJA OG-ROI-DVI

5. Other Vendors with Acceptable Solutions

a. Evertz
b. Imagine Communications

K. Type 1 HDMI converter ($HDMI_1$)

1. Acceptable products:

a. AJA Hi5-PLUS with appropriate power supply
b. Black Box VSC-SDI-HDMI
c. Decimator DD-HX

2. Quantity: As required plus two (2)

L. Type 1 SDI to NDI Converter ($NDI\ TX_1$)

1. (4) 3G HDSDI Input
2. (4) NDI Stream Output
3. Acceptable Product

a. BirdDog BD4KQUAD with

1) Middle Atlantic U1V

b. NewTek Spark Plus FG-002903-R001 with

1) Middle Atlantic U1V

a) Note: This is a single channel solution

M. Type 1 NDI to SDI Converter ($NDI\ RX_1$)

1. (4) 3G HDSDI Output
2. (4) NDI Stream Input
3. Acceptable Product

a. BirdDog BD4KQUAD with

1) Middle Atlantic U1V

b. NewTek FG-002903-R001 with

1) Middle Atlantic U1V

a) Note: This is a single channel solution

N. Closed Caption Encoder and Decoder (CCE_1).

1. EEG Solution

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a. EEG HD1492. (Quantity: 1; single path units)
b. EEG DE1285. (Quantity: 1; single path units) with

2) EEG-CCD-49 IP output license

2. Evertz Solution

a. Evertz 7825CCE-AUD-3G+3RU. (Quantity: 1, single path units)

11. AUDIO, MIXER, TIMECODE

A. Type 1 Audio Mixer ($MIXER_1$)

1. Allen & Heath SQ-6 with

a. Allen & Heath SQ Dante Card

2. Yamaha TF-5 with

a. NY64-D

3. As Approved

F. Type 1 Dante Interface (DANTE1)

1. Simultaneous 64x64 I/O
2. Coaxial and Optical MADI Inputs
3. Dual Ethernet Connectivity
4. Acceptable Product

a. AuviTran AVBx3 with

1) AuviTran AxC-Dante
2) AuviTran AxC-MADI/SFP

b. Ferrofish Verto MX
c. Focusrite Pro RedNet D64R
d. Joseph Electronics Dante XBMD-1

G. Type 2 Dante Interface (DANTE2)

1. Simultaneous 16x16 I/O
2. 16 Line Level Analog inputs
3. 16 Line Level Analog Outputs
4. Dual Ethernet Connectivity
5. Acceptable Product

a. AuviTran AVBx3 with

1) AuviTran AxC-Dante
2) AuviTran AxC-AS16M
3) AuviTran AxC-AX16O

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b. Focusrite Pro RedNet D16R
c. Joseph Electronics Dante PMC-2
d. Studio Tech Model 5412-02

H. Dante Network Bridge (DANTE BRIDGE1)

1. Allows linking of 64 audio channels with variable sample rates
2. Bidirectional
3. Acceptable Product

a. AuviTran AVBx3 with

1) AuviTran AxC-Dante (QTY: 2)

b. Studio Tech Model 5482-02

B. Type 1 Speaker ($SPKR_1$)

1. Acceptable Product:

a. Genelec 8010A with

1) Genelec 8010-410W

b. JBL 305P MKII with

1) Rockville RHSB8

a) Note: Provide (1) for every (2) Type 1 speakers

c. As Approved

C. Type 1 Audio Monitor ($AMON_1$)

1. Monitors up to 8 Embedded Audio Channels
2. (2) SDI Inputs
3. Built in Preview Screen
4. Acceptable Product

a. Wholer AMP1-8

D. Type 2 Audio Monitor ($AMON_2$)

1. Monitors up to 8 Embedded Audio Channels
2. (1) SDI Inputs
3. (1) Stereo Analog Input
4. Built in Preview Screen
5. Acceptable Product

a. Marshall Electronics AR-DM51-B

1.2 TV TALENT SUPPORT EQUIPMENT

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A. TV Talent Booth TX Unit (TALENT TX1)

1. (2) 3G SDI Inputs
2. (2) 3G SDI Outputs
3. (4) 1Gb PoE Ports
4. Optical transmission over (1) single mode fiber
5. Rackmount Kit
6. Power Supply
7. Acceptable Product

a. Multidyne VB Box V10-3867-22-SXX4B-ST with

1) Multidyne RU for VB10

B. TV Talent Booth RX Unit (TALENT RX1)

1. (2) 3G SDI Inputs
2. (2) 3G SDI Outputs
3. (4) 1Gb PoE Ports
4. Optical transmission over (1) single mode fiber
5. Rackmount Kit
6. Power Supply
7. Acceptable Product

a. Multidyne VB Box V10-3867-22-SXX4A-ST with

1) Multidyne RU for VB10

C. Talent Support Interface Box

1. Bidirectional DANTE audio support
2. Digital audio and direct-microphone outputs
3. One main and one talkback output channel
4. 2-channel headphone output
5. Quantity: 3
6. Acceptable Product

a. Studio Tech Model 204

D. Talent Support Monitor

1. 21.5” 1080P HD Resolution
2. HD-SDI Input
3. Quantity: 2
4. Acceptable Product

a. CAME-TV CTV-2105
b. Feelworld LUT215
c. Ikegami ULE-217-HDR
d. Joseph Electronics JE210-HDR

E. Talent Announcer Headset

1. Combined headset & boom microphone

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2. XLR Microphone Connector
3. ¼" TRS Headphone connector
4. Quantity: 4
5. Acceptable Product

    a. Sennheiser HMD 300 XQ-2

F. Talent Support Cable Kit

1. 25' Ethercon

    a. Quantity: 3
    b. Acceptable Product

        1) Clark X-CN423CS6-25-NE86
        2) Joseph Electronics JVD2412-NEBB-25
        3) Pro Co C2701-25F

G. 100' Ethercon

1. Quantity: 3
2. Acceptable Product

    a. Clark X-CN423CS6-100-NE86
    b. Joseph Electronics JVD2412-NEBB-100
    c. Pro Co C2701-100F

H. 25' BNC Cable

1. Quantity: 3
2. Acceptable Product

    a. Clark X-CD7506-BLACK-25
    b. Joseph Electronics JVC1694A(BLACK)KBB-25

I. 100' BNC Cable

1. Quantity: 3
2. Acceptable Product

    a. Clark X-CD7506-BLACK-100
    b. Gepco GVC11-BLACK-100
    c. Joseph Electronics JVC1694A(BLACK)KBB-100

J. 200' Tactical Single Mode Fiberoptic Cabling Reel

1. Quantity: 2
2. Acceptable Product

    a. Clarwire X-CWFBTSM6-200-STST with
    b. Hannay AVF-14

K. Type 1 Mobile Equipment Rack (MRACK1)

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1. 14 Rack Units
2. Caster Base
3. Touring Style Case
4. Acceptable Product

    a. Gator Case G-Tour 14U CAST with

        1) Middle Atlantic Products PD-915R

    b. Odyssey FZS14W with

        1) Middle Atlantic Products PD-915R

12. INTERCOM

A. Intercom Master Station (ICOM MS_1):

1. Performance Specification
2. 4 Independent Channels
3. Visual and audible call signaling
4. Program feeds to both channels
5. Remote Mic Kill
6. Stage Announce
7. Built-in Speaker
8. 10 Switch Source Assignment Panel
9. Acceptable Product

    a. Clearcom SB-704
    b. Other Vendors with Acceptable Solutions

        1) RTS

B. Type 1 Intercom Interface (ICOM IF_1)

1. Converts single channel clear com to 4-wire IO
2. (4) Individual Circuits
3. Built in Test Jack
4. Individual Interface transmit receive and null controls
5. Acceptable Product

    a. Clearcom IF4W4
    b. Other Vendors with Acceptable Solutions

        1) RTS
        2) Studio Technologies

C. Type 1 Intercom Beltpack

1. 2-Wire Single Channel
2. Quantity: 5
3. Acceptable Product

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a. Clearcom RS-701
b. Other Vendors with Acceptable Solutions

1) RTS

D. Type 1 IFB Talent Receiver

1. 2-Wire Single channel
2. Quantity: 4
3. Acceptable Product

a. Clearcom TR-50 with

1) Clearcom TS-1

b. Other Vendors with Acceptable Solutions

1) RTS

E. Intercom Signal Splitter

1. XLR-3 Input
2. (7) XLR-3 Outputs
3. Quantity: As Required
4. Acceptable Product

a. Telex TW-7W - F.01U.118.832

F. Intercom Stations

1. Use same manufacturer as selected for Master Station. Note: coordinate sex of headset connector to correlate with headsets and camera connections:

a. Type 1 ICOM Station ($ICOM_1$)

1) Clearcom RM 702
2) Other Vendors with Acceptable Solutions

a) RTS

b. Type 2 ICOM Station ($ICOM_2$)

1) Clearcom RM 704
2) Other Vendors with Acceptable Solutions

a) RTS

c. Type 2 ICOM Station ($ICOM_3$)

1) Clearcom KB-702GM with

a) Clearcom V-BOX

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2) Other Vendors with Acceptable Solutions

a) RTS

G. Headsets: PROVIDE APPROPRIATE XLR CONNECTOR AT THE END OF EACH UNIT.

1. Lightweight

a. Clearcom CC-28x4
b. Quantity: 8

1) Other Vendors with Acceptable Solutions

a) RTS

2. Single Muff

a. Quantity: 5
b. Acceptable Product

1) Clearcom CC-300-X4
2) Other Vendors with Acceptable Solutions

a) RTS

c. Note: coordinate sex of headset connector to correlate with wireless beltpacks and camera connections

3. Single Muff Camera Headsets

a. Quantity: 4
b. Acceptable Product

1) Clearcom CC-300-XX
2) Other Vendors with Acceptable Solutions

a) RTS

c. Note: coordinate sex of headset connector to correlate with camera connections.

H. Headphone.

1. SONY MDR-7506. (Quantity: 1)

13. MISCELLANEOUS EQUIPMENT REQUIREMENTS

A. Equipment Rack to be frame and panel type constructed of 16-gauge cold-rolled steel. Racks to have locking rear door mounted on the frame (not the rails). Empty mounting panel spaces to be filled with blank or vent panels, in a finish to match rack. Provide end panels and top panels as required. Provide shelving as required for equipment mounting within racks. Provide rack supports as required. Provide seven rack keys of each type. Rack color to be gloss or flat black.

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Include extra set of mounting rails in each rack for rear support of panels or equipment. Verify exact rack space required.

1. Racks to be
    a. Racks
        1) Middle Atlantic BGR-4538 with
            a) Middle Atlantic FWD-BGR-RR45
    b. Rack Tops
        1) Middle Atlantic BGR-552FT-FC. (Quantity: 1 per rack)
    c. Side Panels at ends of racks (Only need where exposed; at walls; leave exposed)
        1) Middle Atlantic
    d. Rack Base
        1) Quantity: 1 Per Rack
        2) Acceptable Product
            a) Middle Atlantic BS
2. Support Equipment
    a. Rear Doors:
        1) Middle Atlantic Split Vented Door
    b. Blank Panels
        1) Middle Atlantic EB Series Flanged Blanks
    c. Vent Panels
    d. Rack screws
        1) Middle Atlantic HS
    e. Power distribution
        1) Middle Atlantic PDT series on both sides of rack; Separate circuit breaker feeds to each side for redundancy.
    f. Rear Rack light
        1) Quantity: 1 Per Rack
        2) Acceptable Product
            a) Middle Atlantic LT-GN-PL

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g. Front Rack Light

1) Quantity: 1 Per Rack
2) Acceptable Product

a) Middle Atlantic LT-CABULT-SINGLE

h. Rack Shelves:

1) Heavy Duty pull out shelf.

a) Middle Atlantic SS

2) General shelf standard

a) Middle Atlantic RSH with escutcheon.

i. Hinged Access Panels as noted on the rack elevations

1) Middle Atlantic AP-X (where is X is 2, 4 or 6)

j. Horizontal Cable Management (for CAT5/6 cable management) as noted on the rack elevations

1) Middle Atlantic HHCM-1
2) Middle Atlantic HHCM-2

k. Additional cable management:

1) Middle Atlantic BR-1/BR-2 Cable Brush Grommet Panels
2) Middle Atlantic LPB

B. Cable tray is to be provided above equipment racks to facilitate interrack cabling. Cable tray is to be ceiling mounted six (6) inches above the rack top.

1. 4in by 12in Basket Tray

a. Acceptable Product

1) Legrand Cablofil
2) Approved Equal

C. Wire Mold is to be provided underneath counters to facilitate cabling to the operation positions throughout the control room. Where possible, wire mold is to run directly to racks in lieu of conduit to under counter locations. Wiremold is to be sized to a 40% fill ratio or larger, based on install cabling.

1. Wiremold

a. Acceptable Product

1) Legrand Wiremold Series
2) Approved Equal

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D. Video Tally connections are to be provided to indicate when a particular source is “on-air”. Connections shall be provided between the video switcher and:

1. Camera control units

E. Patch Panels:

1. Identification strips to be printed labels of different color for each major connector grouping. Use a combination of colored fonts on white background and black fonts on colored backgrounds.
2. Video and AES (unbalanced) patch panel with normal through patch jacks.

a. Acceptable Products

1) Bittree B64H-2MWTHD. (Quantity: As required with 10% excess capacity)
2) Equivalent products from AVP are also acceptable

3. Audio Patch Panels—

a. Non-terminated inputs to be shorted through normalling contacts on rear panel.
b. Provide one punch down tool and one replacement tip.
c. Acceptable product:

1) Bittree B96DC-HNSSH/E3 M2OU7B
2) Equivalent products from AVP and ADC are also acceptable

a) Provide additional panels for termination of existing, external cabling; terminations at patch panels by video production system Contractor.

4. Fiber Optic Patch Panels (SMFO PANEL)

a. Enclosure

1) Corning CCH-02U
2) Quantity: As Required

b. Adapter Plates

1) Corning CCH
2) Quantity: As Required

5. Camera Jack Panel

a. Triax/SMPTE Plug/Jack Panel:

1) Panel is to be a modular system type to provide flexibility between triax and SMPTE connectors.
2) Connectors are to electrically isolated from the panel.

a) SMPTE hybrid connectors: Field = Canare FCS015A-FR, Video Rack = Canare FCS015A-MR

3) Modules are to be nonconductive plastic.

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a) Acceptable product:

(1) Gepco Modular Frame HMPF with HMP-S SMPTE module
(2) Clark Modular Frame MPS-O with MP-S SMPTE module

6. General Purpose Interface contact closures available on the DVE, Still Store, Character Generator, Editor, and any other devices shall be brought to a patch panel (normals out) for wiring purposes.
7. CAT6. (Quantity: As required)

F. Patch Cables:

1. Video Patch Cables. Standard Video Patch Cords; each length in a different color

a. Bittree is basis of Design; Provide compatible products from others:

1) 2' in length

a) Bittree VPCM240X-75 . (Quantity: 8)

2) 3' in length.

a) Bittree VPCM360X-75. (Quantity: 8)

3) 4' in length.

a) Bittree VPCM480X-75. (Quantity: 6)

4) 6' patch to male BNC

a) Bittree VPCM240X-7572. (Quantity: 3)

5) Midsize Plug to BNC Patch Cord

a) Bittree VPBM2400-75 (Quantity: 3)

6) Conversion adapter

a) Bittree ADMW12. (Quantity: 2)

7) Equivalent products from AVP and ADC are also acceptable

2. Audio Patch cables

a. Bittree is basis of design
b. Acceptable Product

1) Bittree BPC2405-110. (Quantity: 15)
2) Equivalent products from AVP and ADC are also acceptable

3. TT to Female XLR Adapter Cable

a. Bittree BPCXF4807-110. (Quantity: 4)

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4. TT To Male XLR Adapter Cable

    a. Bittree BPCXM4804-110. (Quantity: 4)

5. Patch Cord Holder OPTIONS:

    a. Pomona 4408. (Quantity: 1), or
    b. Trompeter CH50. (Quantity: 1), or

6. Impact Insertion Tool With spare Tip

    a. Bittree PT1LA (Quantity: 1)

G. Camera, Video and Audio Cables:

1. Camera (SMPTE)

    a. Length: 10 foot--to be used for CCU patch.

        1) Acceptable Product

            a) Gepco GHF92A-0-10-PS.
            b) Clark X-HFCTP-10-MF
            c) Joseph Electronics JSCBLDN(BLUE)PUWFUW-10
            d) MultiDyne MC-SH0010-SIPSIR-MDC

        2) Quantity: 6

    b. Length: 50 foot.

        1) Acceptable Product

            a) Gepco GHF92A-0-50-PS.
            b) Clark X-HFCTP-50-F
            c) Joseph Electronics JSCBLDN(BLUE)PUWFUW-50
            d) MultiDyne MC-SH0050-SIPSIR-MDC

        2) Quantity: 4

    c. Length: 100 foot.

        1) Acceptable Product

            a) Gepco GHF92A-0-100-PS
            b) Clark X-HFCTP-100-MF
            c) Joseph Electronics JSCBLDN(BLUE)PUWFUW-100
            d) MultiDyne MC-SH0100-SIPSIR-MDC

        2) Quantity: 2

2. Video Cables:

    a. Assembly:

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1) Clark X-CD7506-BLUE-##
2) Gepco GVC11-BLUE-##
3) Joseph Electronics JVC1694A(BLUE)KBB-##

b. Quantity: and Lengths:

1) 10 feet (Quantity: 5)
2) 25 feet (Quantity: 5)
3) 50 feet (Quantity: 2)
4) 100 feet (Quantity: 4)

3. Audio Cables:

a. Assembly:

1) Clark
2) Gepco GMC-5-BLUE-xx-MF-NBG
3) Joseph Electronics JAC1192A(BLUE)XMBXFB-##

b. Quantity: and Lengths:

1) 10 feet (Quantity: 5)
2) 25 feet (Quantity: 10)
3) 50 feet (Quantity: 2)
4) 100 feet (Quantity: 4)

H. For all devices with detachable power cord, provide a “shortened” cable to connect directly to power strip without “bundling”; this power cable is preferred in a color other than black. Provide Owner 15 of the original length power cables.

I. ST Cleaning Tool:

1. Acceptable product to include the following:

a. One click cleaner:

1) Clark FOC-CK-OC (Qty 2)

b. Two Swab Pak (one wet, one dry):

1) Clark FOC-CS (Qty. 5)

c. SMPTE Cable Cleaner

1) LEMO WST.KI.125.34

d. Universal cleaning sticks:

1) Clark FOC-CK-CSP (Qty 1)

J. Cable, connectors and miscellaneous hardware

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1. Video (under 100') and AES-U Cable. Precision video cable, PVC jacketed. Solid center conductor. Color: cable to be ordered in 6 colors (other than black) for each separate cabling system:

    a. Gepco VDM-230
    b. Clark CD7559F
    c. Belden 1855

2. INTRA- ROOM Video. Precision video cable, PVC jacketed. Solid center conductor. Color: cable to be ordered in 6 colors (other than black) for each separate cabling system:

    a. Gepco VSD-2001
    b. Clark CD7559F
    c. Belden 1694A

3. CABLE FOR ANY RUNS OUTSIDE OF MAIN EQUIPMENT ROOM. Precision video cable, PVC jacketed. Solid center conductor. Color: cable to be ordered in 6 colors (other than black) for each separate cabling system.

    a. Gepco VHD7000
    b. Clark CD7511DBR
    c. Belden 7855A

4. AES Audio Cable

    a. Belden 1800B
    b. Clark 801

5. Analog Audio Cable

    a. Belden 9451
    b. Clark SPA22GS

6. Antenna Cabling

    a. Belden 7733A
    b. Clark RF50LL

7. Category Cabling

    a. Riser

        1) Belden 2412
        2) Clark CN423C6

    b. Plenum

        1) Belden 2413
        2) Clark CN423C6P

8. Display Port Cable

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a. Extron DisplayPort Ultra

9. DVI Cable

a. Extron DVID SL Ultra

10. HDMI Cable

a. Extron HDMI Ultra

11. HDMI to Display Port Cable

a. Legrand Cables to Go 54326

12. Intercom Cabling

a. For use with 2-wire intercom systems
b. Permanent Short Runs Under 500’

1) Acceptable Product

a) Belden 8762

c. Permanent Long Runs Greater than 500’

1) Acceptable Product

a) Belden 8760

d. For Portable Cables

1) Acceptable Product

a) Belden 8412

e. Other Vendors with Acceptable Solutions

1) Clark Wire
2) Gepco

13. USB Cables

a. Legrand Cables to Go USB Series
b. Triplite U0 Series

K. Connectors

1. XLR type connectors shall incorporate metal shells and bodies and employ a non-hydroscopic dielectric. Panel connectors to be removable from panel front for solder and repair work. Male and Female panel connectors to fit in the same cutout.

a. XLR connectors: Neutrik.

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2. F Connector:

    a. Provide commercial style gold plated connector with integral sleeve for F6 Series, F11 Series, and F59 Headend cable.
    b. Provide seal ring in all moisture intensive environments.
    c. Install with manufacturer recommended compression tool.
    d. Provide weatherized boots and seal covers for all antenna connections.
    e. Verify connector cable type, size and construction with manufacturer.
    f. Acceptable product:

        1) Gilbert Engineering GF-US-6Q series, GF-US-11Q, and GF-US-59Q series respectively.
        2) Gilbert Engineering Seal ring: G-SR-1/2.

3. BNC Bulkhead Connections to utilize gold plated center contacts, insulated from panel feed-through connection:

    a. Kings

4. BNC cable connections to utilize gold plated center contact, dual crimp connections:

    a. Kings

L. Uninterrupted Power Supplies

1. Rack Mount UPS Systems (Quantity: 4)

    a. Hardware Performance Requirements

        1) 1500 VA minimum
        2) Rack mountable
        3) Removable batteries
        4) Support for load expansion
        5) Support for remote monitoring

    b. Vendors with acceptable solutions:

        1) APC
        2) Liebert
        3) Middle Atlantic Products
        4) Vertiv

14. MILLWORK

A. Furniture Console:

1. Console shall be constructed to house audio, video, control and other equipment as shown on drawings. Console shall be constructed by expert craftsman in a fully qualified cabinet shop regularly in business for technical millwork furniture.
2. The term “console” includes actual consoles housing equipment for work while seated; console desks housing little or no equipment; and other millwork or furniture housing monitors, timing or cueing devices, etc.

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3. All shelves, counters and edges to be designed to support 250 pound point load at edge of counter in addition to equipment mounted in or on shelf.
4. Equipment rack frames with drilled and tapped mounting holes shall be included as shown on drawings (reference EIA standards). Unused rack space shall be filled with black blank panels, brushed anodized aluminum.
5. AC power distribution and other requirements shall be as in Part 3; for routing between sections of cabinet, metal conduit and/or wireway shall be used for shielding and protection of circuits or as required by applicable codes. Power distribution must be hardwired into the millwork; pre-fabricated whips and related may not comply with regional expectations.
6. Cabling access is required at each and every counter location. Preferred cabling system is a slot or reveal in the millwork that allows user a great deal of flexibility in locating cabling. Where slot exists in a flat millwork piece, then slot should be equipped with a brush cover or other suitable filler material that allows cables to be easily connected and dressed through openings (e.g. www.mockett.com; brush wire manager series).

    a. Circular grommets are not allowed
    b. A slot or cable reveal at the intersection of counter with vertical "rack" elements is preferred wherever possible.

7. Certain equipment shall be mounted into the millwork (e.g. console mount intercom stations, camera control shading joysticks, etc.); do not cut into millwork, until on site and user can evaluate operating configuration.
8. Seismic bracing and bases for millwork as required.
9. Field verify all site conditions prior to final shop drawing submittal to Owner’s Representative.
10. Steel Components

    a. Steel components shall be 11g. or 3/16” cold rolled (type B), laser cut, de-burred and press break formed for strength and accuracy. Powder coating finish is polyester/epoxy oven baked with Airstatic process.

11. Aluminum Extrusion

    a. Aluminum extrusion to be 6061 with clear anodizing. Slot for attachment of standard, custom and client supplied components. Steel components to be factory placed for speed of on-site assemble and accuracy.

12. Wood Components

    a. Wood components to meet AWI Premium Grade Standards, construction to include solid woods, multiply plywood sheet, medium density fiber board and high density/high quality particle board. All components to be permanently plant assembled with screws, glue and staples. Black Melamine surfaces to cover equipment bay interiors and there are no exposed raw wood surfaces.

13. Millwork Locations to be Provided:

    a. Freestanding millwork

        1) Rear monitor Track;
        2) Turret, shelf, or recessed monitor configuration on an individual bay basis
        3) Front and rear access lower equipment bays
        4) Fully articulating monitor support arms

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5) Integral cable management
6) Locations

a) Control C208D

(1) TD Counter

7) Basis of Design:

a) Forecast Masterail
b) Forecast FC-AA0313 Articulating Monitor Arm mounts

8) Other Acceptable Suppliers:

a) Beck.tv
b) Laguna Designs
c) Lund Halsey
d) Middle Atlantic Products
e) Time Base Consoles

15. UTILITY COMPUTERS

A. Type 1 Computer ($COMP_1$)

1. Acceptable Product

a. BSI RMS1107 with

1) Intel i5-10400
2) ASRock Z590
3) 8GB DDR4 RAM
4) 1TB SATA SSD
5) Microsoft Windows 10 Pro
6) 24” Sliding Rails
300W Power Supply
7) TPM Module

b. Superlogics SL-1U-H81SLV-GC with

1) Intel i5-4570S
2) 8GB DDR3 1600 RAM
3) 1TB SSD
4) Microsoft Windows 10 Pro
5) 26” Adjustable Slide Rails

16. NETWORK SWITCH

A. Type 1 Network Switch ($SWITCH_1$)

1. Coordinate network switch with owner for converged network uplink
2. (48) 1Gb/S Ports

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3. (2) 10Gb/S SFP+ Ports
4. Layer 3 Networking
5. Managed
6. POE+
7. Acceptable Product

    a. Cisco Catalyst 9300
    b. Netgear GSM4352PA
    c. Ubiquity USW-Pro-48-POE

8. Other Vendors with Acceptable Solutions

    a. HP
    b. Juniper

17. KEYBOARD, VIDEO, MOUSE EXTENDERS

A. Type 1 Computer Interface (EXT_1) & Type 1 Computer Receiver (EXR_1)

1. Single Head Display Port or HDMI
2. USB 2.0
3. Acceptable Product

    a. Adder XD641P-DP-US
    b. Blackbox KVXLCH-100

B. Type 2 Computer Interface (EXT_2) & Type 2 Computer Receiver (EXR_2)

1. Dual Head Display Port or HDMI
2. USB 2.0
3. Acceptable Product

    a. Adder XD642P-DP-US
    b. Blackbox KVXLCHDP-200

C. Type 1 USB 2.0 Extension (USB TX_1) (USB RX_1)

1. Extends USB2.0 USB over Category Cable
2. 328’ Max Cable Distance
3. Acceptable Product

    a. Blackbox IC408A-R2
    b. Crestron USB-EXT-2 KIT
    c. Extron USB Extender Plus T (60-1471-12) with

        1) Extron USB Extender Plus R (60-1471-13)

D. Type 1 Mouse ($MOUSE_1$)

1. Acceptable Products:

    a. Microsoft P58-00061

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b. As Approved

2. Quantity: As Required plus 1

E. Type 2 Mouse ($MOUSE_2$)

1. Acceptable product

a. Logitech G502

F. Type 1 Keyboard ($KEYBOARD_1$)

1. Acceptable Products

a. Microsoft ANB-00001
b. As Approved

2. Quantity: As Required plus 1

G. Type 2 Keyboard ($KEYBOARD_2$)

1. Mini keyboard & trackpad combo
2. Acceptable Product

a. E-SDS KB1011

H. Type 3 Keyboard ($KEYBOARD_3$)

1. Rack Mount sliding Keyboard
2. Acceptable Products

a. Middle Atlantic RM-KB

I. Type 4 Keyboard ($KEYBOARD_4$)

1. Provide dedicated wired keyboard for graphics station
2. Acceptable Product

a. Logitech G413
c. As Approved

18. BROADCAST CABLING

A. SMPTE Hybrid Cable:

1. Cable to be provided with Appropriate NEC rating.

a. Riser Rated Three Channel HD (SMPTE) Camera Cable:

1) For general use where allowed by code.
2) High-Definition Television (HDTV) hybrid fiber optic camera cable.
3) Cable to provide copper and fiber connectivity for 3 channel SMPTE lines.

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4) Acceptable Product:

a) Belden 7824R
b) Clark HFC3R
c) OCC CX021HBAB9GR
d) Shattuc SCOP .3FCAMR

b. Plenum Rated Three Channel HD (SMPTE) Camera Cable:

1) For use within plenum spaces or as required by Code.
2) High-Definition Television (HDTV) hybrid fiber optic camera cable.
3) Cable to provide copper and fiber connectivity for 3 channel SMPTE lines.
4) Acceptable Product:

a) Belden 7824P
b) Clark HFC3P
c) OCC CX021HBAB9YP
d) Shattuc: SCOP.3FCAMP

B. Precision SDI Cable:

1. Riser Rated Digital Coax Cable:

a. For general use where allowed by code.
b. Type: RG-6U coax cable.
c. Solid center conductor.
d. Acceptable product:

1) Belden 1694a
2) Clark CD7506DBR

2. Plenum rated Digital Coax Cable for use only within plenum spaces or as required by Code:

a. For use within plenum spaces or as required by Code.
b. Type: RG-6U coax cable.
c. Solid center conductor.
d. Acceptable product:

1) Belden 1695A
2) Clark CD7506P

C. Analog Audio Cables:

1. Neatly dress unused pairs in rear of junction box or rack.

a. Riser Rated Audio Cable 6 pair:

1) For general use where allowed by Code.
2) Provide multi-pair shielded cable. Use six-pair cabling where six pairs is scheduled.
3) Provide two six pairs for DT-12 cabling.
4) Each pair of insulated conductors to be individually jacketed with foil shield with drain wire and two jacketed conductors.
5) Conductors to be 22 AWG stranded tinned copper.

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6) Acceptable product:

a) Belden 1816R
b) Clark 706
c) Shattuc SCA.2206

b. Plenum Rated Audio Cable 6 pair:

1) For use within plenum spaces or as required by Code.
2) Provide multi-pair shielded cable. Use six-pair cabling where six pair is scheduled.
3) Each pair of insulated conductors to be individually jacketed with foil shield with drain wire and two jacketed conductors.
4) Conductors to be 22 AWG stranded tinned copper.
5) Acceptable product:

a) Belden 1816P
b) Clark 706P

c. Riser Rated Audio Cable 4 pair:

1) For general use where allowed by Code.
2) Provide multi-pair shielded cable. Use four-pair cabling where four pairs is scheduled.
3) Each pair of insulated conductors to be individually jacketed with foil shield with drain wire and two jacketed conductors.
4) Conductors to be 22 AWG stranded tinned copper.
5) Acceptable product:

a) Belden 1815R
b) Clark 704
c) Shattuc: SCA.2204

d. Plenum Rated Audio Cable 4 pair:

1) For use within plenum spaces or as required by Code
2) Provide multi-pair shielded cable. Use four-pair cabling where four pair is scheduled.
3) Each pair of insulated conductors to be individually jacketed with foil shield with drain wire and two jacketed conductors.
4) Conductors to be 22 AWG stranded tinned copper.
5) Acceptable product:

a) Belden 1815P
b) Clark 22EPS4P (heat shrink each pair)
c) Shattuc: SCA.2204ISP (heat shrink each pair)

e. Riser Rated Audio Cable 2 pair:

1) For general use where allowed by Code.
2) Provide multi-pair shielded cable. Use two-pair cabling where two pairs is scheduled.
3) Each pair of insulated conductors to be individually jacketed with foil shield with drain wire and two jacketed conductors.

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4) Conductors to be 22 AWG stranded tinned copper.
5) Acceptable product:

a) Belden 1814R
b) Clark RS22G2
c) Shattuc SCA.2202

f. Plenum Rated Audio Cable 2 pair:

1) For use within plenum spaces or as required by Code
2) Provide multi-pair shielded cable. Use two-pair cabling where two pairs is scheduled.
3) Each pair of insulated conductors to be individually jacketed with foil shield with drain wire and two jacketed conductors.
4) Conductors to be 22 AWG stranded tinned copper.
5) Acceptable product:
6) Belden 9451DP
7) Clark RS22G2P
8) Shattuc SCA.2202ISP

g. Analog Audio Cable single pair (Inner Rack Wiring):

1) Provide for inner rack wiring.
2) PVC outer jacket.
3) Conductors to be 22 AWG stranded tinned copper.
4) Acceptable product:

a) Belden 9451
b) Clark SPA22GS
c) Shattuc: SCA.2201

D. Connectors

1. XLR-3M

a. Connector type: XLR.
b. Gender: Male.
c. Style: Panel mount.
d. Acceptable Product

1) Neutrik NC3MDL-B-1

2. XLR-3F

a. Connector type: XLR.
b. Gender: Female.
c. Style: Panel mount.
d. Acceptable Product

1) Neutrik NC3FDL-B-1

3. BNC Bulkhead Connector

a. Connector type: 75-ohm BNC.

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b. Gender: Female.
c. Style: Bulkhead Jack.
d. Acceptable Product

1) Canare BCJ-JRK with IU-7/16 isolation bushing
2) Kings 2029-17-9
3) Neutik NBB75FI
4) Trompeter UBJ-28

4. RF-45 Panel Mount

a. Connector type: 8 conductor RJ series data.
b. Data Rate: CAT 6 compliant, up to 10 GBit/s.
c. Gender: Female.
d. Style: Panel mount.
e. Acceptable Product

1) Neutrik NE8 series

E. Panels

1. Blank Panels:

a. Type: Flanged.
b. Material: 16-gauge aluminum.
c. Finish: Black brushed anodized.
d. Acceptable product:

1) Belden PNL Series
2) Middle Atlantic BL series
3) Clark RP-A Series

2. Coax Panels:

a. Type; Flanged panel
b. Material: Brush anodized aluminum panel, equal to Middle Atlantic BL series.
c. Panel adapter: Kings 2029-17-9
d. Acceptable product:

1) Belden/Gepco Custom
2) Clark Wire and Cable Custom
3) Approved Whirlwind Custom

F. Triax/SMPTE Plug/Jack Panel:

1. Panel is to be a modular system type to provide flexibility between triax and SMPTE connectors.
2. Connectors are to be electrically isolated from the panel via nonconductive plastic modules.
3. Canare Field SMPTE hybrid connectors: Canare FCS015A-FR.
4. Clark Field SMPTE hybrid connectors: Field = Clark X-HFC-FXW-ST-A6-1.5m.
5. Canare Rack Interconnect SMPTE hybrid connectors: FCS015A-MR.
6. Clark Rack Interconnect SMPTE hybrid connectors: Clark X-HFC-EDW-ST-A6-1.5m.
7. Acceptable product:

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a. Studio Panel:

1) Panel to have a 45-degree angle.

a) Clark Modular Frame RP-MPA-I with MP-S SMPTE module. MP-B blank module

b. Rack panel:

1) Clark Modular Frame RP-MPA-O with MP-S SMPTE module. MP-B blank module
2) OCC RC2U (Contact: Charlie Nehls 972 509-1500)

G. SMPTE Hybrid Components:

1. SMPTE Splice Box ($SPLICE_1$):

a. Provide splice box to be securely mounted in the back of JBT box or triax/SMPTE panel.
b. Splice box to provide for fusion splicing and fiber management.
c. Nylon style connector for terminating copper lines.
d. Coordinate below pigtails with splice box or enclosure.
e. Acceptable product:

1) Canare FCE-4
2) Canare FCE-6 (where two triple cables terminate)
3) Clark HFC-SB4
4) OCC RC2U for SMPTE (Contact: Charlie Nehls 972 509-1500)

H. Plug SMPTE Connector and Pigtails:

1. Provide SMPTE socket connector with 1-meter cable to terminate to above splice box.
2. Provide with dust cap tethered to angled panel.
3. Provide isolation plate for electrical isolation if required (depending on configuration).
4. Provide 3 spare pigtails of each type.
5. Acceptable product:

a. Canare FCS015A-MR with dust cap
b. Clark X-HFC-EDW-ST-A6-1.5
c. Lemo MDT (coordinate pigtail connectors with splice box)
d. OCC SMPTE Socket – OCA-LMFR1SCP006-5050 LEMO, (Canare Connector also available) (Contact: Charlie Nehls 972 509-1500)

I. Socket SMPTE Connector and Pigtail:

1. Provide connector with isolation plate and tethered dust cap.
2. Provide quantity of pigtails in accordance with cable schedule.
3. Provide Owner with three spare cables.
4. Acceptable product:

a. Canare FCS015A-FR with IU-FCF-SET and dust cap
b. Clark X-HFC-FXW-ST-A6-1.5
c. Lemo ECU (coordinate pigtail connectors with splice box)

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d. OCC SMPTE Plug - OCA-LFFR1SCPP006-5050 LEMO, (Canare connectors also available) (Contact: Charlie Nehls 972 509-1500)

19. BROADCAST ENCLOSURES

A. Broadcast Connection Enclosure (JBT)

1. Acceptable Product:

a. Bulloch Fabrication (refer to JBT device description on AV00-00)
b. Other vendors with acceptable solutions

1) American Midwest Power
2) Joseph Electronics

20. DEMONSTRATION, TRAINING, AND EVENT ATTENDANCE

A. Manufacturer's trainers or manufacturer's authorized or approved trainers to provide operations and service training on the following major equipment

1. Production Switcher (all levels)

a. Submit resume on trainer on this device for approval.
b. 8 hours onsite in no more than 4 hours per session.
c. Provide an experienced switcher TD to program macros, custom controls, DVE moves, etc. for first events. This will include consultation on: creative content, programming of content, interfacing to file servers, etc.
d. Switcher TD is specifically to be experienced in broadcast production
e. Curriculum:

1) Internal timing adjustments
2) Normal switcher operations
3) Use of aux busses with DVE
4) Programming switcher effects memory
5) Software configuration for:
6) DVE
7) Editor
8) GPIs
9) Automation System
10) Routing Switcher
11) Camera/robotic interfaces,
12) Other interfaced devices

f. Trainer's Daily reports shall be emailed to those being trained, the Owner's representative, the manufacturer's training department, the systems Contractor and the GC/CM as appropriate. The reports should include information required as part of the submittal; as well as detailed information on setup and operational training specific to the project installation. The Daily reports should be cumulative and edited as appropriate during the training duration.

2. Slo Mo / Clips training

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a. 8 hours onsite in no more than 4 hours per session.
b. Training shall be separate from commissioning. Plan on original trainer to be present at first designated sporting event.
c. Trainer's Daily reports shall be emailed to those being trained, the Owner's representative, the manufacturer's training department, the systems Contractor and the GC/CM as appropriate. The reports should include information required as part of the submittal; as well as detailed information on setup and operational training specific to the project installation. The Daily reports should be cumulative and edited as appropriate during the training duration.
d. If manufacturer's training is not available, Contractor is to substitute own forces for training hour requirements.

5. Graphics/Character Generator implementation specialist (20 hours).

a. Submit resume on implementation specialist on this device for approval.
b. Provide an experienced CG Owner to assist in development and implementation of CG templates. This will include consultation on: creative content, programming of content, interfacing to graphic and statistical systems, etc.
c. CG implementation is specifically to be experienced in game entertainment production (not just broadcast production), preferably in a sporting facility with unique aspect ratio displays.
d. CG Owner is specifically to be experienced with database interfacing to Daktronics DakStats, Statvision, Optasport RTD and summary database or other scoring systems (e.g. MLBAM XML; Scorepad, Status Pro, etc.).
e. It is expected that some of this involvement and time will be in advance to actual on site time and work.
f. It is expected that trainer will need to attend one (1) game as well as the day before the opener (which shall not count towards 20 hours of the training above).
g. No more than 8 hours of this time shall be as traditional CG training; the bulk of the time shall be in assistance of building templates, transitions, 3D effects, clip playout and the like.
h. Trainer's Daily reports shall be emailed to those being trained, the Owner's representative, the manufacturer's training department, the systems Contractor and the GC/CM as appropriate. The reports should include information required as part of the submittal; as well as detailed information on setup and operational training specific to the project installation. The Daily reports should be cumulative and edited as appropriate during the training duration.

B. Approach

1. Manufacturer's training should be assumed to take place on the project site, unless agreed to by the Owner.
2. Training should be scheduled to be non-overlapping, unless agreed to by the Owner.
3. Actual training schedule shall be by agreement with Owner. Do not assume that training will occur over 8 hour days. It is more likely that training will be scheduled in 2-4 hour increments; perhaps over a period of weeks (or even months).
4. In the event that a portion of the training time is occupied in troubleshooting the equipment installation, commissioning the equipment, then the training time shall be extended an equal amount of time.
5. The following is a general idea of the training "curriculum":

a. A general familiarization of the architecture of the device.
b. An explanation of how the device interfaces to the rest of the Video Production System (including data connections; timing requirements and the like).

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c. General training on operating the device.
d. Specific training on device operation (e.g. on the CG, entering statistics; how to access data retrieval sources; how to create repeatable formats and layouts).
e. Saving information; backing information up.
f. Basic troubleshooting
g. Specific troubleshooting (this information may be conveyed to personnel other than the device's "Owners").
h. How to upgrade software; precautions taken while doing (e.g. backing-up existing software).

C. Provide not less than 20 hours of "systems operation and maintenance" instruction to Owner designated personnel on the use and operation of the System.

1. A minimum of three separate sessions, by an instructor fully knowledgeable and qualified in system operation. The System Reference Manuals should be complete and on site at the time of this instruction.

D. Event Attendance

1. Video Production System

a. In addition to training and warranty requirements, this Contractor shall provide event support services to facilitate troubleshooting and effect repair of the specified systems during critical events.

1) Be present on event day from at least 4 hours prior to start, until the time released by the Owner.
2) During these events perform such tasks (e.g. assistance with timing, patching, routing, shading, troubleshooting cabling problems, etc.) as requested by user.
3) Event support personnel shall be a project engineer associated with the original system design, configuration and engineering.
4) During warranty, provide these services for 5 events as designated by Owner
5) Schedule 2 days with team before expiration of the system warranty to review systems and equipment operation.

3.EXECUTION

1. GENERAL

A. All equipment and materials shall be new. Take care during installation to prevent scratches, dents, chips, etc.

B. Mount equipment and enclosures plumb and square. Permanently installed equipment to be firmly and safely held in place. Design equipment supports to support loads imposed with a safety factor of at least three. Seismic bracing shall be installed on appropriate equipment where local codes require such installation.

C. Cover edges of cable pass-through holes in chassis, racks, boxes, etc., with rubber grommets or Brady GRNY nylon grommetting.

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2. AC POWER AND GROUNDING

A. Coordinate and make final connection of power and ground wiring to racks. Hard wire power wiring directly to internal AC receptacles to ensure uninterrupted operation.

B. Install 3-conductor, isolated ground outlets in each rack. Provide a minimum of two spare outlets in each rack. Label each outlet as to which AC circuit is feeding it and provide the same information in the circuit breaker panel. Majority off the device powering should be “dual corded” for redundant distribution.

C. Install a copper ground buss bar top to bottom in each rack, insulated from the rack. Ground equipment chassis not having a three wire power cord to these busses using nuts, bolts and lock washers with No. 12 wire. Connect ground wire from each AC outlet in rack to this buss bar. Connect each rack buss bar to main ground wire in local power panel with properly sized insulated cable.

D. For all devices with detachable power cord, provide a “shortened” cable to connect directly to power strip without “bundling”; this power cable is preferred in a color other than black. Provide Owner 15 of the original length power cables.

3. EQUIPMENT RACKS, EQUIPMENT HOUSINGS AND CONSOLES

A. Mount equipment in racks and consoles and fully wire and test before delivery to job site. If field conditions prevent prior assembly of racks, notify Owner’s Representative in writing that racks will be fabricated on site and the reasons for the change.

B. Provide adequate whisper type ventilation.

C. Looking at the rack from the rear, locate AC power wiring on the left; line level audio, video, and RF wiring on the right. Panels or equipment mounted on the rear rack rails shall not block access to any front mounted components.

D. Where power supplies exist on both sides of the rack provide second power strip on the right (excepting patch panel racks).

E. Provide blank panels to fill unused panel space within the equipment rack / housing / Console.

4. SYSTEM WIRING

A. Take precautions to prevent and guard against electromagnetic and electrostatic hum. For line level audio signals, float cable shields at the output of source device. Shields not connected to be folded back over cable jacket and covered with heat-shrink tubing. Do not cut off unused shields.

B. Exercise care in wiring; damaged cables or equipment will not be accepted. Isolate cables of different signals or different levels; and separate, organize, and route to restrict channel crosstalk or feedback oscillation in any amplifier section. Keep wiring separated into groups for microphone level circuits, line level circuits, loudspeaker circuits, and power circuits.

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C. Make joints and connections with rosin-core solder or with mechanical connectors approved by the Architect's Consultant; where spade lugs are used, crimp properly with ratchet type tool. Spade lugs mounted on 22 gauge or smaller cable to be soldered after crimping.

D. Execute wiring in strict adherence to standard professional practice.

E. Neatly lace vertical and horizontal wiring inside rack with lacing bars. Horizontal wiring in rack to be neatly tied in manageable bundles with cable lengths cut to minimize excess cable slack but still allow for service and testing. Provide horizontal support bars if cable bundles sag. Neatly bundle excess AC power cable from rack mounted equipment with velcro cable ties; where short power cables are not available. Rack wiring to be bundled with velcro cable ties or hoop distribution system. Electrical tape and adhesive backed cable tie anchors are not acceptable.

F. Provide adequate service loops so that equipment mounted on rack slides may be pulled fully out, to their locked position without straining cable.

G. All mini-BNC, mini-DIN and RCA/phono connections shall be made directly to the cable in question; whips and adapters are not acceptable.

H. Wiring and connections shall be completely visible and labeled in rack. Termination resistors shall be 1% tolerance; fully visible and not concealed within equipment or connectors.

I. Custom rack panels shall be 1/8" thick aluminum, standard rack sizes, brushed black anodized finish unless otherwise noted. (Brush in direction of aluminum grain only.) Custom connector plate (speaker, microphone, etc.) finishes shall be selected from manufacturer's full range of standard finishes. Plastic plates will not be accepted, even if building standard in other areas.

1. All engraving shall be 1/8" block sans serif characters unless noted otherwise. On dark panels or push buttons, letters shall be white; on stainless steel or brushed natural aluminum plates, or light-colored push buttons, letters shall be black.

J. All patch panels shall be wired so signal "sources" (outputs from devices) appear on the upper row of a row pair; all "loads" (inputs to devices) appear on the lower row of a row pair. All patch panel designation strips shall utilize alphanumeric and descriptive labels. The jack positions in each horizontal row shall be numbered sequentially from left to right. The horizontal jack rows shall be lettered sequentially from top to bottom. The alphanumeric identification of each jack shall be included on the functional block drawings.

K. General Equipment and Cable Labeling:

1. Provide engraved lamicoid labels on the front and rear of active equipment mounted in racks. Mount labels in a neat, plumb and permanent manner. Embossed labels are not acceptable. Equipment labels to have at least three lines of engraving with the first line listing the general name of the device, i.e., COMB GENERATOR, or RF SWITCHER. The second line to include the schematic reference of the device, i.e., COMB GEN, or RF SWITCH. The bottom line to indicate what other devices or areas this equipment controls, i.e., FEEDS SPLITTER or MONITOR/RECEIVER.
2. Provide an engraved label over each user-operated control that describes the function or purpose of the control. Label size to be adjusted to fit available space.
3. Engraved labels to have 1/8" high characters minimum. Labels to be black with white characters except where indicated.
4. Cables and wiring to be logically, legibly and permanently labeled for easy identification. Labels on cables to be adhesive strip type covered with clear heat-shrink tubing. Factory

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stamped heat shrink tubing may be used in lieu of the adhesive strip style label. Hand-written or self-laminating type labels are not acceptable.

5. Wiring designations to be an alpha-numeric code that is unique for each cable. Locate the cable designation at the start and end of each cable run and within 3" of the point of termination or connection. For cable runs that have intermediate splice points, the cable shall have the same designation throughout with an additional suffix to indicate each segment of the run. Cable labels shall identify source and destination codes on each label. Actual cable designation assignments to be determined by Contractor. Add cable designation codes to system schematic drawings included with Project Record Drawings.
6. Label each terminal strip with a unique identification code in addition to a numerical label for each terminal. Show terminal strip codes on system schematic drawings included with Project Record Drawings.
7. Provide adhesive labels on the rear of equipment where cables attach to indicate the designation of the cable connected at that point.
8. Provide labels at both ends of equipment power cables with the general name of the device they are powering listed.
9. Provide adhesive labels on the top and bottom of DC power supplies with the general name of the device they are powering.
10. Provide adhesive labels below each outlet on all power strips indicting which device is being powered.

L. Device labeling shall consist of two types: functional drawing reference and operational naming convention. Device physical labeling shall apply to functional drawings and physical labels on devices, operational naming convention shall allow user to provide flexible labeling between devices and their function (e.g. camera naming/numbering, file server labels).

M. Installation of Cable and Wiring

1. Install cable in a manner to adhere to manufacturer’s specifications for maximum cable pulling tension, minimum bend radius, and rigging calculations and restrictions.
2. Provide appropriate support at all horizontal-to-vertical transitions in order to keep the weight of the cable from degrading at the point of transition.
3. Provide splice free wiring and cabling from origination to destination.
4. Make joints and connections with rosin-core solder or with mechanical connectors approved by the Owner’s Representative; where spade lugs are used, crimp properly with ratchet type tool.
5. Take precaution to prevent and guard against electromagnetic and electrostatic hum. For line-level audio signal, float cable shield at the output of source device. Shield not connected to be folded back over cable jacket and covered with heat-shrink tubing. Do not cut off unused shield.
6. Isolate cables and wires of different signals or different levels; and separate, organize, and route to restrict channel crosstalk or feedback oscillation in any amplifier section in compliance with ASDI article 12.3.
7. Cover edges of cable and wire pass-through holes in chassis, housings, boxes, etc., with rubber grommets or Brady GRNY nylon grommetting.
8. Install cable so that a radius bend of no less than ten times the cables OD is maintained.

N. Housing Cabling and Wiring

1. Provide 1’-6” minimum service loop within junction boxes to enable plates to be removed from the junction box and serviced.
2. Install cable and wire neatly tied in manageable bundles with cable lengths cut to minimize excess cable slack but still allow for service and testing. Provide horizontal support bars if cable bundles sag.

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3. Cables should be dressed to permit individual plates and panels to be removed, without disturbing adjacent plates or panels.
4. Neatly bundle excess AC power cable from housing mounted equipment with plastic cable ties.
5. Provide plastic cable ties or lacing twine to bundle cabling and wiring. Electrical tape and adhesive backed cable tie anchors are not acceptable.
6. Install with connections completely visible and labeled.

5. CONTRACTOR TESTS AND ADJUSTMENTS

A. Verify the following before beginning actual tests and adjustments on the system:

1. All products are installed in proper and safe manner according to manufacturer's instructions.
2. Insulation and shrink tubing are present where required.
3. All Dust, debris, solder splatter, etc. is removed.
4. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
5. All labeling has been provided.
6. Temporary facilities and utilities have been properly disconnected, removed and disposed of off-site.
7. All products are neat, clean and unmarred and parts securely attached.
8. All broken work, including glass, raised flooring and supports, ceiling tiles and supports, walls, doors, etc. have been replaced or properly repaired, and debris cleaned up and discarded.
9. All extra materials, portable equipment and spares shall be delivered and stored at the premises as directed.

B. Prior to energizing the System verify and perform the following tests and adjustments in compliance with applicable EIA standards. Record the results of each test in the Project Record Manual.

1. Electronic devices are properly grounded.
2. Test each AC power receptacle with a circuit checker for proper hot, neutral and ground connections.
3. Powered devices have AC power from the proper circuit.
4. Measure and record the DC resistance between the technical ground in any equipment rack or console and the main building ground. Resistance should be 0.15 ohms or less.

C. Preparation for Acceptance, prior to final inspection:

1. Verify each individual component is operating properly
2. Verify each individual component's performance meets the manufacturer's published performance for this unit.
3. Verify proper operation from controlling devices to controlled devices.
4. Verify proper adjustment, balance and alignment of equipment for optimum quality and to meet the manufacturer's published specifications.
5. Establish and mark normal settings for each level control, and appropriately record these settings within the "System Operation and Maintenance Manual."
6. Verify that all communications and networking services are installed and in proper working condition (Ethernet, IP addressing)
7. Other tests on equipment or systems as deemed appropriate, such as, but not limited to:

a. Cameras

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1) Verify Camera power on
2) Verify all indicators on Camera reflect no short circuit or open circuit conditions
3) Verify Pan-Tilt arms function smoothly
4) Verify Focus control is connected and working
5) Verify Zoom control is connected and working
6) Verify Camera Head is balanced in front, back and center
7) Verify Intercom headset is working
8) Verify Return Video is functional
9) Verify the Video mode is set proper mode (HD/SD)
10) Verify Aspect Ratio is set to proper mode (16:9/4:3)

b. Camera Base Stations:

1) Verify all SMPTE connectors from base stations to cameras fit snugly into each other and are secure.
2) Verify that there is no interruption in SMPTE cable by checking communication link indicator between camera and base station is OK.
3) Verify On-Air/Tally and ISO indicators function as per manufacturer's specifications.
4) Verify cable lengths do not exceed standard maximum recommended lengths for respective cable.

c. CCUs/OCPs

1) Verify relevant cameras are assigned and connected to respective CCU/OCP.
2) Verify assigned IP addresses and subnet mask are configured correctly
3) Verify iris control sensitivity, mode, range and center is setup and joystick is calibrated
4) Verify shading control is turned on
5) Verify White Balance is set and parameters stored.
6) Verify control of camera iris

d. Video Production Switcher

1) Verify assigned IP address and subnet mask is configured correctly
2) Verify all sources are defined, labeled and routed accurately
3) Verify all output assignments are accurate and labeled (program vs. preview)
4) Verify all external devices (DDRs, VTRs, etc) are routed accurately
5) Verify source to button mapping and labeling is to end user preferences

e. Monitors

1) Verify all camera preview cameras have picture from assigned cameras and are labeled as such
2) Verify program and preview monitors have the correct picture routed to them from production switcher
3) Verify DDRs, VTRs monitors have picture
4) Verify aspect ratio is set to 16:9 for native HD signal
5) Verify monitors are calibrated and color matched

f. Cable Testing

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1) Cable testing is used to verify that the cable meets the manufacturer's specifications after installation and termination of the cable.
2) The cable testing data provides a reference for troubleshooting future problems with the cable plant.
3) SMPTE Hybrid Cable

    a) Provide a Method of Procedure (MOP) for testing:

        (1) Provide information of the test equipment (manufacture and model #) used for tests. Date of last calibration if applicable.
        (2) Provide a detail description of the test performed for each cable system. Provide functional diagram (if it provides information that is difficult to describe) of test setup with description of test cables used (including lengths if applicable for TDR and OTDR tests). THE MOP should be available to field personnel to perform testing. The MOP to be used to verify test setup and testing during check out.
        (3) Refer to Close Out Documentation in Part 1 of this specification for close out documentation.

    b) Fiber Testing

        (1) Perform visual optic inspection to verify connectors are properly polished and free of defects such as direct, scratches and polishing defects before performing data measurements.
        (2) SMPTE cable to be tested at the splice box before pigtails are installed to verify cable and terminations at the splice box is correct. Provide final testing with splice boxes and pigtails installed. Include all 3 channels for triple SMPTE cable, even if they are not initially terminated with pigtails.
        (3) Perform bi-directional field testing of each terminated strand of fiber optic cable listed in this Section for length, loss and polarity. Field testing equipment must include both an optical loss test set (OLTS) and optical time domain reflectometer (OTDR). Testing measurements are required to meet transmission performances listed in ANSI/TIA-568.3-D/4.2/Table 1 at both 850 nm and 1300 nm for multimode fiber, and both 1310 nm and 1550 nm for single-mode fiber. The shortest pulse width should be used to provide maximum resolution for OTDR tests.
        (4) Submit cable certification reports of the following field-testing measurement methods:

            (a) Attenuation
            (b) Length
            (c) Polarity
            (d) OTDR traces

        (5) Cable certification reports must bear the location/room number and cable identifier for each cable tested. Test results/reports in electronic copies by closet must be delivered to the Project Manager according to the submittal procedures.

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(6) Deliver an electronic file containing all individual test records and the software required to display and print the test records using a typical personal computer (PC).

(a) Deliver test results in raw data and in PDF format on a memory stick or DVD.

4) Copper Cable Tests:

a) Provide a Method of Procedure (MOP) for testing:

(1) Provide information of the test equipment (manufacture and model #) used for tests. Date of last calibration if applicable.
(2) Provide a detail description of the test performed for each cable system. Provide functional diagram (if it provides information that is difficult to describe) of test setup with description of test cables used (including lengths if applicable for TDR and OTDR tests). THE MOP should be available to field personnel to perform testing. The MOP to be used to verify test setup and testing during check out.
(3) Refer to Close Out Documentation in Part 1 of this specification for close out documentation.
(4) Hi-Pot testing

(a) Riser rated cable – 2500-volt DC
(b) Plenum rated cable – 1600-volt DC

5) Video Coax

a) Low Power Tests: Utilize a Gepco TT-22 with Triax to BNC adapters or equal for test units. Document any issues and action to correct as part of the final report.
b) High Power Test: After low power test, perform a high voltage wiring and cabling test with a megohmeter (Megger®) to test for the following:

(1) Center conductor to shield isolation: Test using appropriate DC voltage for a period of not more than 2 seconds and look for high capacitance in the cable. Set the sensitivity for over-current to 50% setting.
(2) Plenum cable requires a lower voltage.

c) TDR tests:

(1) Perform Time Domain Reflectometer (TDR) tests on coax cable to test for cable irregularities and length.
(2) Perform TDR test on the inner conductor and shield. Provide test data in graph form as part of the as built documentation provided to owner.

d) Or Return Loss (RL) Tests:

(1) Provide a dual port network analyzer with VSWR bridge and impedance matching transformers.

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(2) Sweep cables from 5MHz to 270MHz.
(3) Repair cables that do not meet manufacturer's Return Loss (RL). Typical return loss readings for RG-6 digital coax.
(4) Return Loss for frequencies from 5MHz to 270MHz to be a Minimum of 21dB.

(a) Provide test data in graph form as part of the as built documentation provided to owner. Provide manufacture's stated Return Loss as part of the documentation.

e) Sweep Tests:

(1) Sweep using a spectrum analyzer with an internal generator. Provide a coax jumper cable to loop test signal from tracking generator back to analyzer.
(2) Sweep cables up to a minimum of 270MHz. Record the coax loss at 100MHz, 270MHz and 500MHz.

6) Audio Cables

a) Test XLR's where they are hard split.
b) Test conductors and shield for shorts to building ground.
c) Test for shorts between conductors and shield.
d) Test that cable is wired to industry standard pin 2 high, pin 3 low and pin 1 screen (shield).

7) Test Results

a) Provide an Excel spreadsheet with the following tables
b) Cable # (should be final as built cable #).
c) From Location
d) From Location panel # port #
e) To Location
f) To Location panel # and port #
g) Cable manufacture and model #.
h) Notes: Record any issues and fixes during the testing.
i) Cable length from TDR:
j) HI-POT test between center pin and inner shield
k) HI-POT notes from any issues and remedy to fix issue.
l) TDR reference test number for TDR data file.
m) Submit graphs of TDR tests for review by the consultant.
n) Note any cable failures and the fixes to bring cable into spec

D. Commissioning. Commissioning shall be performed by a combination of the Contractor, the manufacturer or a separate commissioning agent retained by the Contractor. The following identifies some, but not all, of the commissioning tasks expected of the commissioning team. This list is not intended to be comprehensive and should be considered a general guideline for the Contractor without a defined commissioning process statement.

1. Cameras and tripods.

a. Setup camera in accordance with Manufacturer's procedure
b. Balance camera and lens on tripod

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c. Confirm presence and proper operation of:

1) Lens controllers
2) Tripod feet, spreaders
3) All cases and carts
4) Rain slicker(s), if any
5) Viewfinders and attachments
6) Batteries and battery chargers
7) Specified microphones
8) Specified wireless hardware
9) Specified camera lighting

d. Set lens back-focus
e. Exercise full zoom/focus control on lens
f. Confirm Remote control panel properly interacts with camera
g. Confirm tallies function as expected at each CCU and Camera. Provide/plan on green and red tally.
h. Confirm Intercom connections are balanced and functional; including CCU front panel connections
i. Confirm program audio connections are properly functioning
j. Confirm return video functions as appropriate

2. Time Code

a. Confirm time code is set to appropriate clock and offset for team/league requirements
b. Confirm time code is distributed to all devices with time code inputs (including file servers, tape machines, multi-viewers, etc.)
c. Confirm time code records properly at all devices
d. Confirm time code does not cross talk into audio or video circuits

3. Computers, Networking, IP and Data

a. Coordinate IP address for any equipment supplied herein.

1) Program Gateways
2) Program subnets
3) Coordinate subnets and V-lans with other systems including, but not limited to AV, scoring and video displays, and league statistics.

b. Coordinate firewall and routing configuration if needed between production studio system and house system
c. Set all clocks, software and hardware, to listen to local or network NTP server.
d. If appropriate create auto-logon scripts
e. Establish logical share names, including, but not limited to, AV, scoring and video displays, and league statistics.
f. Set startup process to include logging into appropriate services and servers (e.g. establish SQL connection between Character Generator and data service)
g. Establish a defined back up process and train user
h. Install all relevant software including, but not limited to:

1) Clients preference for browser(s)
2) Word processing, spreadsheet, presentation and general office software
3) Adobe Acrobat

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4) Software used to control, monitor and troubleshoot any hardware provided herein
5) Creative/Graphic suites as appropriate

i. Ghost all boot and configuration hard drives after setup and acceptance, but before the users begin training.
j. Ghost all boot and configuration hard drives 1 month after acceptance.
k. Connect all data interlinked devices (e.g. CGs, protocol translators, robotic cameras, etc) with their sources using appropriate control routing switcher, patches, distribution devices and the like, Confirm

1) Baud rate, programming speed
2) Desired operations are functional and reliable
3) Interconnection with other systems including, but not limited to, AV, scoring and video displays, and league statistics.

l. Rack and UPS sensors (SENSOR).

1) Setup all rack and room temperature, humidity and moisture sensors with appropriate alarming, notification, and SNMP alarms. .
2) Setup all UPS alarms with appropriate alarming, notification, and SNMP alarms

4. KVM Systems

a. Label all source and destinations with meaningful labels (e.g. COMP 15-01 is not acceptable; C15-01; Riedel Director is).
b. Coordinate labeling to include the registered device name, MAC address and IP Address.
c. Determine the extent that certain users should be locked out (e.g. not all users should have access to CG keyboard).

5. Intercom

a. Setup each station with labels as coordinated with the Owner.
b. Test each user station to every other station.
c. Stress test the system under event standards so that users are located at each station and attempt to communicate as they would for the event.
d. Setup all wireless communication so that talk/listen is available throughout the covered area. Test with high ambient noise conditions.
e. Balance all users, user station, and intercom sources.
f. Null all party line circuits
g. Test Audio Monitoring Paths using the intercom system; verify appropriate gain structure, adjust as required.

6. Audio Phase and Stereo imaging.

a. Check audio phase from each device to each destination, through routing switcher and direct patch. Correct any anomalies.
b. Check Left/Right pairing from each device to each destination, through routing switcher and direct patch. Correct any anomalies.
c. Set audio levels through each device to each destination, through routing switcher and direct patch for unity gain. Adjust interfacing devices to accommodate level differences that occur. Correct any anomalies.

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d. Use appropriate test tapes and signals and tones to verify playback level of file servers, tape machines and any device with audio playback capability.

7. SMATV, IPTV, Broadcast cabling and Sound System interconnections.

   a. Check audio phase from each device to each destination, through routing switcher and direct patch. Correct any anomalies.
   b. Check Left/Right pairing from each device to each destination, through routing switcher and direct patch. Correct any anomalies.
   c. Set audio levels through each device to each destination, through routing switcher and direct patch for unity gain. Adjust interfacing devices to accommodate level differences that occur. Correct any anomalies.

8. Coordinate proper naming and labeling between video and audio sources and destinations that originate elsewhere including, but not limited to Sound, Broadcast, MATV, IPTV, Video Display and LED Scoring devices which may be related work. This shall include but not be limited to: common device labels and nomenclature at each end, rack numbering, all routing interfaces.

   a. After cables are landed and coordinate verify proper connection with each supplier.
   b. Confirm that physical labels correspond to drawing labels and most importantly any alphanumeric control system labels (e.g. Tuner 1 should also be called SAT RX 5 and DIRECTV 7)

9. Production and Routing switcher configurations to Owner/Owner preferences this shall include, but not be limited to:

   a. All equipment settings
   b. Configurations
   c. Software setup
   d. All hardware, button, and software labeling on devices into groups as requested by Owner/Owner.
   e. Routing switcher programming including real and virtual naming configurations, salvo setup and programming and the like.
   f. Audio Routing

      1) Provide appropriate virtual labels for audio sources; building mono, left right pairs as directed by the Owner for recording multiple audio sources and/or routing to external locations.
      2) Set gain between exterior ties and the routing system
      3) Verify gain of feeds to and from the PA system, adjust as necessary
      4) Configure MADI routing paths to exterior devices, if MADI interface is present.
      5) Assist user in setting up routing to VCRs and File servers for appropriate game and non-game audio configurations.

   g. Proper Alphanumeric transfer of sources to destinations including under-monitor tally designations, tally and between production and routing switchers. This shall include, but not be limited to:

      1) Multi-viewers
      2) In-monitor tally/under monitor displays whether connected via router or direct to auxiliary bus

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h. Salvos

1) Establish pre-game and game salvos for all video and audio sources and destinations.
2) Modify salvos after all event attendance.
3) Archive each salvo.

i. Interfaces to other devices for proper operation (e.g. machine and file server control from the production switcher, through a control routing layer, to the end devices).
j. Tally programming
k. GPI and/or switcher peripheral setup and control of:

1) Character Generator(s)
2) File server(s)
3) Video Display Processors (which are likely supplied by others)
4) Routing Switcher
5) Audio playback devices
6) Audio Mixers
7) Cameras and robotics

l. Setup and configure all protocol converters that may be used between devices including but not limited to:

1) Different switching systems
2) Scoring and Video Display systems controllers

10. Video Routing and Multi-image viewing

a. Using a SMPTE pathological pattern test each check video path from each device to each destination, through routing switcher and direct patch. Correct any anomalies.
b. With user, determine initial multi-image viewer configuration and layout.
c. Assign both functional drawing reference and operational naming convention.
d. Video board processors
e. Setup of video processing returns

11. Distribution Gear and Signal Processing. Setup all software remote interface and operation software including but not limited to:

a. Device labeling corresponding to drawings as well as functional use
b. Signal path processing and/or interconnection paths as allowable
c. Set alarm and notifications screens as allowed.

12. Closed Captioning

a. Setup video and audio routing into and out of the device.
b. Coordinate connection of the captioning steno machine to the encoder
c. Set priority on encoder based upon user preference (e.g. local steno override or is ignored).
d. Coordinate addressing inputs/outputs from the decoder to scoring and video display.
e. Setup intercom station to receive a headset only on the 2nd output of the intercom station

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f. Setup listening mix

13. Record all software settings and creating appropriate back up records (paper and electronic as appropriate).
14. Confirm all equipment, loose or fixed, is on site. Provide written list and confirmation of such. Note that this list may be the same as the serial number list required for closeout submittals.
15. SMFO Cables

    a. List each fiber strand separately with description and cable number. Include the measured length of the cable using OTDR and power attenuation.

6. TEST EQUIPMENT

A. Provide the following equipment on site for final acceptance testing. Test equipment to be available for the entire period through final system acceptance. Prior to start of testing, provide a list to the Owner's Representative of test equipment make and model numbers that will be used.

1. Dual-trace oscilloscope: 100 MHz bandwidth, 1 mV/cm sensitivity, TV trigger.
2. Multimeter: Measurement range, DC to 20,000 Hz, 100 mV to 300 V, 10 ma to 10A.
3. Television signal generator: Tektronix
4. 75 ohm, 1 percent terminators, connection adapters, test cabling, etc., as required.
5. Fiber Optic Cable Test Kit: Optical Wavelength Laboratories KIT-WT-WSVSDST.
6. Provide two portable VHF or UHF business band radios for use during acceptance testing. Radios should have a transmission range sufficient to cover entire project. Radios to include rechargeable batteries and recharger along with "holster" for wearing on belt. Radios to be available for duration of testing process, including any follow-up visits required prior to final acceptance.

7. ACCEPTANCE

A. Upon completion of installation and initial tests and report specified in Part 3, acceptance testing shall be performed by the Architect's Consultant.

B. Acceptance testing will include operation of each major system and any other components deemed necessary. Contractor will assist in this testing and provide any test equipment required specified herein. Contractor shall provide at least 1 technician available for the entire testing period (day and night), to assist in tests, adjustments, and final modifications. Tools and material required to make any necessary repairs, corrections, or adjustments shall be furnished by the Contractor. Testing process is estimated to take a minimum of 3 days.

C. The following procedures will be performed on each System:

1. Video Signal: From all source inputs (for cameras, character generators, video tape units, etc.) through all VDAs, processors, switchers, etc., to all signal destinations. Verification of correct signal timing for each source, via each path will be made using standard test patterns. Each processing device will be checked such that the signal passes through the device in the no processing mode such that unity luminance, chrominance, and signal timing and phasing conditions are achieved.
2. Control functions shall be checked for proper operation, from controlling devices to controlled devices.

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3. The audio fidelity test shall consist of driving the system with pink noise and measuring the response in each 1/3 octave band from 40 to 16,000 Hz. Octave, 1/3 octave, or notch filters as specified shall be used to adjust the response as necessary to fit the requirements of the space.
4. Adjust, balance, and align equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for each level control and record these settings, in the "System Operation and Maintenance Manual."
5. Installed and loose equipment will be inventoried for correct quantity.
6. Any other test on any piece of equipment or system deemed appropriate.

D. In the event the need for further adjustment or work becomes evident during equalization and/or acceptance testing, the Contractor will continue his work until the system is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications, the Contractor will pay for additional time and expenses of the Architect's Consultant.

E. The Architect's Consultant's fees and costs involved in acceptance testing are not the responsibility of the Video Control Contractor, except as described in Part 3 of this specification.

F. In the event that the Video Production System is used prior to final acceptance, attendance in support of that usage shall not be construed as acceptance, or as event attendance.

END OF SECTION 116350

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SECTION 123661 - SOLID SURFACE COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Solid surface material countertops.
2. Solid surface material backsplashes.
3. Solid surface material end splashes.

1.3 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

C. Samples for Verification: For the following products:

1. Countertop material, 6 inches (150 mm) square.
2. Wood trim, 8 inches (200 mm) long.
3. One full-size solid surface material countertop, with front edge and backsplash, 8 by 10 inches (200 by 250 mm), of construction and in configuration specified.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.7 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.

1. Manufacturers and products as listed on Drawings.
2. Type: Provide Standard type unless Special Purpose type is indicated.
3. Colors and Patterns: As selected by Architect from manufacturer's full range.

B. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.

C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 COUNTERTOP FABRICATION

A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Premium.

B. Countertops: 1/2-inch- (12.7-mm-) thick, minimum, solid surface material with front edge built up with same material.

C. Backsplashes: 1/2-inch- (12.7-mm-) thick, solid surface material.

D. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

E. Joints: Fabricate countertops in sections for joining in field, with joints at locations indicated, and approved by Architect.

1. Joint Locations: Not within 18 inches (450 mm) of a sink or cooktop and not where a countertop section less than 36 inches (900 mm) long would result, unless unavoidable.

F. Cutouts and Holes:

1. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

A. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m), 1/4 inch (6 mm) maximum. Do not exceed 1/64-inch (0.4-mm) difference between planes of adjacent units.

B. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

C. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

D. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

F. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.

G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

1. Seal edges of cutouts in particleboard subtops by saturating with varnish.

H. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123661

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SECTION 126300 – FIXED AUDIENCE SEATING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fixed stadium chairs, floor or riser mounted, with self-lifting seat that rises to a uniform 3/4-safety fold position.

1.3 SUBMITTALS

A. Product data for each chair model specified to include construction details, material descriptions and finish options

B. Seating layout (shop drawings) developed from the contract drawings that show aisle widths, chair spacing for each row, row-lettering and chair-numbering scheme, chair dimensions and back pitch. Layout drawings to also include locations for accessories, including left- and right-hand tablet arms, electrical devices, accessibility provisions and attachments to other work.

C. Samples for verification & finish selection to include:

1. Initial finish selections to be made from manufacturer's standard color and fabric guides.
2. Final powder coat selection to be approved from manufacturers standard-sized samples not less than 1" x 3".
3. Final plastic color selection to be approved from manufacturers standard-sized samples not less than 2" x 3".

D. Maintenance instructions and inspection guidelines furnished for each chair model specified.

E. Manufacturer's warranty.

1.4 QUALITY ASSURANCE

A. Source Limitations:

1. Obtain each type of fixed seating required, including accessories and mounting components, from a single manufacturer.

1.5 PROJECT CONDITIONS

A. Field Measurements:

1. Take field measurements to verify or supplement dimensions indicated on contract drawings prior to manufacturing.

1.6 PROJECT COORDINATION

A. Do not deliver or install seating until space is free of lifts and/or scaffolding used by other trades which may interfere with installation and/or damage seating.

B. Coordinate concrete requirements needed for proper installation.

1.7 WARRANTY

A. Provide a manufacturer's warranty covering the material and workmanship for the specified warranty period from date of Substantial Completion.

B. Warranty Periods:

1. Structural Components: one year.
2. Operating Mechanisms: one year.
3. Plastic, Wood and Painted Components: five years.
4. Upholstery Fabric: one year.

PART 2 – PRODUCTS

2.0 MANUFACTURERS

A. Acceptable manufacturers include:
1. Irwin Seating Company
2. Camatic Seating
3. Hussey Seating

2.1 MATERIALS AND FINISHES

A. Cast Iron shall meet requirements for ASTM A 48/A 48M, Class 30, gray iron castings free of blow holes and hot checks with parting lines ground smooth.

B. Prior to powder coating, metal and cast iron parts shall be treated with a zinc phosphate cleaning process for superior finish adhesion. All cast iron and steel parts shall be coated with a corrosion inhibiting primer to a minimum thickness of 1 mil. The hybrid thermosetting powder coat finish shall be applied by electrostatic means to a thickness of 2 - 5 mils. After coating, parts shall be oven baked to create a durable finish that meets the following test standards for weathering and corrosion:

1. No blistering, cracking, de-lamination or chalking
2. 5 Year South Florida
3. Delta E ≤ 5 when tested per ASTM D2244
4. Loss of Gloss at a minimum of:

   a. 40% for 5 Year South Florida Powders when tested to ASTM D523

5. No greater than a No. 8 rating for colors and a No. 6 rating for whites per ASTM D4214, test method A
6. Cross Hatch Adhesion of 5B (No Loss) per ASTM D3359B
7. Pencil Hardness with a minimum rating of 2H per ASTM D3363
8. Front impact of at least 80in-lbs when tested per ASTM D2794
9. No more than 5% rust after 1500 hours tested per ASTM B117
10. Any perceived blistering, cracking, or de-lamination at no less than a scribe rating of 7 (1/16" or 2mm maximum creep) per ASTM D1654
11. Color: Selected by Architect from manufacturer's standard offering.

C. Molded Plastics:

1. Structural components shall be mar and dent resistant high density glass-filled polypropylene with UV stabilizers.
2. Decorative components shall be mar and dent resistant high density polyethylene (HDPE) with UV stabilizers.
3. Plastic Components Color: Selected by Architect from manufacturer's standard offering.

2.2 FIXED STADIUM SEATING – GENERAL AUDIENCE SEATING

A. Permanent arrangement of fixed audience seating as shown on seating layout drawings.

1. Approved manufacturers subject to compliance with requirements outlined herein.
2. Basis-of-design for fixed audience seating is Irwin Seating Company model 39.45.35.45 Senator or comparable product approved by Substitution.
3. Substitutions: Refer to Section 012500 "Substitution Procedures" for requirements.

B. Standards shall be one-piece Class 30 cast gray iron standards, featuring a gently curved, contemporary open design. Standards shall be cast to provide exceptional strength and to maintain proper height and angle for seats and backs and to provide proper clearance of the riser face. Standards shall be cast with integral blocks for back and seat attachment. Armrests shall also be an integral part of the standards castings, providing a comfortably wide, scrolled arm support.

C. Aisle standards shall be cast to provide the same functions as the center standards, and shall be designed to provide a simple decorative closed end at the aisles. The center of the aisle standard face shall have a raised, inclined landing to provide a convenient location for a row-identification letter.

D. Back components shall be one-piece, double-wall blow-molded plastic construction, high density, high impact-resistance linear polyethylene with smooth surface. Backs shall be molded with horizontal slats having minimal openings to carry the theme of baseball park chairs, with a chapeau shape for the top of the back. The backs shall be 18" length, extending to a height of 32 inches above level floor, and shall be generously curved side-to-side, with gentle vertical compound contouring. The blow-molded plastic shall be designed to be a sturdy, structural component and serve in concert with the upper extension of the cast iron standards. Attachment of molded plastic backs to standards shall be accomplished by 1/4" heat-treated aluminum alloy truss-head bolts securing the blow-molded plastic to integrally molded lugs on the cast iron standards, the bolting arrangements fitted with integrally mounted spacers to maintain the integrity of the plastic. The backs shall be recessed for provision of number plates. The back assembly shall be certified through routine ISO testing to withstand a 250 lb. static load test applied approximately 16" above the seat assembly and a 100,000 cycle 40 lb. swing impact test.

E. Molded Plastic Seat:

1. The seat components shall be one-piece, double-wall construction and formed with impact-resistant, blow-molded, (HDPE) high-density polyethylene plastic. The seats shall feature three (3) shallow, horizontal recesses molded in the smooth seat surface to create four (4) aesthetic "slats". The tops of the seats shall be formed to provide even, comfortable support for the seated individual by properly contouring to the shape of the human form. Seat components shall be molded to avoid sharp, pressure-generating ridges by gently falling away at the front of the seat. The underside of the seat shall be recessed to provide support of the seat surface. Structural seat- lift arms shall transfer the occupant load to the cast iron pivot and the chair's support structure (standards). Seat-lift arms shall be formed from engineered injection-molded, thermoplastic polyurethane (TPU) and painted to blend aesthetically with the blow-molded plastic.
2. Seats shall lift automatically to a uniform three-quarter fold position when unoccupied, and shall rotate on two molded, structural, glass-filled nylon hinge rods in internally molded channels with

integral down-stops for exceptional strength. Seat-lift shall be accomplished by compression springs and lubricated, high-tech plastic cams, providing quiet, gentle seat uplift. Seats shall self-rise to a uniform position when unoccupied. The mechanism shall be certified through routine ISO testing to exceed 300,000 cycles during ASTM Designation F851-87 Test Method for Self-Rising Seat Mechanism. In addition, the seat shall withstand as a 600 lb. static load test applied approximately 3” from the front edge of the seat assembly and a 50,000 cycle 125 lb. vertical drop impact test.

2.3 FIXED STADIUM SEATING – GENERAL REQUIREMENTS

A. Chair width shall vary to accommodate sightlines and row lengths.

B. Back pitch shall be fixed as shown on seating layout drawings.

C. A numbering system shall be provided for identification of all chairs. Number and letter plates shall be furnished as shown on the approved seating layout, and shall be 1-3/4" x 2-3/4" elliptical-shaped anodized aluminum. Number plates shall be located in a molded recess in the upper corner of the back, while row letters shall be located on a raised land on the side of the aisle standards. Number and letter plates shall be attached with bright-plated matching hardware.

D. Cupholders shall be provided and attached to the rear of each chair in locations detailed on the seating layout drawings and shall be HDPE molded plastic. Upper opening diameter of the molded cupholder shall be 3-3/4", with a bottom restriction to accommodate a variety of container sizes. Cupholders shall be attached at the joining of adjacent backs of the chairs.

E. Aisle standards shall be cast with an integral ring to hold a 5-1/4” aluminum plate screen-printed with an approved logo. Plate shall be secured to the standard with an adhesive backing. Artwork shall be customer supplied in a format suitable for reproduction by the manufacturer.

F. Accessible Seating:

1. Shall be designated on the seating layout drawings and designed to allow an individual to transfer from a wheelchair to the stadium chair. The aisle standard shall be equipped with an armrest capable of lifting to a position parallel with the chair back, opening sideways access to the seat. Aisle standards so equipped shall be provided with a label, displaying an easily recognizable "handicapped" symbol. Decorative requirements of aisle standards are waived for the handicapped access standards.

   a. Note: Verify alternative of open floor areas for wheel chairs with Drawings, if approved by authority having jurisdiction.
   b. Provide removable chairs (skid/sled mounted with easily removable fasteners) where wheelchair spaces are indicated. Coordinate final location with owners.

G. Furnish extra materials from the same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish complete seat and back assemblies for each type and size of chair seat and back; 50 and 10, respectively, for general and premier seating.
2. Furnish armrests equal to 60 complete installed seats.

2.4 FABRICATION

A. Fabricate floor attachment plates to conform to floor slope, if any, so that standards are plumb and chairs are maintained at same angular relationship to vertical throughout project.

B. Fabricate riser attachment plates to conform to riser heights so that standards are plumb and chairs are maintained at same angular relationship to vertical throughout project.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to layout and installation examine floors, risers, and other adjacent work and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the work including, but not limited to, plumb of riser faces and concrete conditions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install seating in locations indicated and fastened securely to substrates according to manufacturer's written installation instructions.

B. Use installation methods and fasteners that produce fixed audience seating assemblies with individual chairs capable of supporting an evenly distributed 600-lb static load applied 3” from front edge of the seat without failure or other conditions that might impair the chair's usefulness.

C. Install seating with chair end standards aligned from first to last row and with backs and seats varied in width and spacing to optimize sightlines.

D. Install riser-mounted attachments to maintain uniform chair heights above floor.

E. Install chairs in curved rows at a smooth radius.

F. Install seating so moving components operate smoothly and quietly.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust chair backs so that they are properly aligned with each other.

B. Adjust self-rising seat mechanisms so seats in each row are aligned when in upright position.

C. Verify that all components and devices are operating properly.

D. Repair minor abrasions and imperfections in finishes with coating that matches factory-applied finish.

END OF SECTION 126300

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SECTION 142400 – MACHINE-ROOM LESS ELEVATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes hydraulic passenger and service elevator.

B. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
2. Division 04 Section "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.

    a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
    b. Divider beams.
    c. Hoist beams.
    d. Structural-steel shapes for subsills that are part of steel fraFor concrete frame buildings, delete subparagraph and associated subparagraphs above and retain subparagraph and appropriate associated subparagraphs below.
3. Division 05 Section "Decorative Metal" for combination units that contain hall push-button stations.
4. Division 09 Section " finish flooring in elevator cars.
5. Division 26 Sections for electrical service for elevators to and including fused disconnect switches at machine room door and standby power source, transfer switch, and connection from auxiliary contacts in transfer switch to controller.
6. Division 27 Section "Communications Horizontal Cabling" for telephone service for elevator.
7. Division 28 Section "Access Control" for security access system equipment used to restrict elevator use.
8. Division 28 Section "Fire Detection and Alarm" for smoke detectors in elevator lobbies to initiate emergency recall operation and heat detectors in shafts to disconnect power from elevator equipment before sprinkler activation and for connection to elevator controllers.
9. Division 31 Section "Earth Moving" for excavating well hole to accommodate cylinder assembly.

C. Allowances: Provide finished passenger and service elevator cars under the Elevator Car Allowance specified in Division 01 Section "Allowances." Allowance includes furnishing and installing the following:

1. Car wall finishes including trim.
2. Car floor finishes.
3. Car ceiling finishes.
4. Car and hoistway door finishes.
5. Car door sills.
6. Car light fixtures.
7. Handrails.
8. Cutouts and other provisions for installing elevator signal equipment in cars.

D. Unit Prices: Rock excavation for cylinder well holes will be paid for under the unit price indicated in the Contract and as specified in Division 01 Section "Unit Prices."

1.3 DEFINITIONS

A. Definitions in ASME A17.1 apply to work of this Section.

B. Defective Elevator Work: Operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

C. Service Elevator: A passenger elevator that is also used to carry freight.

1.4 SUBMITTALS

A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for the following:

1. Car enclosures and hoistway entrances.
2. Operation, control, and signal systems.

B. Shop Drawings: Show plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment and signals. Include large-scale layout of car control station and standby power operation control panel. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.

C. Samples for Initial Selection: For finishes involving color selection.

D. Samples for Verification: For exposed finishes of cars, hoistway doors and frames, and signal equipment; 3-inch- square Samples of sheet materials; and 4-inch lengths of running trim members.

E. Informational Submittals:

1. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.
2. Qualification Data: For Installer.
3. Manufacturer's or fabricator's certificate indicating percentage of post-consumer recycled content by weight and pre-consumer recycled content by weight for each Product specified under this Section.

F. Closeout Submittals:

1. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.

   a. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.

2. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
3. Warranty: Special warranty specified in this Section.
4. Continuing Maintenance Proposal: Service agreement specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Elevator manufacturer or manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain elevators**,** including through one source from a single manufacturer.

1. Provide major elevator components, including pump-and-tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cabs, and entrances, manufactured by a single manufacturer.

C. Regulatory Requirements: Comply with ASME A17.1 and elevator design requirements for earthquake loads in ASCE 7.

1. Effective peak velocity acceleration (Av) for Project's location is [**less than 0.10 (seismic risk zones 0 and 1)**] [**greater than or equal to 0.10, but less than 0.20 (seismic risk zone 2)**] [**greater than or equal to 0.20 (seismic risk zones 3 and 4)**].
2. Design earthquake spectral response acceleration, short period (Sds) for Project is 0.324g
3. Project's seismic design category is C defer to structural drawings.
4. Elevator importance factor is **1.5**.

D. Accessibility Requirements: Comply with Section "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." 407 in ICC A117.1.

E. Fire-Rated Hoist way Entrance Assemblies: Door and frame assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252, IBC 2015.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging.

B. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's written recommendations to prevent damage, deterioration, or soiling.

1.7 COORDINATION

A. Coordinate installation of sleeves, block outs, and items that are embedded in concrete or masonry for elevator equipment. Furnish templates and installation instructions and deliver to Project site in time for installation.

B. Furnish well casing and coordinate delivery with related excavation work.

C. Coordinate sequence of elevator installation with other work to avoid delaying the Work.

D. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders, sumps, and floor drains in pits; entrance subsills; and electrical service, electrical outlets, lights, and switches in pits and machine rooms.

1.8 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective elevator work within specified warranty period.

1. Warranty Period: One-year maintenance warranty from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide one year's maintenance service by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

1. Perform maintenance, including emergency callback service, during normal working hours.
2. Include 24-hour-per-day, 7-day-per-week emergency callback service.

a. Response Time: Two hours or less.

B. Continuing Maintenance Proposal: Provide a continuing maintenance proposal from Installer to Owner, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

C. Continuing Maintenance Proposal: Provide a continuing maintenance proposal from Installer to Owner with terms, conditions, and obligations as set forth in, and in the same form as, "Draft of Elevator Maintenance Agreement" at end of this Section, starting on date initial maintenance service is concluded.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. KONE Inc.
2. Otis Elevator Co.
3. Schindler Elevator Corp.
4. ThyssenKrupp Elevator.

2.2 SYSTEMS AND COMPONENTS

A. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components published by manufacturer as included in standard preengineered elevator systems and as required for complete system.

B. Hydraulic Silencers: Provide hydraulic silencer containing pulsation-absorbing material in a blowout-proof housing at pump unit.

C. Piping: Provide size, type, and weight piping recommended by manufacturer, and provide flexible connectors to minimize sound and vibration transmissions from power unit.

1. Provide dielectric couplings at cylinder units.
2. Casing for Underground Piping: PVC pipe complying with ASTM D 1785, joined with PVC fittings complying with ASTM D 2466 and solvent cement complying with ASTM D 2564.

D. Hydraulic Fluid: Elevator manufacturer's standard fire-resistant fluid with additives as needed to prevent oxidation of fluid, corrosion of cylinder and other components, and other adverse effects.

E. Hydraulic Fluid: Nontoxic, readily bio-degradable, fire-resistant fluid made from vegetable oil with antioxidant, anticorrosive, antifoaming, and metal-passivating additives. Hydraulic fluid is approved by elevator manufacturer for use with elevator equipment.

1. Product: Subject to compliance with requirements, provide "Hydro Safe" by Hydro Safe Oil Division, Inc.

F. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Section.

G. Protective Cylinder Casing: PVC or HDPE pipe casing complying with ASME A17.1, of sufficient size to provide not less than 1-inch clearance from cylinder and extending above pit floor. Provide means to monitor casing effectiveness to comply with ASME A17.1.

H. Corrosion Protective Filler: A nontoxic, petroleum-based gel formulated for filling the space between hydraulic cylinder and protective casing. Filler is electrically nonconductive, displaces or absorbs water, and gels or solidifies at temperatures below 60 deg F.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Hydro Safe Oil Division, Inc.; No-Ox-Id Liquid Elevator Casing Filler E-800.
b. Union-Gard, a division of Dome Services L.L.C.; Union-Gard 160.

I. Car Frame and Platform: Welded steel units.

J. Guides: Provide either roller guides or sliding guides at top and bottom of car and counterweight frames. If sliding guides are used, provide guide-rail lubricators or polymer-coated, non-lubricated guides.

2.3 OPERATION SYSTEMS

A. General: Provide manufacturer's standard microprocessor operation system for elevator as required to provide type of operation system indicated.

B. Single-Car Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:

1. Standby Power Operation: On activation of standby power, car is returned to a designated floor and parked with doors open. Car can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at main lobby fire command station. Manual operation causes automatic operation to cease.
2. Standby-Powered Lowering: On activation of standby power, if car is at a floor it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to a preselected floor, opens its doors, and shuts down. If car is below the preselected floor, it is lowered to the next lower floor, opens its doors, and shuts down.
3. Standby-Powered Lowering: On activation of standby power, car is lowered to the lowest floor, opens its doors, and shuts down.
4. Battery-Powered Lowering: If power fails and car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to a preselected floor, opens its doors, and shuts down. If car is below the preselected floor, it is lowered to the next lower floor, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.
5. Battery-Powered Lowering: When power fails, car is lowered to the lowest floor, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.
6. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors will begin closing.
7. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight can be adjusted.

C. Group Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators and elevator groups where indicated:

1. Standby Power Operation: On activation of standby power, cars are returned to a designated floor and parked with doors open. Only one car is moved upward at a time, with priority given to loaded cars. If a car cannot be returned after two attempts, it is removed from the system. When all cars have been returned or removed from the system, one car is automatically placed in service. If car selected for service cannot operate within 60 seconds, the system removes car from service and places another car in service. Cars can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at main lobby fire command station. Manual operation causes automatic operation to cease.
2. Standby Power Operation: On activation of standby power, cars are returned to lowest floor and parked with doors open. If a car cannot be returned, it is removed from the system. One car is selected for service on standby power by a switch located at lower lobby fire command station.
3. Standby-Powered Lowering: On activation of standby power, cars that are at a floor remain at that floor, open their doors, and shut down. Cars that are between floors are lowered to a preselected floor, open their doors, and shut down. Cars that are below the preselected floor are lowered to the next lower floor, open their doors, and shut down.
4. Standby-Powered Lowering: On activation of standby power, cars are lowered to the lowest floor, open their doors, and shut down.
5. Battery-Powered Lowering: If power fails, cars that are at a floor remain at that floor, open their doors, and shut down. Cars that are between floors are lowered to a preselected floor, open their doors, and shut down. Cars that are below the preselected floor are lowered to the next lower floor, open their doors, and shut down. System includes rechargeable battery and automatic recharging system.
6. Battery-Powered Lowering: When power fails, cars are lowered to the lowest floor, open their doors, and shut down. System includes rechargeable battery and automatic recharging system.
7. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors will begin closing.
8. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight can be adjusted.
9. One elevator is removed from group operation and directed to the floor where service was initiated. On arriving at the floor, elevator opens its doors and parks and a lighted sign directs passengers to exit elevator. Car is placed in operation by selecting a floor and pressing door close button or by operating keys witch to put car in independent service. After responding to floor selected or being removed from independent service, car is returned to group operation. If car is not placed in operation within a preset time after being called, it is returned to group operation.
10. Independent Service: Key switch in car control station removes car from group operation and allows it to respond only to car calls. Key cannot be removed from keys witch when car is in independent service. When in independent service, doors close only in response to door close button.
11. Loaded-Car Bypass: When car load exceeds 80 percent of rated capacity, car will respond only to car calls, not to hall calls.

D. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.

1. Keyswitch Operation: Push buttons are activated and deactivated by security key switches at hall push-button stations. Key is removable in either position.
2. Keypad Operation: Allows each landing to be restricted or unrestricted. When a restricted landing button is pressed, a "Restricted Floor" lamp lights and remains lit until landing access code has been entered into a keypad or predetermined time period has elapsed. Car calls for restricted landings do not register until landing access code is entered into keypad within predetermined time period after landing button is pressed.

    a. Access codes are programmed at each car operating panel using a security keyswitch. Keypad operation can be activated and deactivated by security keyswitch at main landing.

3. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby, that causes to return immediately to lower level and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.

2.4 DOOR REOPENING DEVICES

A. Infrared Array: Provide door reopening devices with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more of the light beams shall cause doors to stop and reopen.

B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

2.5 FINISH MATERIALS

A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.

B. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

1. Textured Stainless-Steel Sheet: Product with texture rolled into exposed surface.

a. Available Product: Subject to compliance with requirements, a product that may be incorporated into the Work includes, but is not limited to, Otis Elevator.
b. Metal surface is satin polished after rolling.

C. Stainless-Steel Bars: ASTM A 276, Type 304.

D. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.

E. Aluminum Extrusions: ASTM B 221, Alloy 6063.

F. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500 or No. C77600.

G. Plastic Laminate: none

2.6 CAR ENCLOSURES

A. General: Provide Stainless steel wall panels, with removable car roof, access doors, power door operators, and ventilation.

1. Provide standard railings complying with ASME A17.1 on car tops where required by ASME A17.1.
2. Provide finished car including materials and finishes specified below.
3. Refer to "Allowances" Paragraph, in Part 1 "Summary" Article, for items to be provided under the Elevator Car Allowance. Provide items not included in the Elevator Car Allowance as needed for finished car including materials and finishes specified below.

B. Materials and Finishes: Provide manufacturer's standards, but not less than the following:

1. Subfloor: Underlayment grade, exterior plywood, 5/8-inch nominal thickness.
2. Floor Finish: Specified in a Division 09 Section, color as selected by Architect from manufacturer's full range.
3. Stainless-Steel Wall Panels: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
4. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet or by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
5. Sight Guards: Provide sight guards on car doors.
6. Sills: Extruded metal, with grooved surface, 1/4 inch thick.
7. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.

8. Handrails: Metal, Metallic-Finish, Ceiling: Flush panels, with [incandescent downlights in the center of four low-voltage down lights in each panel. Align ceiling panel joints with joints between wall panels.
9. Manufacturer's standard handrails, of shape, metal, and finish indicated.

2.7 HOISTWAY ENTRANCES

A. General: Provide manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Provide frame size and profile to coordinate with hoistway wall construction.

1. Where gypsum board wall construction is indicated, provide self-supporting frames with reinforced head sections.

B. Materials and Fabrication: Provide manufacturer's standards, but not less than the following:
1. Stainless-Steel Doors and Transoms: Flush, hollow-metal construction; fabricated from stainless-steel sheet or by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
2. Sight Guards: Provide sight guards on doors matching door edges.
3. Sills: Extruded metal, with grooved surface, 1/4 inch thick.
4. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.

2.8 SIGNAL EQUIPMENT

A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with **long-life incandescent lamps and acrylic or other permanent, nonyellowing translucent plastic diffusers or LEDs**.

B. Car Control Stations: Provide manufacturer's standard **recessed or semi-recessed** car control stations. Mount in return panel adjacent to car door, unless otherwise indicated.

C. Swing-Return Car Control Stations: Provide car control stations mounted on rear of hinged return panel adjacent to car door and with buttons, switches, controls, and indicator lights projecting through return panel but substantially flush with face of return panel.

1. Mark buttons and switches with standard identification for required use or function that complies with ASME A17.1. Use both tactile symbols and Braille.
2. Provide "No Smoking" sign matching car control station, either integral with car control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.

D. Emergency Communication System: Provide system that complies with ASME A17.1 and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." On activation, system dials preprogrammed number of monitoring station and identifies elevator location to monitoring station. System provides two-way voice communication without using a handset and provides visible signals that indicate when system has been activated and when monitoring station has responded. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

E. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Division 28 Section "Fire Detection and Alarm."

F. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car control station. Also provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served.

1. Include travel direction arrows if not provided in car control station.

G. Hall Push-Button Stations: Provide one hall push-button station at each landing for each elevator.

H. Hall Push-Button Stations: Provide hall push-button stations at each landing as indicated.

1. Provide manufacturer's standard wall-mounted units.
2. Provide units with flat faceplate for mounting with body of unit recessed in wall.
3. Equip units with buttons for calling elevator and for indicating desired direction of travel.
4. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in Division 28 Section "Fire Detection and Alarm."

I. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide one of the following:

1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
2. Units with flat faceplate for mounting with body of unit recessed in wall and with illuminated elements projecting from faceplate for ease of angular viewing.
3. Units mounted in jambs of entrance frame

J. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.

1. At manufacturer's option, audible signals may be placed on car.

K. Hall Position Indicators: Provide illuminated, digital-display-type position indicators, located above hoistway entrance at ground floor. Provide units with flat faceplate for mounting and with body of unit recessed in wall.

1. Integrate ground-floor hall lanterns with hall position indicators.

L. Standby Power Elevator Selector Switches: Provide switches, as required by ASME A17.1, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed. Provide illuminated signals that indicate when they are operational and when they are at the designated emergency return level with doors open.

M. Fire Command Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby power elevator selector switch(es), as required by ASME A17.1, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.

N. Corridor Call Station Pictograph Signs: Provide signs matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station, unless otherwise indicated.

2.9 ELEVATORS

A. Elevator Description:

1. Group Number: 1
2. Elevator Number(s): 1
3. Type: Under-the-car single cylinder.
4. Type: Hole less, beside-the-car, single-acting, single cylinder.
5. Rated Load: 4500 lb
6. Freight Loading Class for Service Elevators: Class A.
7. Rated Speed: 150 fpm
8. Operation System: Single automatic operation.
9. Auxiliary Operations:

a. Standby power operation.
b. Battery-powered lowering.
c. Automatic dispatching of loaded car.
d. Nuisance call cancel.
e. Independent service for service elevator Subparagraph below is an extra-cost feature that may be retained with center-opening doors for large cars with heavy peak traffic, such as in an office building, and for hospital elevators. It may also be retained for service elevators with entrances at both front and rear.

10. Car Enclosures:

a. Inside Width: 68 inches (5’-8”) from side wall to side wall.
b. Inside Depth: 124.5 inches (10-4-1/2”
c.) from back wall to front wall, see drawings.
d. Inside Height: 94 inches to underside of ceiling.
e. Front Walls (Return Panels): Polished stainless steel with integral car door frames.
f. Car Fixtures: Polished stainless steel, No. 8 finish.
g. Side and Rear Wall Panels: stainless steel, No. 4 finish
h. Reveals: Polished stainless steel, No. 8 finish
i. Door Faces (Interior): Polished stainless steel, No. 8 finish
j. Door Sills: Aluminum, mill finish
k. Ceiling: Polished stainless steel, No. 8
l. Handrails: 1-1/2 inches round, mirror-polished stainless steel, No. 8 finish of car.
m. Floor: Manufacturer's standard per full range of division 9 finishes.
n. Floor prepared to receive specified in Division 09 Section Finishes.
o. Floor prepared to receive resilient tile (specified in Division 09 Section "Resilient Tile Flooring").
p. Floor prepared to receive sheet vinyl (specified in Division 09 Section "Resilient Sheet Flooring").
q. Floor Thickness, Including Setting Materials: above plywood subfloor.

11. Hoistway Entrances:

a. Width: 48 inches
b. Height: 84 inches
c. Type: Single-speed side sliding
d. Fire-Protection Rating: 1-1/2 hours with 30-minute temperature rise of 450 deg F].
e. Frames at First Floor at Basement Floors: Polished stainless steel, No. 8 finish
f. Frames at Other Floors: stainless steel, No. 8 finish
g. Doors and Transoms at First Floor at Basement Floors: Polished stainless steel, No. 8 finish
h. Sills Aluminum, mill finish
i. Sills at Other Floors: Aluminum, mill finish

12. Hall Fixtures at Other Floors: Polished stainless steel, No. 8 finish
13. Additional Requirements:

a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from polished stainless steel, No. 8 finish

b. Delete subparagraph below if not required.
c. Provide blanket hooks in all cars complete set(s) of full-height protective blankets.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.

1. For the record, prepare a written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Provide waterproof well casing as necessary to retain walls of well hole.

B. Install cylinder in protective casing within well hole. Before installing protective casing, remove water and debris from well hole and provide permanent waterproof seal at bottom of well casing.

1. Fill void space between protective casing and cylinder with corrosion protective filler.
2. Align cylinders and fill space around protective casing with fine sand.

C. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor. Seal between well protective casing and pit floor with 4 inches of nonshrink, nonmetallic grout.

D. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.

E. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.

F. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts designed to effectively prevent transmission of vibrations to structure and thereby eliminate sources of structure-borne noise from elevator system.

G. Install piping above the floor, where possible. Where not possible, install underground piping in Schedule 40 PVC pipe casing assembled with solvent-cemented fittings.

H. Install piping above the floor, where possible. Where not possible, cover underground piping with permanent protective wrapping before backfilling.

I. Lubricate operating parts of systems as recommended by manufacturers.

J. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

K. Leveling Tolerance: 1/4 inch, up or down, regardless of load and direction of travel.

L. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

M. Locate hall signal equipment for elevators as follows, unless otherwise indicated:
1. Place hall lanterns either above or beside each hoistway entrance.
2. Mount hall lanterns at a minimum of 72 inches above finished floor.

3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting use (either temporary or permanent) of elevators, perform acceptance tests as required and recommended by ASME A17.1 and by governing regulations and agencies.

B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times tests are to be performed on elevators.

3.4 PROTECTION

A. Temporary Use: Comply with the following requirements for elevator used for construction purposes:

1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
2. Provide strippable protective film on entrance and car doors and frames.
3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
5. Do not load elevators beyond their rated weight capacity.
6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator(s). Refer to Division 01 Section "Demonstration and Training."

B. Check operation of elevator with Owner's personnel present and before date of Substantial Completion. Determine that operation systems and devices are functioning properly.

C. Check operation of elevator with Owner's personnel present not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

END OF SECTION 142400

SECTION 143100 - ESCALATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes [**high-traffic,**] [**interior**] [**and**] [**exterior**] escalators.

B. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
2. Division 05 Section "Structural Steel Framing" for attachment plates, angle brackets, and other preparation of structural steel to support escalator trusses.
3. Division 08 Section "Access Doors and Frames" for wall and ceiling access panels and access doors in escalator enclosures.
4. Division 09 Sections for enclosures of, and finishes applied to, exterior of escalators.
5. Division 10 Section "Signage" for caution signs required by ASME A17.1.
6. Division 26 Sections for electrical service to escalators, including disconnect switches.
7. Division 28 Section "Fire Detection and Alarm" for smoke detectors that activate escalator alarm and, after at least 15 seconds, cause the interruption of power to the escalator motor and brake and for connection to escalator controllers.

1.3 DEFINITIONS

A. High-Traffic Escalators: Escalators designed specifically for use where high-traffic volumes produce dense occupancy resulting in structural, machinery, and brake loads much higher than normal.

B. Defective Escalator Work: Operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

1.4 PERFORMANCE REQUIREMENTS

A. Rated Speed: **90 fpm**.

B. Braking Performance: Provide brakes that stop escalator in up-running mode at a rate no greater than 3 ft./s^2.

C. Braking Performance: Provide brakes that produce a stopping force on escalator in up-running mode that is one-third that used in down-running mode.

D. Step/Skirt Performance Index: Not more than 0.15.

E. Structural and Mechanical Performance for High-Traffic Escalators: For the purpose of structural design, driving machine and power transmission calculations, and brake calculations, design high-traffic escalators for loads not less than [**2**] **<Insert number>** times the design loads required by ASME A17.1.

F. Structural Performance of Balustrades, Deck Barricades, and Handrails: Provide components and assemblies capable of withstanding the effects of loads indicated in ASCE 7 for handrail assemblies and guardrail systems.

1.5 SUBMITTALS

A. Product Data: Include capacities, sizes, performances, safety features, finishes, and similar information.

B. Shop Drawings: Show plans, elevations, sections, and details indicating coordination with building structure and relationships with other construction. Indicate variations from specified requirements, maximum loads imposed on building structure at points of support, and power requirements. Indicate access and ventilation for escalator machine space.

C. Samples for Initial Selection: For exposed materials involving color selection.

D. Samples: For exposed finishes, 3-inch- square Samples of sheet materials, and 4-inch lengths of running trim members.

E. Informational Submittals

1. Qualification Data: For Installer.

2. Credit MR 4.1[**and 4.2**]: Manufacturer's or fabricator's certificate indicating percentage of post-consumer recycled content by weight and pre-consumer recycled content by weight for each Product specified under this Section.

3. Credit MR 5.1[**and 5.2**]: Manufacturer’s certificate demonstrating that each material or product indicated was extracted, harvested, or recovered, as well as manufactured within 500 miles of the project site.

a. **<Insert Local/Regional Material>**.

4. Manufacturer Certificates: Signed by manufacturer certifying that escalator layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for escalator system being provided.

F. Closeout Submittals

1. Operation and Maintenance Data: For escalators to include in emergency, operation, and maintenance manuals.

a. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.

2. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted escalator use.
3. Warranty: Special warranty specified in this Section.
4. Continuing Maintenance Proposal: Service agreement specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Escalator manufacturer[**or manufacturer's authorized representative who is trained and approved for installation of units required for this Project**].

B. Source Limitations: Obtain escalators[**and moving walks, specified in another Division 14 Section,**] through one source from a single manufacturer.

C. Regulatory Requirements: Comply with ASME A17.1.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging.

B. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's recommendations to prevent damage, deterioration, or soiling.

1.8 COORDINATION

A. Coordinate installation of sleeves, block outs, escalator equipment with integral anchors, and other items that are embedded in concrete or masonry for escalator equipment. Furnish templates, sleeves, escalator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.

B. Coordinate sequence of escalator installation with other work to avoid delaying the Work.

C. Coordinate locations and dimensions of other work relating to escalators including sumps and floor drains in pits, electrical service, and electrical outlets, lights, and switches in pits.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective escalator work within specified warranty period.

1. Warranty Period: [**One year**] <**Insert warranty period**> from date of Substantial Completion.

1.10 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide [**one years'**] <**Insert time period**> full maintenance service by skilled employees of escalator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper escalator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

1. Perform maintenance, including emergency callback service, during normal working hours.
2. Include 24-hour-per-day, 7-day-per-week emergency callback service.

a. Response Time: Two hours or less.

B. Continuing Maintenance Proposal: Provide a continuing maintenance proposal from Installer to Owner, in the form of a standard [**one-year**] [**two-year**] [**five-year**] <**Insert agreement period**> maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Fujitec America, Inc.
2. KONE Inc.
3. Otis Elevator Co.
4. Schindler Elevator Corp.
5. ThyssenKrupp Elevator.
6. <**Insert manufacturer's name.**>

2.2 MATERIALS

A. Stainless Steel: ASTM A 240/A 240M, Type [**304**] [**316**] [**304, except use Type 316 for exterior escalators**].

1. Satin Finish: No. 4 directional satin.
2. Polished Finish: No. 8 mirror polish.
3. Gold-Colored Satin Finish: No. 4 directional satin with gold-colored oxide or titanium nitride finish.
4. Gold-Colored Mirror Finish: No. 8 mirror polish with gold-colored oxide or titanium nitride finish.

B. Satin Bronze Sheet: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal), fine satin finish, lacquered.

C. Satin Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (architectural bronze), fine satin finish, lacquered.

D. Steel Sheet: Cold-rolled steel sheet, ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.

E. Clear Tempered Glass: ASTM C 1048, Condition A (uncoated surfaces), Type 1 (transparent glass, flat), Class 1 (clear), Quality q3 (glazing, select), Kind FT (fully tempered), [**10.0**] [**12.0**] mm thick.

F. Tinted Tempered Glass: ASTM C 1048, Condition A (uncoated surfaces), Type 1 (transparent glass, flat), Class 2 (tinted), Quality q3 (glazing, select), Kind FT (fully tempered), [**10.0**] [**12.0**] mm thick.

1. Color: [**Bronze**] [**Gray**] [**Green**] <**Insert color**>.

2.3 COMPONENTS

A. General: Provide preengineered escalators complying with requirements. Unless otherwise indicated, provide standard components as indicated in manufacturers' publications and as required for a complete escalator.

B. General: Provide high-traffic escalators complying with requirements. Unless otherwise indicated, provide heavy-duty components as indicated in manufacturers' publications and as required for a complete escalator.

1. Provide escalators with [**two**] [**three**] [**four**] flat steps at top and bottom landings.

2. Fabricate exposed metalwork, including deck covers, balustrade panels, and trim to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use; increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as necessary. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.

C. Opaque Balustrades: Manufacturer's standard profile or arrangement of moving handrails on fully paneled guide rail with interior balustrade panels, deck covers, skirts, trim, and accessories.[**Prepare for exterior finish below the deck covers, specified in another Section.**]

D. Transparent Balustrades: Manufacturer's standard profile or arrangement of moving handrails on guide rail that is supported by tempered glass panels, with deck covers, skirts, trim, and accessories.[**Prepare for exterior finish below the deck covers, specified in another Section.**]

E. Guards at Ceiling Intersection: Clear plastic.

F. Handrails: Smooth, jointless, reinforced neoprene.

1. Color: [**Black**] [**Match Architect's sample**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

G. Deck Covers and Trim: [**Satin stainless steel**] [**Polished stainless steel**] [**Gold-colored satin stainless steel**] [**Gold-colored polished stainless steel**] [**Satin bronze**].

H. Antislide Devices: [**Satin stainless steel**] [**Polished stainless steel**] [**Gold-colored satin stainless steel**] [**Gold-colored polished stainless steel**] [**Satin bronze**].

I. Balustrade Interior Panels: [**Satin stainless steel**] [**Polished stainless steel**] [**Gold-colored satin stainless steel**] [**Gold-colored polished stainless steel**] [**Satin bronze**].

J. Balustrade Exterior Panels[**and Escalator Soffits**]: [**Satin stainless steel**] [**Polished stainless steel**] [**Gold-colored satin stainless steel**] [**Gold-colored polished stainless steel**] [**Satin bronze**].

K. Skirt Panels[**, if Applicable**]: [**Satin stainless steel**] [**Polished stainless steel**] [**Satin stainless steel with exposed surface coated with clear PTFE**] [**Steel panels with exposed surface coated with PTFE**] [**Manufacturer's standard low-friction material**].

L. Steps: One-piece, die-cast aluminum with demarcation grooves at front and rear of tread surface.

1. Finish: Powder-coated, [**gray**] [**black**] <**Insert color**>.
2. Step Demarcation: Yellow inserts at sides and back of step treads.
3. Nosing Demarcation: 2-inch- wide yellow stripe at nosings of step treads.

M. Combs: [**Integrally colored structural plastic**] [**Cast aluminum**] [**Cast aluminum with powder-coated finish**].

1. Comb Color: [**Yellow**] [**Black**] [**Gray**] [**Red**] <**Insert color**>.

N. Floor Plates: [**Cast or extruded aluminum**] [**Stainless steel**] with grooved or patterned surface and mill finish.

O. Abrasive-Surface Floor Plates: [**Cast or extruded aluminum**] [**Stainless steel**] with grooved or patterned surface and with abrasive material embedded in or metallically bonded to floor-plate surface and having a coefficient of friction of 0.6 or higher when tested according to ASTM C 1028.

P. Operational Control: Provide[**escalators designed and equipped to run equally in either direction. Provide key-operated switches for directional control and**] key-operated starter switches located on exterior deck above newel base at both upper and lower landings of escalators.

2.4 FEATURES

A. Fault Indicator: Provide escalators with a microprocessor unit that monitors safety devices, motor temperature, and escalator speed and records in nonvolatile memory date, time, and device identification if a safety device is activated or escalator malfunctions.

1. Provide built-in[**or plug-in**] unit to display recorded information.

B. Reduced-Current Starting: Provide escalator motors with wye-delta or solid-state starting.

C. Energy-Saving Feature: Provide escalator motors and controls designed for motors to run on partial windings (at reduced power) when not under full load.

D. Provide motors complying with NEMA MG 1, Insulation Class B.

E. Brake-Saving Feature: Provide stopping mechanism that allows escalator to coast to a stop before applying brakes, unless stopping is initiated by a safety device.

F. Equip step drive mechanism with automatic step-chain lubricators.

G. Oil Drip Pan: Provide metal pan under full width and length of escalator to collect and hold oil and grease drippings from lubricated components. Design and fabricate drip pan to sustain a load of 250 lbf on a 1.0-sq. ft. area at any location without permanent deflection.

H. Direction Indicator Lights: Provide red and green indicator lights at least 2 inches in diameter in [**right-hand**] [**both**] balustrade newels at both upper and lower landings. Green light indicates entrance end, and red light indicates exit end. When escalator is stopped, red lights are illuminated at both ends.

I. Combplate Lights: Provide recessed light fixtures with flush lenses mounted in skirt panels at each side of combplates designed to illuminate steps at combplate.

J. Overspeed Governor: Provide units with overspeed governor that is activated if speed of steps exceeds rated speed by more than 20 percent.

K. Upper-Landing, Step Upthrust Device: Activated if a step is displaced against upthrust track at upper curve in passenger-carrying line of track system.

L. Comb-Step Impact Device: Activated if a horizontal force in direction of travel is applied exceeding 112 lbf at either side or exceeding 225 lbf at center of front edge of combplate, or a resultant force in upward direction is applied exceeding 150 lbf at center of front edge of combplate.

2.5 EXTERIOR ESCALATORS

A. Fabricate exposed components from [**stainless steel**] [**bronze**], unless otherwise indicated.

B. Hot-dip galvanize escalator trusses and other structural components to comply with ASTM A 123/A 123M. Use only stainless-steel or zinc-plated fasteners for assembly of escalator components.

C. Fabricate oil drip pan from galvanized steel sheet. Provide drain and oil/water separator in oil drip pan.

D. Provide drains, weeps, and drips to prevent water accumulation on horizontal surfaces and to direct water away from electrical equipment and moving parts.

E. Provide enclosures complying with NEMA 250, Type 4 for electrical connections, switches, and equipment.

F. Provide totally enclosed motors complying with NEMA MG 1, Insulation Class B.

G. Equip step drive mechanism with automatic step-chain lubricators.

H. Provide electric heaters with integral thermostats in escalator truss space to maintain temperature above 40 deg F.

I. Equip combplates with 400-W electric heaters to prevent ice and snow accumulation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine escalator areas, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance. Examine supporting structure, machine spaces, and pits; verify critical dimensions; and examine conditions under which escalators are to be installed.

1. Proceed with installation only after unsatisfactory conditions have been corrected.
2. For the record, prepare written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions.

B. Set escalators true to line and level, properly supported, and anchored to building structure. Use established benchmarks, lines, and levels to ensure dimensional coordination of the Work.

C. Adjust installed components for smooth, efficient operation, complying with required tolerances and free of hazardous conditions. Lubricate operating parts, including bearings, tracks, chains, guides, and hardware. Test operating devices, equipment, signals, controls, and safety devices.[**Install oil drip pans and verify that no oil drips outside of pans.**]

D. Repair damaged finishes so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of escalator installation and before permitting use of escalators, perform acceptance tests as required and recommended by ASME A17.1 and by authorities having jurisdiction.

1. For escalators specified to comply with requirements more stringent than those of ASME A17.1, perform tests for compliance with specified requirements. Test optional safety devices.

B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times tests are to be performed.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate[**, adjust, and maintain**] escalators. Refer to Division 01 Section "Demonstration and Training."

B. Check operation of escalators with Owner's personnel present and before date of Substantial Completion. Determine that operation systems and devices are functioning properly.

C. Check operation of escalators with Owner's personnel present not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

END OF SECTION 143100

SECTION 144200 - WHEELCHAIR LIFTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Inclined platform lifts.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.

1.3 DEFINITIONS

A. Definitions in ASME A18.1 apply to Work of this Section.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components, and finishes for lifts.
2. Include rated capacities, operating characteristics, electrical characteristics, safety features, controls, finishes, and accessories.

B. Shop Drawings: For each lift.

1. Include plans, elevations, sections, details, attachments to other work, and required clearances.
2. Indicate dimensions, weights, loads, and points of load to building structure.
3. Include details of equipment assemblies, method of field assembly, components, and location and size of each field connection.
4. Include diagrams for power, signal, and control wiring.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of sizes indicated below:

1. Metal Finish: Manufacturer's standard-size unit, not less than 3 inches (75 mm) square.
2. Tubular Products and Running Trim: Manufacturer's standard-size unit, 6 inches (150 mm) long.
3. Hardware: Manufacturer's standard, exposed, door-operating device.

1.5 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lift to include in operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Parts list with sources indicated.
b. Recommended parts inventory list.

B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted use of lifts.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of lifts that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

B. Regulatory Requirements: Comply with ASME A18.1, "Safety Standard for Platform Lifts and Stairway Chairlifts."

BASIS OF DESIGN: Garaventa Lifts Xpress II

2.2 INCLINED PLATFORM LIFT

A. Inclined Platform Lift, General: Preengineered lift system.

B. Number of Stops: As indicated in Drawings.

C. Platform Size: 30 by 48 inches (760 by 1220 mm).

D. Rated Speed: 20 fpm (0.10 m/s).

E. Power Supply: As indicated on Drawings.

F. Emergency Operation: Provide connection to indicated standby (emergency) power to raise or lower units in case of malfunction or power loss.

G. Platform: Stainless-steel floor plate with checkered texture.

H. Automatic Folding Platforms: When not in use, platforms shall automatically fold up against wall to minimize projection into stairway.

I. Ramp: Retractable ramp matching platform to provide transition from floor to lift platform. Ramp lowers to floor automatically when lifts reach landing and enclosure door opens. Ramp rises automatically when lift control is activated for lift to leave landing.

1. Ramp Size: End ramps a minimum of 32 inches (815 mm) wide; length as required for slope.
2. Ramp Slope: Maximum 1:12.
3. Ramp Finish: Finish ramps to match lift platform.

J. Support to Structure: Provide framing and brackets to support vertical loads from floor or stair treads and only lateral loads from walls. Fabricate framing and brackets from stainless-steel rectangular tubing, plates, shapes, and bars.

K. Guide Rails: Fabricate from stainless-steel tubing.

L. Accessories: Provide units with the following accessories:

1. Caution sign as required by ASME A18.1.

2.3 MATERIALS

A. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.

B. Stainless-Steel Tubing: ASTM A 554, Grade MT-304.

C. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.

D. Stainless-Steel Floor Plate: ASTM A 793.

E. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing structural members, guide rails, machines, and other lift components where installation of devices is specified in another Section.

F. Expansion Anchors: Anchor-bolt-and-sleeve assembly of material indicated below with capability to sustain a load equal to 10 times the load imposed as determined by testing according to ASTM E 488 conducted by a qualified independent testing agency.

1. Material: Group 1, Alloy 304 or Alloy 316, stainless-steel bolts and nuts complying with ASTM F 593 (ASTM F 738M) and ASTM F 594 (ASTM F 836M).

G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.

2.4 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 FINISHES

A. Stainless-Steel Finishes:

1. Grab Rail Finish: Directional satin finish No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, critical dimensions, and other conditions affecting performance of the Work.

B. Minimum Headroom Clearance: Verify that installed lift will have a minimum headroom of 80 inches (2032 mm) above any point on platform floor at any point of travel.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with ASME A18.1 and manufacturer's written instructions for installation of lifts unless otherwise indicated.

B. Wiring Method: Conceal conductors and cables within housings of units or building construction. Do not install conduit exposed to view in finished spaces. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

C. Adjust stops for accurate stopping and leveling at each landing, within required tolerances.

1. Leveling Tolerance: 1/4 inch (6 mm) up or down, regardless of load and direction of travel.

D. Adjust retractable ramps to meet maximum allowable slope and change-in-elevation requirements, and to lie fully against landing surfaces.

E. Lubricate operating parts of lift, including drive mechanism, guide rails, hinges, safety devices, and hardware.

F. Test safety devices and verify smoothness of required protective enclosures and other surfaces.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lifts. Include a review of emergency systems and emergency procedures to be followed at time of operational failure and other building emergencies.

B. Check operation of lifts with Owner's personnel present and before date of Substantial Completion. Determine that operating systems and devices are functioning properly.

C. Check operation of lifts with Owner's personnel present not more than one month before end of warranty period. Determine that operating systems and devices are functioning properly.

END OF SECTION 144200

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SECTION 210500 – COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 DESCRIPTION

A. The General Conditions, Supplementary Conditions, Special Conditions and Division 01 through Division 32 as set forth in these Specifications are hereby incorporated into and shall become a part of the Specifications for work under Division 21, insofar as they apply hereto.

B. Furnish material, labor, tools, accessories and equipment to complete and leave ready for complete operation of the Fire Suppression systems for this project as described in these Specifications, as shown on the Drawings and as required.

C. As it may apply to all Division 21 Specification Sections herein, the term “Owner” shall refer to the Owner and/or his Duly Authorized Representative inclusively.

D. As it may apply to all Division 21 Specification Sections herein, the term "Engineer" shall refer to the Engineer-of-Record and/or the Project Design Professional inclusively.

1.2 REGULATORY REQUIREMENTS

A. Conform to all rules and regulations of any utility company/purveyor in the planning and execution of the work as shown by these Contract Documents.

B. Obtain all inspections or additional permits required by all laws, ordinances, rules, regulations or standards of any Authority Having Jurisdiction. Obtain certificates of such inspections and permits and submit same to the Architect. The Contractor shall pay all fees, charges and other expenses in connection therein for Fire Suppression work including permits, inspection fees, re-inspection fees (as necessary), etc. associated with the building permit.

C. Perform all work in strict accordance with all applicable laws, codes, rules, regulations and standards of any Authority Having Jurisdiction. In case of conflict between the Contract Documents and the above requirements, the more stringent requirements shall govern.

D. Unless noted otherwise, the following latest enforced Edition (complete with all local amendments and interim agreements in effect) of the following shall apply to this work:
   1. ANSI International (ANSI)
   2. American Society of Mechanical Engineers (ASME)
   3. American Society of Plumbing Engineers (ASPE)
   4. American Water Works Association (AWWA)
   5. ASTM International (ASTM)
   6. Authority Having Jurisdiction (AHJ)
   7. Environmental Protection Agency (EPA)
   8. FM Global (FM)
   9. National Fire Protection Association (NFPA)
      a. NFPA 13, Standard for the Installation of Sprinkler Systems
      b. NFPA 14, Standard for Installation of Standpipe and Hose Systems
      c. NFPA 20, Standard for the Installation of Stationary Fire Pumps for Fire Protection
      d. NFPA 24, Standard for the Installation of Private Fire Service Mains
      e. NFPA 25, Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems
      f. NFPA 70, National Electrical Code

g. NFPA 101, Life Safety Code
h. NFPA 291. Recommended Practice for Fire Flow Testing and Marking of Hydrants
i. NFPA 1963. Standard for Fire Hose Connections

10. National Institute for Certification in Engineering Technologies (NICET)
11. Occupational Safety and Health Administration (OSHA)
12. State of Ohio
    a. Ohio Building Code (OBC)
    b. Ohio Fire Code (OFC)
13. Underwriters Laboratories (UL)
14. Owner's material and installation requirements.
15. Owner's insurance underwriter's requirements.
16. Other applicable codes, requirements, rules and/or regulations of bodies lawfully empowered and having jurisdiction over this project.

1.3 QUALIFICATIONS

A. Installer: Company specializing in performing work of this Section with minimum of three year's documented experience.

B. Design Professional: Registered as a Professional Engineer in the discipline of Fire Protection and/or a NICET-certified Level III or Level IV Fire Protection Designer, licensed in the applicable state to design Fire Suppression systems. Registrations, certifications and/or licenses shall be current and in good standing with the Authority Having Jurisdiction.

C. Field Superintendent: Registered as a Professional Engineer in the discipline of Fire Protection and/or a NICET-certified Level II Fire Protection Designer, licensed in the applicable state to design Fire Suppression systems. Registrations, certifications and/or licenses shall be current and in good standing with the Authority Having Jurisdiction.

D. A minimum of five (5) years of experience on projects and systems of similar size and scope is required of the Contractor submitting a bid for the Fire Suppression work under this Contract.

1.4 MATERIALS, MANUFACTURERS AND SUBSTITUTIONS

A. Unless otherwise specifically indicated, furnish materials and equipment which are new.

B. When two or more products are named together in the Specifications, bids shall be based upon any of the products named upon consideration that the product named first, unless indicated otherwise, has been designated or used as the Basis-of-Design.

C. The Bidder shall ascertain that the product upon which he chooses to base his bid has the specific features enumerated and is equal to the required specifications and that it will properly fit the space and the adjacent work. Any additional costs, including cost of work by others, involved in completing the work with said products and the responsibility for its fitting and operating as a part of the system rests solely with the Bidder.

D. The Specifications permit the Bidder to propose substitution of any one of a like material that is generally considered to be equal to the manufacturers named in the specifications for consideration with his bid and must be indicated on the substitution sheet. However, the Bidder shall base his bid on the name or make of any article, device, material, form of construction, fixture, etc., named in the Specifications.
    a. At the request of the Engineer, the Bidder shall provide manufacturer's specification sheets/documentation for review and consideration. The determination of the acceptance of the substitution by the Engineer shall be at his/her discretion and shall be final.

1.5 WARRANTIES

A. In addition to requirements of Division 01, the Contractor shall turn over to the Owner all certificates of equipment guarantee and/or warranty covering remaining guarantee and/or warranty period at end of his guarantee period.

B. In addition to requirements of Division 01, provide all services necessary to assure the proper operation of all systems installed under this Section of the specifications for one year after final acceptance. Completely inspect the systems at least twice during that time, at the change of seasons and make any necessary adjustments in system. Two (2) weeks before the date for beginning each inspection, inform the Engineer in writing. The requirement for inspections is not intended to, nor is the Contractor obligated to perform any work during the one (1) year period which, in the opinion of the Engineer, is normal maintenance. However, if faulty or defective parts are found during the inspection, repair or replace them in accordance with the guarantee provisions of these Specifications.

C. In addition to compliance with the Conditions of the Contract, the Contractor is hereby made aware that certain manufacturer's equipment guarantees are valid only for a period of one year from the date of shipment or installation and will therefore not be valid until the date of guarantee set forth herein. The Contractor will therefore be responsible for all material, labor and equipment for the full guarantee period as set forth herein.

D. Furnish labor and material required to fulfill the requirements of this guarantee at no additional cost to the Owner.

1.6 QUALITY ASSURANCE

A. The Fire Suppression Contractor shall be responsible for all costs associated with changes to valves, pipe sizes, fittings, trim, sprinklers, etc. caused by the change of equipment from the Basis-of-Design specified to other named manufacturers. The Contractor is responsible to ensure that equipment supplied from other manufacturers will fit within the space allocated with appropriate clearances for maintenance, operation, service, code requirements, etc. Any Contractor utilizing a manufacturer other than the basis-of-design shall be responsible for any additional requirements for electrical service, concrete pad size, physical space limitations and capacities at no additional cost to the Owner. If manufacturers are listed, no other manufacturers except those listed within the Sections of this Division will be acceptable.

B. Work provided or performed by the Contractor, his Subcontractor or his tradesmen shall be guaranteed to be replaced and made good at his own expense any defects which may develop within one (1) year after final payment and acceptance by Owner due to faulty workmanship or material upon receipt of written notification of the defect from Owner.

1.7 SUBMITTALS

A. Submit under provisions of Division 01.

B. Proposed Products List: Include Products specified in Division 21 Specifications.

C. Submit Shop Drawings and product data grouped to include complete submittals of related systems, products and accessories in a single submittal.

D. Mark dimensions and values in units to match those specified.

E. Submit prior to any Shop Drawing submittals for the Engineer's review a proposed list of equipment seven (7) days after letter of intent or award of Contract, whichever occurs first.

F. In addition to provisions of Division 01, submit one (1) set of Shop Drawings and/or one (1) electronic set having each sheet (except pages bound in a brochure) and each brochure marked with identification and containing information described below. To facilitate coordination, submit all drawings in logical order. Submit assembly drawings, where possible, complete with all related subassembly drawings, wiring diagrams and necessary data.

G. Identification to Include:
1. Project name.
2. Identification by specification heading number under which equipment or material is described and by name, number and intended use as designated by Contract Drawings and Specifications.
3. Information: Include the following data:
   a. Manufacturer's model number or catalog number, size and performance curves and data. Indicate operating points on curves and tabular data for each piece of equipment that curves or data represent.
   b. Indication of all performance data, construction materials, finishes and modifications to manufacturer's standard design called for in specifications.
   c. Roughing in, foundation and support points dimensions.
   d. Electrical information, including elementary diagrams, connection diagrams and nameplate data.

H. Any submittal(s) not in compliance with the above criteria or are incomplete will be returned to the Contractor, without review, for correction and re-submission or discarded at the Engineer's discretion.

1.8 COORDINATION DRAWINGS

A. General:
1. The Construction Manager or the General Trades Contractor (as designated) shall be in charge of the coordination drawing process and shall be responsible to resolve all conflicts and settle any disputes resulting from the coordination drawing process.
2. Contract Drawings are diagrammatic and are not to be scaled. Included in the Base Bid shall be all offsets, fittings, etc. for a completed project. Only if major rerouting of piping is required with significant cost increases, as approved by the Owner, the Architect and/or the Engineer, will additional money be warranted.
3. Field discrepancies shall be resolved by the field foreman. When discrepancies cannot be resolved, the signed-off coordination drawings shall be re-examined for rights.
4. Documented, coordinated, dimensioned work will have precedence. Owner will not pay for rework of a particular trade. Uncoordinated work will not be tolerated or accepted.
5. Coordination drawings shall be a phased process with the General Trades Contractor, MEP Contractors, Fire Suppression Contractor, Architect and Engineer determining the sequence of work.
6. Each Contractor shall coordinate the exact location of their work with the work of other trades prior to fabrication or installation of same. Verify all dimensions and elevations. Provide additional offsets and sections of material as may be required to meet the applicable job condition requirements. Coordinate with and review all related specification sheets and submittals of all equipment suppliers prior to start of work.

B. Process
1. The Mechanical Contractor shall have precedence for the allotment of available space for the routing of his ductwork.
2. The Mechanical Contractor shall be responsible for all trades, pre-coordinating their layouts and shop drawings with each other.
3. The Mechanical Contractor shall prepare drawings in Revit (most current edition). He shall be responsible for the base drawings to be used by all other Contractors. Base drawings shall include architectural, structural and reflected ceiling plan information.

4. The Mechanical Contractor shall prepare ductwork drawings, at a minimum scale of 1/4" = 1'-0", in Revit (most current edition). After he has finished a compact disc or USB mass storage device with base drawing and ductwork, it shall be circulated in the following order:
   a. Plumbing Contractor
   b. Mechanical Contractor (for HVAC Piping)
   c. Fire Suppression Contractor
   d. Electrical Contractor
   e. General Trades Contractor
5. Each Contractor shall use the compact disc or USB mass storage device for preparation of their installation drawings.
6. After all trades have completed the coordination process, the General Trades Contractor shall hold a coordination meeting to resolve conflicts. Each contractor shall have available a drawing of his layout to be used for overlaying purposes. A representative of each contractor, the Architect and the Engineer shall attend. All conflicts shall be resolved at the coordination meeting. The Architect and Engineer shall resolve all major conflicts as to the degree each Contractor shall alter their layout in order to allow for sufficient space for installation of the work.
7. When all coordination is complete, the Mechanical Contractor shall distribute two (2) sets of prints of the coordination drawings to each of the trades involved in the project, one (1) set for the Owner and one (1) set for as-built drawings.

C. Fire Suppression, Plumbing, Mechanical (Piping) and Electrical Contractors:
   1. Piping and conduits shall be located and dimensioned from column center lines. Size, center line elevation and required pitch shall be clearly noted.
   2. Long drain lines shall have center line elevations indicated at 20-foot intervals.

D. General Trades Contractor:
   1. All furring and holes shall be clearly noted.
   2. All ceiling heights shall be clearly noted.

E. Service Areas: Contractors shall indicate service areas for all equipment by shaded/hatched/ crosshatched areas on drawings.

1.9 RECORD DRAWINGS

A. In addition to Division 01, the Contractor shall keep on the project site one complete set of working drawings on which he shall record any deviation or changes made from contract drawings made during construction. Record drawings shall show changes in:
   1. Size, type, capacity, etc. of any materials, device, or piece of equipment.
   2. Location of any device or piece of equipment.
   3. Location of any outlet or source in building service systems.
   4. Routing of any piping, conduit, ducts, sewers, or other building services.

B. Record drawings shall also record the location of all concealed water and electric service, water piping, building and horizontal drains, stacks and leaders, vents, ducts, conduit and other piping by identification of measured dimensions to each such line from readily identifiable and accessible walls or corners of the building.

C. Record drawings shall be kept clean, undamaged and shall not be used for any purpose other than recording deviations from working drawings and exact locations of concealed work.

D. Record drawings shall be continuously maintained up-to-date and be available for inspection anytime during normal working hours.

E. After the project is completed, the record drawings shall be delivered to the Engineer in good condition, as a permanent record of the installation as actually constructed.

1.10 ELECTRONIC FILES

A. Drawings for this project were prepared using Revit software. Electronic files are available upon request for use by the successful contractor(s) for planning, coordination and installation.

B. There will be no charge for projects prepared using Revit that must be converted to AutoCAD or Navisworks format. Revit model files will NOT be available.

C. The Drawings Request form can be obtained from the Architect's office, completed and submitted to his/her attention.

1.11 OPERATING INSTRUCTIONS

A. Instruct the Owner's personnel in the details of operation and maintenance of all Contractor-furnished equipment. Instructions shall be based on operating manuals furnished for the equipment and shall demonstrate procedures and methods described in manuals.

B. Arrange and pay for the services of qualified personnel from the manufacturers of various major equipment for instruction. Provide this operating instruction for three (3) working days of not less than eight (8) hours, starting from the time that the entire system (or if sections are to be started at various times, from the time that each section) is in satisfactory operation. Time spent in making trial runs, changes or major adjustments are not to be included in the instruction time.

C. Provide Fire Suppression Booklet and Operations Instructions: Submit three (3) manuals in one of the following formats per the requirements of the Owner:
   1. Bound in the best grade hardback, loose-leaf, three (3) -ring binders.
   2. Placed on compact disc.
   3. Placed on USB mass storage device (flashdrive).

D. All operating and maintenance instructions shall present full details for care and maintenance of all Fire Suppression systems and equipment installed. The operating instructions shall include the following information:
   1. Operating Instructions Manuals:
      a. Provide written instructions of the following format for each system with submittal of invoice for 75-percent of total contract.
      b. Submit one copy for approval before releasing to the Owner.
      c. Upon receipt of the approval, submit three copies to the Engineer.
      d. If providing three (3) -ring hard-backed binders, bind the written operating instructions, shop drawings, equipment specification sheets and manufacturer's instructions where they can be accommodated into a size 8-1/2- x 11-inches.
   2. Provide multiple binders, compact discs or USB mass storage devices (number as required) where one cannot accommodate information.
      a. First Page - Title of job, Owner, address, date of submittal, name of Contractor and name of Engineer.
      b. Second Page - Index or Table of Contents.
      c. Third Page - Introduction to first section containing a complete written description of systems.
      d. First Section - Written description of system contents, where actually located in the building, how each part functions individually and how system works as a whole. Conclude with a list of items requiring service and either state the service needed or refer to the manufacturer's data in the binder that described the proper service.
      e. Second Section - A copy of each shop drawing with an index at the beginning of the section.
      f. Third Section - A copy of each manufacturer's installation instructions.
      g. Fourth Section - A copy of each manufacturer's operating instructions and parts

lists along with recommended spare parts lists with index at the beginning of the section.

h. Fifth Section - A copy of each manufacturer's maintenance instructions

i. Sixth Section - A list of all equipment used on the job, Contractor's purchase order numbers, supplier's name and address, date of start-up of each piece of equipment.

j. Seventh Section - Copies of all control wiring, flow diagrams and valve charts.

1.12 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual Specification sections.

B. Deliver to Owner at location(s) as directed; obtain receipt prior to final payment.

1.13 DRAWINGS AND SPECIFICATIONS

A. It is intended that work covered by the Contract Documents include everything required and necessary to make the various systems complete and operative, irrespective of whether or not every item is specifically provided for. Any omission of direct reference herein to any essential item shall not excuse contractor from complying with the above intent.

B. Calculated dimensions take priority over scaled ones. The Contractor shall take no advantage of and shall promptly call to the attention of the Owner any error, omission or inconsistency in the Contract Documents.

C. Special attention is directed to requirements that equipment and materials stated in the Contract Documents shall be furnished, except if otherwise noted, completely installed, adjusted and left in safe and satisfactory operating condition. Accessories, appliances and connections necessary for operation of equipment shall be provided to the satisfaction of the Owner.

D. Materials, apparatus or equipment specified or otherwise provided for on Contract Documents, Addenda or Bulletins issued subsequent to award of contract shall be the same brand, type, quality and character originally specified, unless otherwise provided.

E. Layout of equipment, accessories, specialties and suspended, concealed or exposed piping systems are diagrammatic unless dimensioned. In preparing shop drawings, Contractor shall check project conditions before installing work. If there are any interferences or conflicts, they shall be called to attention of the Engineer immediately for clarification.

F. The Drawings indicate required size and points of termination of piping and suggest proper routes to conform to structure avoid obstructions and preserve clearances. However, it is not intended that drawings indicate all necessary offsets, and it shall be the work of this contractor to make the installation in such a manner as to conform to structure, avoid obstructions, preserve headroom and keep openings and passageways clear, without further obstruction or cost to the Owner.

G. Shop drawings shall be furnished by the Contractor indicating all changes to meet space requirements, code requirements and as necessary to resolve all space conflicts.

H. It is intended that all apparatus be located symmetrical with architectural elements and shall be installed at exact height and locations as shown on the Architectural Drawings. Refer to architectural details in completing and correlating work.

I. The Contractor shall fully inform himself regarding any and all peculiarities and limitations of the

spaces available for the installation of all work and materials furnished and installed under the contract. He shall exercise due and particular caution to determine that all parts of his work are made quickly and easily accessible.

J. It cannot be too strongly emphasized that, except for work specifically excluded herein, every system shall be turned over to the Owner installed completed with components ready for normal operation.

K. Concealment: Unless otherwise specified, all work aboveground to be above suspended ceilings and in walls except in unfinished spaces. Areas without ceiling work to be installed as high as possible.

PART 2 - NOT APPLICABLE

2.1 NOT USED

PART 3 – EXECUTION

3.1 PROJECT CONDITIONS

A. Install Work in locations shown on Drawings, unless prevented by project conditions.

B. Prepare drawings showing proposed rearrangement of work to meet project conditions including changes to work specified in other Sections. Obtain permission of the Owner before proceeding.

C. Drawings to indicate desired position of equipment and routing of piping. Coordinate routing of piping and all other installations with installations of other trades prior to making installations.

D. Replace and restore to their original undamaged condition facilities of every description damaged or disturbed during progress of work. Such replacement or restoration applies to both surface and subsurface installations and materials. This includes fences for security, access routes, sidewalks, etc.

E. Where cutting of building structure such as floors, walls, roof, or framing is necessary, perform cutting operations only as authorized by the Owner as specified in Division 02. Cutting and patching of facilities shall be included in this Contract. Patch and finish all such openings in accordance with the applicable requirements given in other sections of these Specifications.

F. Patching shall be done by tradesmen skilled in the trade involved. Holes cut in structural steel must be drilled or punched and not burnt with torch.

G. Repair and/or replace any damaged materials as directed by the Owner. Cutting and patching by this Contractor to be as specified in Architectural Sections.

H. Patch, close and seal all openings used by this Contractor. Where openings are used by more than one trade, each trade shall be responsible for an equal share of patching, closing and sealing openings.

I. Complete the work to assure proper operation of each system with the least possible damage to or interference with surrounding construction and using materials specified or to match existing.

3.2 SEQUENCING AND SCHEDULING

A. Construct work in sequence under provisions in Division 01.

B. Coordinate completely all phases of and scheduling of work with the Owner and with other trades. Obtain approval from the Owner prior to execution of any work.

3.3 PRODUCT DELIVERY, STORAGE AND HANDLING

A. In addition to Division 01, protect piping and equipment at all times against entrance of dirt and injury to pipe joints and equipment surfaces during construction by means of caps, plugs, canvas, mounting on skids or plastic covers.

B. During shipment and before and during installation, protect materials and equipment from weather damage and possible theft. Keep materials and equipment off ground by means of wood blocks or skids. Follow manufacturer's suggested procedure for protection of equipment which will be idle for an extended period of time prior to start up.

3.4 EXCAVATION AND BACKFILL

A. Perform all excavation and backfill required to complete the work in accordance with Division 32. Protect excavations, barricade walkways and minimize vehicular and pedestrian disruption.

3.5 CONCRETE WORK

A. Provide all poured concrete bases and do all concrete work in accordance with Division 03.

B. Refer to Drawings for overall concrete base size. Concrete base shall be minimum 4-inches high with 1/2-inch 45-degree chamfer on top edge.
   1. EXCEPTION: Chamfer may be omitted for top edge(s) of concrete bases located directly adjacent to walls.

C. Install dowel rods to connect concrete base to concrete floor. Unless indicated otherwise, install dowel rods on maximum 18-inch centers around the full perimeter of concrete base.

D. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

E. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

F. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.6 PROTECTION AND DAMAGE

A. In addition to the provisions and stipulation of the General Conditions, provide various types of protection as follows:
   1. Protect finished floors from chips and cutting oil by the use of metal drip receiving pan and oil-resistant floor cover.
   2. Protect equipment and finished surfaces from welding and cutting splatters with baffles and splatter blankets.
   3. Protect equipment and finished surfaces from paint droppings, insulation adhesive and sizing droppings, etc. by use of drop cloths.

B. All equipment shall be stored at the site with openings, bearings, etc., covered to exclude dust and moisture. All stockpiled pipe shall be placed on dunnage and protected from weather and from entry of foreign material. All material shall be stored to prevent the possibility of theft.

C. Piping and construction openings and excavations required for fire suppression work shall be covered when work is not in progress as follows:
   1. Cap pipe openings with fittings or plugs.
   2. Cover wall and ceiling openings with plywood or canvas covered framing.
   3. Cover floor openings and excavations with structural material of adequate strength to support traffic.

D. The Owner's property and the property of other contractors shall be scrupulously respected at all times (including damage from construction activities and leakage). Provide drop cloths and Visqueen or similar barriers where dust and debris is generated to protect adjacent area.

E. The Contractor shall be held responsible for damage caused by his work or through neglect of his tradesmen. Repairing of damaged work shall be done by contractor as directed by the Architect. Cost of repairs shall be paid by the Contractor.

F. The Owner reserves the right to make emergency repairs as required to keep equipment in operation without voiding the Contractor's guarantee bond nor relieving the Contractor of his responsibilities during the bonding period.

3.7 TESTING AND ADJUSTING

A. Furnish all necessary temporary equipment and instruments required for adjustments and for operating tests. Submit list of instruments which will be used, including data of most recent calibration of each instrument.

B. When a test is to be made, notify the Owner not less than 48-hours before the test is scheduled to start so that he may witness the test or any part of it, if they elect to do so. The start of any test or handling system may also be deferred by not more than two (2) working days if the proposed date conflicts with other commitments of the personnel assigned to witness the tests.

C. Pressure Tests:
   1. Test piping and prove tight, at the hydrostatic pressures. Test piping which is to be concealed before the construction is started. Disconnect devices, equipment and attached piping which are not designed for the test pressure and install plugs and blind flanges to close openings.
   2. Replace work found defective or repair if so directed.

D. Perform soil test per Division 31.

E. Equipment:
   1. After satisfactory testing and cleaning of all piping as specified herein, place all equipment in operation. Pressure test equipment to rated pressure for a period of 2-hours.
   2. Take all necessary readings to determine that equipment is operating satisfactorily. This includes temperatures in and out as well as ampere readings and voltage readings of all phases.

F. Test Reports: After all tests have been completed or at intervals during the testing if requested by the Owner, submit data on motor load readings on each phase and simultaneous voltage readings across each phase with motor nameplate data.

3.8 OPERATION OF SYSTEM

A. After the entire system has been adjusted, operate it for a period not less than three (3) working days or not less than eight (8) hours each day to demonstrate that performance is satisfactory and that each item of equipment has the capacity specified. If the Engineer agrees or directs major portions of the system may be operated at different times, in lieu of operations of the entire system at once. Correct all operating deficiencies observed during the test runs.

B. When excessive vibration of equipment is noted during this operation, have the manufacturer's representative check shafts, motors, motor supports, fan wheels, sheaves, equipment mountings, bearings and couplings and other components of the equipment which are vibrating.

C. Make all corrections necessary to eliminate the vibration to the satisfaction of the Engineer.

D. When the Engineer deems it to be necessary to do so, make another test after corrective work is completed for the full period specified above.

E. After replacement or repair, test work again as specified. Repeat until satisfactory.

F. Keep complete and accurate record of test data. Submit, in triplicate a, typewritten report of all test data to the Owner.

G. Provide restraints to eliminate all excess pipe movement.

3.9 FINISH

A. Prime piping and structural and/or supporting steel members or parts that are exposed with one coat of Porter gray primer, or equal as approved by the Engineer, after work is in place.
   1. Clean and re-paint any factory- or shop-painted surfaces that are damaged, scarred or with signs of corrosion. Paint to match original factory paint.
   2. Clean surfaces to remove all dirt, oil, grease dust, scale and foreign matter before applying paint. Designate all piping with temporary removal markings for guidance during priming and painting.
   3. All primer and paint shall be as manufactured by:
      a. Gildden Co., a division of PPG Industries, Inc.
      b. Martin-Senour Paints.
      c. PPG Industries, Inc.
      d. The Sherwin-Williams, Co.
      e. None of the manufacturers listed for products under this Paragraph shall be considered as Basis-of-Design.

B. Shop fabricated or Manufactured Equipment and Materials:
   1. Unless factory finished is specified, prime, prior to shipment to job. If prior painting is not part of manufacturer's standard procedure, paint equipment and materials immediately after they are put in place, as specified for field painted items.
   2. Items not to be painted:
      a. Galvanized or similarly treated surfaces unless furnished as part of unitary assembly.
      b. Non-ferrous surfaces
      c. Non-metallic surfaces
      d. Plated surfaces
      e. Inside of pipes, conduits and electrical devices
      f. Gearing and machine finished surfaces
      g. Underground piping, unless otherwise specified.

C. Painting:
   1. Refer to Division 01 for requirements.

2. Clean surfaces to remove all dirt, oil, grease, dust, scale and foreign matter before applying paint.
3. Finish painting to be done per Division 09 - Finishes or as specified within individual sections of this specification.

D. Permanent Identification: After piping has been insulated and finish painted identify all exposed piping with painted stencils. As specified in other sections of this specification.

3.10 FINAL CLEANING

A. In addition to the requirements of Division 01, the Contractor shall provide final cleaning of the work consisting of cleaning each surface or unit of work to normal "clean" condition expected for a first-class building cleaning and maintenance program. Comply with the manufacturer's instructions for cleaning operations.
1. Remove labels which are not required as permanent labels.
2. Clean transparent materials, including mirrors and window/door glass, to a polished condition, removing\substances which are noticeable as vision-obscuring materials. Replace broken glass.
3. Clean exposed exterior and interior hard-surfaced finishes, including metals, masonry, concrete, painted surfaces, plastics, tile, wood, special coatings and similar surfaces, to a dirt-free condition, free of dust, stains, films and similar noticeable distracting substances. Except as otherwise indicated, avoid disturbance of natural weathering of exterior surfaces. Restore reflective surfaces to original reflective.
4. Clean concrete floors broom clean at the conclusion of each working day.
5. Clean project site, including landscape and development areas, of litter and foreign substances and responsibly dispose thereof. Sweep paved areas to a broom-clean condition; remove stains, petro chemical spills and other foreign deposits. Rake grounds which are neither planted nor paved, to a smooth, even-textured surface.

3.11 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stop materials. Refer to Division 07 Section "Through-Penetration Firestopping" for materials.

L. Verify final equipment locations for roughing-in.

M. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.12 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting with minimum interference to other installations.

D. Install equipment to allow right-of-way for piping installed at required slope.

3.13 PROJECT SITE SAFETY

A. The Engineer claims no expertise in and assumes no responsibility for any and all safety procedures and protocols associated with the Contractor's work. The Contractor shall exercise due diligence and comply with all established safety standards and regulations as listed by OSHA and any equipment manufacturers' requirements as they may relate to personal safety. The Contractor shall ensure that all of his Subcontractor(s) and/or Tradesmen are apprised of all safety-related standards and procedures as they may relate to their work and immediately correct any violation of OSHA standards and regulations or equipment manufacturers' safety recommendations.

END OF SECTION

SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 as set forth in these Specifications are hereby incorporated into and shall become a part of this Section.

1.2 SUMMARY

A. Section Includes:
   1. Sleeves.
   2. Stack-sleeve fittings.
   3. Sleeve-seal systems.
   4. Sleeve-seal fittings.
   5. Grout.
   6. Silicone sealants.

B. Unless noted otherwise, none of the manufacturers listed for products under this Section shall be considered Basis-of-Design.

1.3 SUBMITTALS

A. Product Data: For each type of product.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Manufacturers
   1. Advance Products and Systems, Inc
   2. CALPICO, Inc
   3. GPT (an EnPro Industries company)

B. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.

C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, anticorrosion coated or galvanized, with plain ends and integral welded waterstop collar.

D. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers
1. Josam
2. MIFAB
3. Jay R Smith Mfg Co
4. Wade (a division of Tyler Pipe)
5. Watts Drainage
6. Zurn Industries, LLC

B. Description: Manufactured, Dura- or Duco-coated galvanized cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers
1. Advance Products and Systems, Inc
2. CALPICO, Inc
3. GPT (an EnPro Industries company)
4. Metraflex Company
5. Proco Products

B. Description:
1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
2. Designed to form a hydrostatic seal of 20-psig minimum.
3. Sealing Elements: EPDM-rubber or Nitrile (Buna N) interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
4. Pressure Plates: Carbon steel or composite plastic.
5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B 633, of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers
1. Advance Products and Systems, Inc
2. CALPICO, Inc
3. GPT (an EnPro Industries company)
4. Metraflex Company
5. Proco Products

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

C. Plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Description: Non-shrink, for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.6 SILICONE SEALANTS

A. Manufacturers
1. Dow Corning Corporation
2. GE Construction Sealants, Momentive Performance Materials, Inc.
3. May National Associates, a subsidiary of Sika Corporation
4. Ploymeric Systems, Inc.
5. Proco Products, Inc.
6. Schnee-Morehead, Inc., an ITW Company
7. Sherwin-Williams Company
8. Smooth On

B. Silicone, S, NS, 25, NT: Single-component, non-sag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C 920, Type S, Grade NS, Class 25, Use NT.

C. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.
1. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
1. Sleeves are not required for core-drilled holes.
2. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

C. Install sleeves in concrete floors and concrete walls as new slabs and walls are constructed.
1. Cut sleeves to length for mounting flush with both surfaces.
   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2-inches above finish floor level.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth and location of joint.

E. Fire Resistance-Rated and Smoke-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.
1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."
3. Install section of cast-iron sanitary waste pipe to extend sleeve to 2-inches above finished floor level. For cast-iron sanitary waste piping see Section 22 13 16, "Sanitary Waste and Vent Systems."
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:
   1. Concrete Slabs-on-Grade:
      a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system, galvanized-steel wall sleeves with sleeve-seal system, galvanized-steel-pipe sleeves with sleeve-seal system.
         1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
      b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system, galvanized-steel wall sleeves with sleeve-seal system or galvanized-steel-pipe sleeves with sleeve-seal system.
         1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
   2. Concrete Slabs above Grade:
      a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves, stack-sleeve fittings or sleeve-seal.
      b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves or stack-sleeve fittings.
   3. Interior Partitions:
      a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves or PVC-pipe sleeves.
      b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION

SECTION 210518 - ESCUTCHEONS FOR FIRE SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 as set forth in these Specifications are hereby incorporated into and shall become a part of this Section.

1.2 SUMMARY

A. Section Includes: Escutcheons.

1.3 DEFINITIONS

A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to complying with the requirements of this Section, provide products from one of the following:
   1. BrassCraft Manufacturing
   2. Dearborn Brass
   3. Jones Stephens Corp
   4. Keeney Manufacturing
   5. Mid-American Fittings
   6. ProFlo, a Ferguson Enterprise

B. None of the manufacturers listed for products in this Section shall be considered as Basis-of-Design.

2.2 ESCUTCHEONS

A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

C. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel or brass with polished, chrome-plated finish and spring-clip fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
   1. Escutcheons for New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
      b. Bare Piping at Wall and Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
      c. Bare Piping at Wall and Ceiling Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
      d. Bare Piping in Unfinished Service Spaces: One-piece steel with polished, chrome-plated finish.
      e. Bare Piping in Unfinished Service Spaces: One-piece cast brass with polished, chrome-plated finish.
      f. Bare Piping in Equipment Rooms: One-piece steel with polished, chrome-plated finish.
      g. Bare Piping in Equipment Rooms: One-piece cast brass with polished, chrome-plated finish.

3.2 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION

SECTION 210523 - GENERAL DUTY VALVES FOR FIRE SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Two-piece ball valves with indicators.
2. Bronze butterfly valves with indicators.
3. Iron butterfly valves with indicators.
4. Check valves.
5. Bronze OS&Y gate valves.
6. Iron OS&Y gate valves.
7. NRS gate valves.
8. Trim and drain valves.

1.3 DEFINITIONS

A. The following abbreviations are referenced within this Section:
1. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
2. NRS: Non-rising stem.
3. OS&Y: Outside screw and yoke.
4. SBR: Styrene-butadiene rubber.
5. VAC: Volts (alternating current)

1.4 SUBMITTALS

A. Product Data: For each type of valve.

1.5 DELIVERY, STORGAE AND HANDLING

A. Prepare valves for shipping as follows:
1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces and weld ends.
3. Set valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:
1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

D. Protect flanges and specialties from moisture and dirt.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" and shall bear UL mark.

B. FM Global Approved: Valves shall be listed in its "Approval Guide."

C. Source Limitations for Valves: Obtain valves for each valve type from single manufacturer.

D. ASME Compliance:
1. ASME B16.1 for flanges on iron valves.
2. ASME B1.20.1 for threads for threaded-end valves.
3. ASME B31.9 for building services piping valves.

E. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

F. NFPA Compliance: Comply with NFPA 24 for valves.

G. Valve Pressure Ratings:
1. Minimum Pressure Rating: 175-psig.
2. Not less than the minimum pressure rating indicated or higher as required by system pressures.

H. Valve Sizes: Same as upstream piping unless otherwise indicated.

I. Valve Actuator Types:
1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
2. Handwheel: For other than quarter-turn trim and drain valves.
3. Hand lever: For quarter-turn trim and drain valves NPS 2 and smaller.

J. Unless noted otherwise, none of the manufacturers listed for products under this Section shall be considered as Basis-of-Design.

2.2 TWO-PIECE BALL VALVES WITH INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Victaulic Company FireLock Series
2. Anvil International, Inc.
3. NIBCO INC.

B. Description
1. UL 1091, except with ball instead of disc and FM Global standard for indicating valves (butterfly or ball type), Class Number 1112.
2. Body Design: Two piece.
3. Body Material: Forged brass or bronze.
4. Port Size: Full or standard.

5. Seats: PTFE.
6. Stem: Bronze or stainless steel.
7. Ball: Chrome-plated brass.
8. Actuator: Worm gear or traveling nut.
9. Supervisory Switch: Internal or external.
   a. Valve Operation: Integral electrical, 125-VAC, prewired, single-circuit, supervisory switch indicating device, with weatherproof actuator housing.
10. End Connections for Valves NPS 1 through NPS 2: Threaded ends.
11. End Connections for Valves NPS 2-1/2: Grooved ends.

2.3 BRONZE BUTTERFLY VALVES WITH INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Victaulic Company.
   2. Fivalco Inc.
   3. Globe Fire Sprinkler Corporation.
   4. Milwaukee Valve Company.

B. Description
   1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 1112.
   2. Body Material: Bronze.
   3. Seat Material: EPDM.
   4. Stem Material: Bronze or stainless steel.
   5. Disc: Bronze or stainless steel with EPDM coating.
   6. Actuator: Worm gear or traveling nut.
   7. Supervisory Switch: Internal or external.
      a. Valve Operation: Integral electrical, 125-VAC, prewired, single-circuit, supervisory switch indicating device, with weatherproof actuator housing.
   8. Ends Connections for Valves
      a. NPS 1 through NPS 2: Threaded ends.
      b. NPS 2-1/2: Grooved ends.

2.4 IRON BUTTERFLY VALVES WITH INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Victaulic Company
   2. Fivalco Inc.
   3. Globe Fire Sprinkler Corporation.
   4. Kennedy Valve; a division of McWane, Inc.
   5. Milwaukee Valve Company.
   6. NIBCO INC.

B. Description
   1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
   2. Body Material: Cast or ductile iron with EPDM or epoxy coating.
   3. Seat Material: EPDM.
   4. Stem: Stainless steel.
   5. Disc: Ductile iron or nickel plated and EPDM coated.
   6. Actuator: Weather-resistant worm gear or traveling nut.

7. Supervisory Switch: Internal or external.
   a. Valve Operation: Integral electrical, 125-VAC, prewired, single-circuit, supervisory switch indicating device, with weatherproof actuator housing.
8. Body Design: Lug with grooved-end connections.

2.5 CHECK VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Victaulic Company
   2. Anvil International, Inc.
   3. Fivalco Inc.
   4. Globe Fire Sprinkler Corporation.
   5. Kennedy Valve; a division of McWane, Inc.
   6. Milwaukee Valve Company.
   7. NIBCO INC.
   8. Watts Water Technologies.

B. Description
   1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
   2. Type: Single swing check.
   3. Body Material: Cast iron, ductile iron, or bronze.
   4. Clapper: Bronze, ductile iron, or stainless steel with elastomeric seal.
   5. Clapper Seat: Brass, bronze, or stainless steel.
   6. Hinge Shaft: Bronze or stainless steel.
   7. Hinge Spring: Stainless steel.
   8. End Connections: Flanged, grooved, or threaded.

2.6 BRONZE OS&Y GATE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Victaulic Company
   2. Anvil International, Inc.
   3. Fivalco, Inc.
   4. Globe Fire Sprinkler Corporation.
   5. Kennedy Valve; a division of McWane, Inc.
   6. Milwaukee Valve Company.
   7. NIBCO INC.
   8. Watts Water Technologies, Inc.

B. Description
   1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
   2. Body and Bonnet Material: Bronze or brass.
   3. Wedge: One-piece bronze or brass.
   4. Wedge Seat: Bronze.
   5. Stem: Bronze or brass.
   6. Packing: Non-asbestos PTFE.
   7. End Connections: Threaded.

2.7 IRON OS&Y GATE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Victaulic Company
   2. Anvil International, Inc.
   3. Fivalco, Inc.
   4. Globe Fire Sprinkler Corporation.
   5. Kennedy Valve; a division of McWane, Inc.
   6. NIBCO INC.
   7. Watts Water Technologies, Inc.

B. Description
   1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
   2. Body and Bonnet Material: Cast or ductile iron.
   3. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
   4. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
   5. Stem: Brass or bronze.
   6. Packing: Non-asbestos PTFE.
   7. End Connections: Flanged, grooved or threaded.

2.8 NRS GATE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Victaulic Company
   2. American Cast Iron Pipe Company; Waterous Company subsidiary.
   3. Clow Valve Company; a division of McWane, Inc.
   4. Kennedy Valve; a division of McWane, Inc.
   5. Mueller Co.; Water Products Division.
   6. NIBCO INC.

B. Description
   1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
   2. Body and Bonnet Material: Cast or ductile iron.
   3. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
   4. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
   5. Stem: Brass or bronze.
   6. Packing: Non-asbestos PTFE.
   7. End Connections: Flanged, grooved or threaded.

2.9 TRIM AND DRAIN VALVES

A. Ball Valves
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Victaulic Company.
      b. Conbraco Industries, Inc.; Apollo Valves.
      c. Fire-End & Croker Corporation.
      d. Milwaukee Valve Company.
      e. NIBCO INC.
      f. Potter-Roemer.
      g. Tyco Fire & Building Products LP.

h. Watts Water Technologies, Inc.

2. Description
   a. Body Design: Two piece.
   b. Body Material: Forged brass or bronze.
   c. Port size: Full.
   d. Seats: PTFE.
   e. Stem: Bronze or stainless steel.
   f. Ball: Chrome-plated brass.
   g. Actuator: Hand lever.
   h. End Connections for Valves NPS 1 through NPS 2-1/2: Threaded ends.
   i. End Connections for Valves NPS 1-1/4 and NPS 2-1/2: Grooved ends.

B. Angle Valves
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fire Protection Products, Inc.
   b. NIBCO INC.
   c. United Brass Works.
2. Description
   a. Body Material: Brass or bronze.
   b. Ends: Threaded.
   c. Stem: Bronze.
   d. Disc: Bronze
   e. Packing: Asbestos-free.
   f. Actuator: Hand lever; malleable iron, bronze or aluminum.

C. Globe Valves
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. NIBCO INC.
   b. United Brass Works.
2. Description
   a. Body Material: Bronze with integral seat and screw-in bonnet.
   b. Ends: Threaded.
   c. Stem: Bronze.
   d. Disc Holder and Nut: Bronze.
   e. Disc Seat: Nitrile.
   f. Packing: Asbestos-free.
   g. Actuator: Hand lever; malleable iron, bronze or aluminum.

2.10 ALARM DEVICES

A. General: UL 753 and FM Global's "Approval Guide" listing, of types and sizes to mate and match piping and equipment.

B. Supervisory Switches: Single pole, double throw; designed to signal valve in other than fully open position.

C. For additional information see Section 21 14 30, "Fire Suppression Specialties."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 GENERAL REQUIREMENTS FOR VALVES INSTALLATION

A. Comply with requirements in the following Sections for specific valve installation requirements and applications:
   1. Section 21 12 00 "Fire-Suppression Standpipes" for application of valves in fire-suppression standpipes.
   2. Section 21 13 13 "Wet-Pipe Sprinkler Systems" for application of valves in wet-pipe, fire-suppression sprinkler systems.
   3. Section 21 13 16 "Dry-Pipe Sprinkler Systems" for application of valves in dry-pipe, fire-suppression sprinkler systems.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above the pipe center.

E. Install valves in position to allow full stem movement.

F. Install valve tags. Comply with requirements in Section 21 05 53 "Identification for Fire-Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.

G. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections.

H. Install automatic (ball-drip) drain valve at each check valve for fire-department connection.

3.3 ALARM DEVICE INSTALLATION

A. General: Comply with NFPA 24 for devices and methods of valve supervision.

B. Supervisory Switches: Supervise valves in open position.
   1. Valves: Grind away portion of exposed valve stem. Bolt switch, with plunger in stem depression, to OS&Y gate-valve yoke.
   2. Indicator Posts: Drill and thread hole in upper-barrel section at target plate. Install switch, with toggle against target plate, on barrel of indicator post.

C. Connect alarm devices to building's fire-alarm system. Wiring and fire-alarm devices are specified in Division 28.

END OF SECTION

SECTION 210533 - HEAT TRACING FOR FIRE SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes heat tracing for fire-suppression piping with self-regulating, parallel resistance electric heating cables.

1.3 SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
   2. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.

B. Shop Drawings: For electric heating cable.
   1. Include plans, elevations, sections, and attachment details.
   2. Include diagrams for power, signal, and control wiring.

C. Field quality-control reports.

D. Sample Warranty: For special warranty.

E. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.

1.4 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

A. Manufacturers: Subject to complying with the requirements of this Section, provide products from one of the following:
   1. Raychem; a brand of nVent
   2. Chromalox, Inc.

3. Delta-Therm Corporation
4. Easy Heat; a division of Emerson Electric Company
5. Nelson Heat Trace; a division of Emerson Electric Company
6. Pyrotenax, a brand of nVent
7. Thermon Americas, Inc.

B. Heating cables shall be self-regulating cables specifically designed for the intended application, tested and approved to CSA 22.2 No. 130-03 and IEEE 515.1 requirements
1. The construction of the self-regulating heating cable shall consist of a continuous core of conductive polymer that is radiation crosslinked, extruded between two (2) 16 AWG nickel-plated copper bus wires that varies its power output in response to pipe temperature changes.
2. The heating cable shall have a modified polyolefin inner jacket for dielectric integrity long-life expectancy.
3. The heating cable shall have a tinned copper braid with minimum 70-percent coverage for ground path and mechanical ruggedness.
4. The heating cable shall have a self-regulating factor of at least 50-percent. The self-regulating factor is defined as the percent reduction of the heating cable power output going from a 40-degree F pipe temperature to a 150-degree F pipe temperature.
5. The heating cable shall have an outer jacket that is approved and clearly marked for the install conditions. The heating cable shall have a modified polyolefin outer jacket printed with cable model number, agency listings, batch number and meter marks (for ease of installation within maximum circuit length).
6. The heating cable shall be designed for the following voltage/wattage, outer jacket and install conditions:
   a. Application: Fire Suppression Piping
   b. Located: Above ground
   c. Jacket: Polyolefin
   d. Minimum maintain temperature: 40-degrees F
   e. Heating cable voltage/wattage: 208/277 VAC - 5 watts/foot @ 50-degrees F
7. The heating cable shall be included in a CSA Certified system
8. Constant wattage cables are not acceptable.

C. Heating Cable Connection Kits
1. Heating cable connection kits shall be by the heating cable manufacturer.
2. Contractor shall provide power connections, splices/tees and end seal kits to properly connect and terminate the heating cable circuit along the specified length of piping.
3. All splices, tees and crosses shall be installed underneath the pipe insulation with service loops installed to allow for future service of the system.
4. Connection kits shall be rated NEMA 4X to prevent water ingress and corrosion. All components shall be UV stabilized and shall not require the installing Contractor to cut into the heating cable core to expose the bus wires.
5. Connection kits shall be UL Listed, CSA Certified and FM approved or as indicated in writing by the manufacturer.

D. Attachment of Heating Cable
1. Attachment method of heating cable to the piping shall be general purpose, high-temperature, glass filament tape for installation at 40-degrees F and above. Contractor shall fix the heating cable to the piping every 12-inches by wrapping the tape completely around the pipe and over the heating cable with a minimum tape overlap of 6-inches.
2. Metal cable ties are not permitted.

E. Identification of Heating Cable System(s)
1. Contractor shall provide manufacturer's labels, vinyl, at least 3 mils thick with pressure-sensitive, permanent, weather resistant, self-adhesive back. Labels shall substantially indicate "Electric Heat Traced" affixed to exterior pipe insulation every ten (10) feet on

opposite sides of the pipe and on all splices, tees, crosses and power connections for the entire length of heat traced piping.

a. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.

b. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

2.2 CONTROLS

A. Single Circuit Local Digital Controller.

1. All self-regulating heating cable shall be controlled via and energy saving, programmable single circuit controller to provide adjustable maintained temperatures in the range of -40-degrees F to 140-degrees F.
2. Contractor shall provide one controller for each heat tracing circuit as indicated on heat tracing schedule (below).
3. Controller shall include a self-test function to verify heat tracing integrity at least once every 24 hours.
4. See table below for complete list of required controller capabilities:

Supply Voltage	100 VAC to 277 VAC		
Enclosure	NEMA4X FRP		
Operating Temp Range	–40°F - 140°F		
Display	6 character alphanumeric LED		
Control	Relay Type: DP, mechanical	Voltage: 277 VAC max	Current: 30 A @ 104°F
Control Algorithms	On/Off		
	Proportional Ambient Sensing Control for energy saving		
Monitoring			
	Temperature	Low Alarm: 0°F to 180°F	High Alarm: 0°F to 200°F
	Ground Fault	Alarm Range: 20 mA -100 mA	Trip Range: 20 mA -100 mA
	Current	Low alarm range: .3 A to 30 A or off	
	Autocycle Test	Interval: 1-240 minutes or 1-240 hours	
Temp Sensor Inputs	Quantity: Two (2)	Type: 100 Ω, platinum 3 wire	
Alarm Outputs			
	AC Relay: Isolated solid state triac, SPST, 0.75A max, 100 VAC to 277 VAC nominal		
	Dry Contact Relay: Pilot duty, 48 VAC/DC, 500 mA maximum, 10 VA max. resistive switching		
	Outputs: Normally Opened or Normally Closed		
Stored Parameters			
	Minimum Temperature	Maximum Temperature	Max. ground fault current
	Maximum Heater current	Contactor cycle count	Time in Use
Alarm Conditions			
	Low & high temperature	Low current	Ground fault alarm & trip
	RTD failure	Loss of programmed values	EMR failure
Communications			
	Protocol: Modbus RTU	Topology: daisy chain	26 AWG shielded twisted pair

B. Temperature Sensors: Fire sprinkler control -- Per IEEE 515.1, Contractor shall provide one (1) 100-ohm, platinum 3-wire RTD for ambient temperature sensing and one (1) 100 ohm, platinum 3-wire RTD for pipe temperature sensing for each heat tracing controller.

C. Approval: The complete heat trace system (heating cable, connection kits and controller) shall be listed by a Nationally Recognized Testing (NRTL) and marked for intended use of freeze protection of standpipes, mains and branch sprinkler piping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Prior to installation of heating cable system, verify that all piping which will be heat traced has passed all testing and inspections as required by NFPA 13 and NFPA 14 and has been approved by the Authority Having Jurisdiction.

B. Preinstallation Testing: Prior to installing heating cable on the piping an insulation resistance test shall be performed by the installing Contractor to ensure the integrity of heating cable as described in the manufacturer's installation and maintenance manual.

3.2 PREPARATION

A. Protection of In-Place Conditions.
   1. All heating cable ends shall be protected from moisture ingress until cable is terminated.
   2. Acceptable methods are installing manufacturer's end seals.

3.3 INSTALLATION

A. Install electric heating cable where indicated and according to NFPA 13, NFPA 14 and NFPA 70 and in accordance with IEEE 515.1.

B. Install electric heating cables after piping has been tested and before insulation is installed.

C. Install insulation over piping with electric cables according to Section 21 07 00 "Fire-Suppression Systems Insulation."

D. Comply with the manufacturer's recommendations contained in their installation and operation manual.

E. All heat tracing components including power connections, splices, tees, crosses and/or end seals must be installed above grade and protected from abuse or damage. By NEC and CEC, electrical connections are not to be permitted to be installed below grade.

F. Temperature sensor shall be installed inside of a 3/4-inch plastic conduit and pushed all the way to the closed end. Contractor to wire temperature sensor to controller and be responsible for extended temperature sensor wiring as required by the site conditions.

G. Install electric heating cable according to the drawings and manufacturer's instructions. The installer shall be responsible for providing a complete and functional system installed in accordance with applicable manufacturer, national and local requirements.

H. Interface with other work
   1. Connection of all electrical wiring and grounding of controller shall be according to Division 26.
   2. Pipe insulation shall be according to Section 21 07 00, "Insulation for Fire Suppression Piping" and is required for a properly operating system.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service technician or representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Field tests and inspections:
   1. The system shall be commissioned in accordance with the manufacturer's installation and operation manual.
   2. All field tests shall be performed by a manufacturer-provided technician.
   3. The following test shall be performed after the heat cable has been installed but before the insulation has been applied to the piping. The results of both sets of tests shall be recorded as detailed by the manufacturer's installation and maintenance manual and included in submittals to the Owner.
      a. Continuity test
      b. Insulation resistance -- 2500 VDC
      c. Capacitance Check -- Circuit Length Verification
      d. Power Check
      e. Ground-fault Test
   4. The technician shall verify the insulation schedule is in compliance with the manufacturer's insulation and operation manual.
   5. The technician shall verify the control parameters are set to the application requirements.
   6. The technician shall verify that the alarm contacts are correctly connected to the NMS (if applicable).

C. Non-Conforming Work: Any heat tracing circuit which fails any of the above tests must be corrected prior to commissioning or startup of the system.

3.5 SYSTEM STARTUP

A. Provide a factory-certified technician or manufacturer's representative.for startup and commissioning of the heat tracing system and controller(s).

B. Coordinate all controller settings prior to programming the controller with a Fire Protection Engineer/NICET Certified Fire Protection Designer for Fire Suppression piping.

C. Provide commissioning report in submittals package to Owner.

END OF SECTION

SECTION 210548 - SEISMIC CONTROLS FOR FIRE SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Restraint channel bracings.
2. Restraint cables.
3. Seismic expansion loops.
4. Seismic-restraint accessories.
5. Mechanical anchor bolts.
6. Adhesive anchor bolts.

B. Related Requirements:
1. Section 22 05 48 "Seismic Controls for Plumbing Piping" for devices for plumbing systems.
2. Section 23 05 48 "Vibration and Seismic Controls for HVAC" for devices for HVAC equipment and systems.

C. Unless noted otherwise, none of the manufacturers listed for products under this Section shall be considered as Basis-of-Design.

1.3 SUBMITTALS

A. Product Data: For each type of product.
1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
   a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to the Authority Having Jurisdiction.
   b. Annotate to indicate application of each product submitted and compliance with requirements.
3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings: Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.

C. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.
1. Include design calculations and details for selecting vibration isolators and seismic restraints complying with performance requirements, design criteria, and analysis data

signed and sealed by the qualified professional engineer responsible for their preparation.

2. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, due to seismic forces required to select vibration isolators, and due to seismic restraints.
3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
4. Seismic-Restraint Details:
   a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
   b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
   c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
   d. Preapproval and Evaluation Documentation: By an agency acceptable to the Authority Having Jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For professional engineer and testing agency.

C. Welding certificates.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to the Authority Having Jurisdiction.

B. Comply with seismic-restraint requirements in the OBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based

on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:
   1. Site Class as Defined in the OBC: D.
   2. Assigned Seismic Use Group or Building Category as Defined in the OBC: II.
      a. Component Importance Factor: 1.5.
      b. Component Response Modification Factor: 1.25.
      c. Component Amplification Factor: 1.0.
   3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 0.32.
   4. Design Spectral Response Acceleration at 1.0-Second Period: 0.18.
   5. Rated strengths, features, and applications shall be as defined in report by an agency acceptable to the Authority Having Jurisdiction.
      a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they are subjected.

2.2 RESTRAINT CHANNEL BRACINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. B-Line, an Eaton business
   2. CADDY; a brand of nVent
   3. Hilti, Inc.
   4. Unistrut; part of Atkore International

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.3 RESTRAINT CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. CADDY; a brand of nVent
   2. Vibration Mountings & Controls, Inc.

B. Restraint Cables: ASTM A 492 stainless-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.4 SEISMIC EXPANSION JOINTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. The Metraflex Co. (Basis-of-Design)
   2. Flexonics
   3. U.S. Bellows, Inc.

B. Expansion Joints:
   1. Flexible hose expansion loops shall be manufactured complete with two parallel sections of corrugated metal house, compatible braid, 180-degree return bend with inlet and outlet connections. Field fabricated loops shall not be permitted.
   2. For fire suppression systems, flexible loops shall be UL-listed and FM Global-approved.
   3. End fittings: Grooved schedule 40 carbon steel
   4. 90-degree elbow fittings: Schedule 40 carbon steel
   5. Corrugated Hose: Stainless Steel, Type 304.
   6. Braid: Type 304 Stainless Steel braid shall be used for any Series 300 Stainless Steel hose.
   7. Fittings Materials of construction and end fitting type shall be consistent with pipe material and equipment/ pipe connection fittings. Copper fittings shall not be attached to stainless steel hose.
   8. Flexible hose expansion loops shall have a factory-supplied, hanger/support lug located at the bottom of the 180-degree return.
   9. Flexible hose expansion loop(s) shall be rated with an operating pressure in accordance with the table below. The operating pressure shall be based on burst pressure with a 4 to 1 safety factor.
   10. Flexible hose expansion loops mounted in the horizontal shall be provided with seismic breakaway hanger as required by the manufacturer.

FLEXIBLE EXPANSION LOOP WITH STAINLESS STEEL HOSE		
Size	Movement	Working Pressure (psig)
1" to 3"	±8"	300
4" to 8"	±8"	175

2.5 SEISMIC-RESTRAINT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. B-Line, an Eaton business
   2. CADDY; a brand of nVent
   3. Mason Industries, Inc.

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.6 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. B-Line, an Eaton business
2. Hilti, Inc.
3. Mason Industries, Inc.
4. Powers Fasteners
5. Simpson Strong-Tie Co., Inc.
6. Unistrut; part of Atkore International

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.7 ADHESIVE ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. B-Line, an Eaton business
2. Hilti, Inc.
3. Mason Industries, Inc.
4. Powers Fasteners
5. Simpson Strong-Tie Co., Inc.
6. Unistrut; part of Atkore International

B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to the Authority Having Jurisdiction.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Division 03.

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Comply with requirements in Division 07 for installation of roof curbs, equipment supports, and roof penetrations.

D. Piping Restraints:
   1. Comply with requirements in MSS SP-127.
   2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
   3. Brace a change of direction longer than 10 feet.

E. Install cables so they do not bend across edges of adjacent equipment or building structure.

F. Install seismic-restraint devices using methods approved by an agency acceptable to the Authority Having Jurisdiction that provides required submittals for component.

G. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

H. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

I. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

J. Drilled-in Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 22 11 16 "Domestic Water Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:
1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION

SECTION 210553 - IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 as set forth in these Specifications are hereby incorporated into and shall become a part of this Section.

1.2 SUMMARY

A. This Section includes the following mechanical identification materials and their installation:
   1. Equipment nameplates.
   2. Equipment markers.
   3. Pipe markers.
   4. Valve tags.
   5. Valve schedules.

B. Identify by labels and tags the following:
   1. Equipment such as riser assemblies, pumps, etc.
   2. Piping and valves exposed in equipment rooms and accessible service areas.
   3. Piping and valves running above accessible ceiling construction and near access panels in non-accessible construction areas.

C. Install laminated plastic markers and metal stamped nameplates for equipment. Provide color banding, flow arrows and contents identification for piping.

D. For labeling requirements pertaining to Fire Suppression Piping with Electric Heat Trace, see Section 21 05 33.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

A. Samples: For color, letter style and graphic representation required for each identification material and device as requested by the Engineer.

B. Valve numbering scheme.

C. Valve Schedules: For each piping system. Furnish three extra copies (in addition to mounted copies) to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, “Scheme for the Identification of Piping Systems,” for letter size, length of color field, colors and viewing angles of identification devices for piping.

1.5 COORDINATION

A. Coordination installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. All trades shall use the same type, style and appearance of identification.

E. Coordinate with the Owner for data on tags and identification with a unique numbering system. The tags and identification shall have the number in both an alpha/numeric font and a bar code font (as applicable). The number and font shall be obtained from the Owner prior to ordering. The Owner's requirements shall supersede those of this Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements provide products by one (1) of the manufacturers specified.
   1. Brady Corp.
   2. Brimar Industries
   3. Craftmark
   4. National Marker Co.
   5. Seton Nameplate Corp.

B. None of the manufacturers listed for products under this Section shall be considered as Basis-of-Design.

2.2 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
   1. Data:
      a. Manufacturer, product name, model number and serial number.
      b. Capacity, operating and power characteristics and essential data.
      c. Labels of tested compliances.
   2. Location: Accessible and visible.
   3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, laminated plastic, white lettering on black background. Markers shall be screw on, except where screws might damage equipment, use a contact-type permanent adhesive.
   1. Terminology: Match schedules as closely as possible.
   2. Size: Sized for 3/4-inch lettering.

2.3 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service

and showing direction of flow.
1. Colors: As indicated in specification schedule.
2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
3. Pipes with OD, including insulation, less than 6-inches: Full wrap around pipe labels extending minimum 360-degrees around pipe at each location.
4. Pipes with OD, including insulation, 6-inches and larger: Either full-band or full wrap around pipe label pipe markers at least three (3) times letter height and of length required for label.
5. Arrows: A separate full wrap around pipe labels with flow direction on each pipe marker to indicate direction of flow
   a. OPTION: Arrows may be integral part of pipe markers above.

2.4 VALVE TAGS

A. Valve Tags: 2-inches diameter tag stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme, approved by Engineer. Provide 5/32-inch hole for fastener.
   1. Material: 16-gauge brass.
   2. Valve-Tag Fasteners: Beaded brass chain.

2.5 VALVE SCHEDULES

A. Valve Schedules: For each piping system, on standard-size, bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulation), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
   2. Frame: Extruded aluminum.
   3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 21 Sections. If more than single-type material, device or label is specified for listed applications, selection is Installer's option.

B. Installing Contractor is responsible for valve tagging, equipment markers and pipe identification of all valves, equipment and piping on packaged pumping skids.

3.2 EQUIPMENT IDENTIFICATION

A. Install equipment markers with screws. If screws might damage equipment, use permanent adhesive on or near each major item of plumbing equipment.

B. Locate markers where accessible and visible. Include markers for the following general

categories of equipment:
1. Main control and operating valves.
2. Pumps.

3.3 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service of each piping system. Install with flow indication arrows showing direction of flow.

B. Install manufactured pipe markers on new and, if not previously provided, existing piping systems in the area of work.

C. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior non-concealed locations as follows:
1. Near each valve and control device.
2. Near each side of penetrations through walls, floors, ceilings and non-accessible enclosures.
3. At access doors and similar access points that permit view of concealed piping.
4. Near major equipment items and other points of origination and termination.
5. Spaced at maximum intervals of 50-feet along each run. Reduce intervals to 25-feet in areas of congested piping and equipment.
6. On piping above removable acoustical ceilings.

D. Pipe Identification

PIPE IDENTIFICATION SCHEDULE			
Type of Service	Band Color	Lettering Color	Designation
Fire Main	Safety Red	White	Fire Main
Wet-Pipe Sprinkler	Safety Red	White	Wet Sprinkler
Dry-Pipe Sprinkler	Safety Red	White	Dry Sprinkler
Preaction Sprinkler	Safety Red	White	Preaction Sprinkler
Wet Standpipe	Safety Red	White	Wet Standpipe
Dry Standpipe	Safety Red	White	Dry Standpipe
Drain	Green	White	Drain

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves and valves within factory-fabricated equipment units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves with captions similar to those indicated in the following:

VALVE TAG SCHEDULE	
Type of Service	Designation
Fire Main	F
Wet-Pipe Sprinkler	SPR
Dry-Pipe Sprinkler	DP
Preaction Sprinkler	PA
Wet Standpipe	SP
Dry Standpipe	DSP
Drain	DR

3.5 VALVE SCHEDULE INSTALLATION

A. Mount valve schedule on wall in accessible location where directed by the Owner. Provide aluminum frame with plexiglass cover for valve chart.

3.6 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work. Labels, tags, etc. must be readable from a standing position.

3.7 CLEANING

A. Clean faces of mechanical identification devices and glass and frames of valve schedules.

END OF SECTION

SECTION 210700 - INSULATION FOR FIRE SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Insulating exterior, above-grade wet-pipe fire mains.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail application of field-applied jackets.
6. Detail application at linkages of control devices.

C. Unless indicated otherwise, none of the manufacturers listed for products under this Section shall be considered as Basis-of-Design.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing agency.
   1. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location directed by Architect. Use materials indicated for the completed Work.
   1. Piping Mockups:
      a. One 10-foot section of (minimum) NPS 2 straight pipe.
      b. One each of a 90-degree threaded, welded, and flanged elbow.
      c. One each of a threaded, welded, and flanged tee fitting.
      d. One NPS 2 or smaller valve, and one NPS 2-1/2 or larger valve.
      e. Four support hangers including hanger shield and insert.
      f. One threaded strainer and one flanged strainer with removable portion of insulation.
      g. One threaded reducer and one welded reducer.
      h. One pressure temperature tap.
      i. One mechanical coupling.
   2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
   3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
   4. Obtain Architect's approval of mockups before starting insulation application.
   5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   7. Demolish and remove mockups when directed.
   8. EXCEPTION: The mockups shall not be required if either of the following two conditions are satisfied for the installation of insulation for Fire Suppression piping:
      a. The Contractor has a minimum of five (5) years of experience, or;
      b. The Contractor assigns this work to a Subcontractor with a minimum five (5) years of experience.
      c. The Contractor shall identify on his Bid Form the Contractor that will be performing insulation work for Fire Suppression systems on this project. At the Engineer's request, documentation of the Contractor's or Subcontractor's experience, including specific project references, shall be provided.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields.

B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop

Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.
      a. CertainTeed Manson.
      b. Johns Manville.
      c. Knauf Fiberglass GmbH.
      d. Owens-Corning Fiberglass Corp.
   2. Block Insulation: ASTM C 552, Type I.
   3. Special-Shaped Insulation: ASTM C 552, Type III.
   4. Board Insulation: ASTM C 552, Type IV.
   5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
   6. Preformed Pipe Insulation with Factory-Applied ASJ or ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
   7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
   1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.
      a. Armstrong Model AP.
      b. Halsted Mitchell.

c. Rubatex.

G. Mineral-Fiber, Preformed Pipe Insulation:
1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.
   a. CertainTeed Manson.
   b. Johns Manville.
   c. Knauf Fiberglass GmbH.
   d. Owens-Corning Fiberglass Corp.
2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195. Provide product as recommended by insulation manufacturer.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 degrees F.

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

B. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
2. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
3. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
4. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 degrees F.
3. Solids Content: 60 percent by volume and 66 percent by weight.
4. Color: White.

2.5 SEALANTS

A. Joint Sealants for Cellular-Glass Products:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 degrees F.
4. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 degrees F.
4. Color: Aluminum.

C. ASJ Flashing Sealants, and PVC Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 degrees F.
4. Color: White.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perm when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
5. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Adhesive: As recommended by jacket material manufacturer.
2. Color: Color as selected by Architect.
3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
   a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
4. Factory-fabricated tank heads and tank side panels.

C. Metal Jacket:
1. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
   a. Factory cut and rolled to size.

b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft-paper.
d. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
a. Factory cut and rolled to size.
b. Material, finish, and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
d. Factory-Fabricated Fitting Covers:
1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. SK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Width: 2 inches.

2. Thickness: 6 mils.
3. Adhesion: 64 ounces force/inch in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Width: 2 inches.
2. Thickness: 3.7 mils.
3. Adhesion: 100 ounces force/inch in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch in width.

2.9 SECUREMENTS

A. Bands:
1. Stainless Steel: ASTM A 167 or ASTM A 240, Type 304; 0.015-inch thick, 1/2-inch wide with wing seal.
2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020-inch thick, 1/2-inch wide with wing seal.

B. Insulation Pins and Hangers:
1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
   a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030-inch thick by 2 inches square.
   b. Spindle: Aluminum or Stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
   c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
2. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
   a. Baseplate: Galvanized carbon-steel sheet, 0.030-inch thick by 2 inches square.
   b. Spindle: Aluminum or Stainless steel], fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
   c. Adhesive-backed base with a peel-off protective cover.
3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, aluminum or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

2.10 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040-inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024-inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
   1. Verify that systems and equipment to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
   1. Carbon Steel: Coat carbon steel operating at a service temperature between 32- and 300-degrees F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
      a. For below-ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
6. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
7. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

C. Insulate instrument connections for sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
   1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
   2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
   3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
   4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
   5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and applicable insulation joint sealant.
   3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
   4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
   4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

   1. Install preformed sections of cellular-glass insulation to valve body.
   2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.

3.7 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
   1. Install pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
   4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install mitered sections of pipe insulation.
   2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed valve covers manufactured of same material as pipe insulation when available.
   2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.
   4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and applicable insulation joint sealant.
   3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
   4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
   4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.10 FINISHES

A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09.
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three

locations of threaded fittings, three locations of welded fittings, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.12 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   1. Indoor fire-suppression piping.
   2. Underground piping.

3.13 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Outdoor Fire-Suppression Piping Filled with Water:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Cellular Glass: 2 inches thick.
      b. Flexible Elastomeric: 2 inches thick.
      c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Outdoor Exposed Piping:
   1. PVC: 20 mils thick.
   2. Painted Aluminum, Smooth or Corrugated with Z-Shaped Locking Seam: 0.016 inch thick.
   3. Stainless Steel, Type 304, Smooth 2B Finish or Corrugated with Z-Shaped Locking Seam: 0.010 inch thick.

END OF SECTION

SECTION 211100 - FACILITY FIRE SUPPRESSION WATER-SERVICE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes fire-suppression water-service piping and related components outside the building and service entrance piping through floor into the building and the following:
   1. Pipes, fittings, and specialties.
   2. Fire-suppression specialties.

B. Related Requirements:
   1. Section 21 12 00 "Fire-Suppression Standpipes" for fire suppression standpipes inside the building.
   2. Section 21 14 30 "Fire Suppression Specialties" for related fire suppression specialties and equipment.

C. None of the manufacturers listed for products under this Section shall be considered as Basis-of-Design.

1.3 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of installation.

C. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with requirements of utility purveyor supplying the water.
   2. Comply with standards of the Authority Having Jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with FM Global's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-suppression water-service piping.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

B. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

C. Protect flanges, fittings, and specialties from moisture and dirt.

D. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE AND FITTINGS

A. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.

B. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end.

C. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end.

D. Grooved-End, Ductile-Iron Pipe Appurtenances:
   1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
      a. Victaulic Company
      b. Anvil International
      c. CPS Products, Inc.
      d. Shurjoint-Apollo Piping Products USA, Inc.
      e. Smith-Cooper International
      f. Star Pipe Products
      g. Tyco by Johnson Controls Company
      h. Viking Corporation
   2. Grooved-End, Ductile-Iron Fittings: ASTM A47/A47M, malleable-iron castings or ASTM A536, ductile-iron castings with dimensions matching pipe.
   3. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

E. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
   1. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, ASME B16.21 rubber gaskets, and steel bolts.

F. Push-on-Joint, Ductile-Iron Fittings: AWWA C153, ductile-iron compact pattern.

1. Gaskets: AWWA C111, rubber.

G. Flanges: ASME B16.1, Class 125, cast iron.

2.2 PE PIPE AND FITTINGS

A. PE, Fire-Service Pipe: FM Global approved, with minimum thickness equivalent to Class 150.

B. Molded PE Fittings: FM Global approved; PE butt-fusion type, made to match PE pipe dimensions and class.

2.3 PVC PIPE AND FITTINGS

A. PVC Pipe: AWWA C900, Class 150 and Class 200, with bell end with gasket, and with spigot end.

B. PVC Fittings: AWWA C900, Class 150 and Class 200, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.

2.4 SPECIAL PIPE FITTINGS

A. Ductile-Iron Flexible Expansion Joints:
1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
   a. EBAA Iron, Inc.
   b. Star Pipe Products
   c. Zurn Industries, LLC
2. Description: Compound, ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections. Assemble components for offset and expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
3. Pressure Rating: 250 psig minimum.

B. Ductile-Iron Deflection Fittings:
1. Manufacturer: Subject to compliance with requirements, provide products by EBAA Iron, Inc.
2. Description: Compound, ductile-iron coupling fitting with sleeve and one or two flexing sections for up to 15-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
3. Pressure Rating: 250 psig minimum.

2.5 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Tubular-Sleeve Pipe Couplings:
1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

a. Cascade Waterworks Mfg. Co.
b. Dresser, Inc.
c. Ford Meter Box Company, Inc.
d. Jay R. Smith Mfg. Co., a division of Morris Group International
e. JCM Industries, Inc.
f. Romac Industries, Inc.
g. Viking Johnson

2. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners, and with ends of same sizes as piping to be joined.
3. Standard: AWWA C219.
4. Center-Sleeve Material: Manufacturer's standard, Ductile iron or Malleable iron.
5. Gasket Material: Natural or synthetic rubber.
6. Pressure Rating: 150 psig minimum.
7. Metal Component Finish: Corrosion-resistant coating or material.

2.6 EARTHWORK

A. Comply with excavating, trenching, and backfilling requirements in Division 31.

2.7 PIPING INSTALLATION

A. Comply with NFPA 24 for fire-service-main piping materials and installation.

B. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
1. Install encasement for piping according to ASTM A674 or AWWA C105.

C. Install PE pipe according to ASTM D2774 and ASTM F645.

D. Install PVC, AWWA pipe according to ASTM F645 and AWWA M23.

E. Bury piping with depth of cover over top at least 48 inches and according to the following:
1. Under Driveways: With at least 42 inches of cover over top.
2. In Loose Gravelly Soil and Rock: With at least 12 inches of additional cover.

F. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

G. Extend fire-suppression water-service piping and connect to water-supply source and building fire-suppression water-service piping systems at locations and pipe sizes indicated.
1. Terminate fire-suppression water-service piping within the building at the floor slab until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building's fire-suppression water-service piping systems when those systems are installed.

H. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

I. Comply with requirements for fire-suppression water-service piping inside the building in the following Sections:
1. Section 21 12 00 "Standpipe Systems"
2. Section 21 13 13 "Wet-Pipe Sprinkler Systems"
3. Section 21 13 16 "Dry-Pipe Sprinkler Systems"

J. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 21 05 17 "Sleeves and Sleeve Seals for Fire Suppression Piping."

K. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 21 05 17 "Sleeves and Sleeve Seals for Fire Suppression Piping."

2.8 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure rating same as or higher than systems pressure rating for aboveground applications unless otherwise indicated.

B. Install flanges, flange adaptors, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

C. Ream ends of tubes and remove burrs.

D. Remove scale, slag, dirt, and debris from outside and inside of pipes, tubes, and fittings before assembly.

E. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.

F. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts.

G. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with bolts according to ASME B31.9.

H. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D2657.

I. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D2774 or ASTM D3139.

J. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

K. Do not use flanges or unions for underground piping.

2.9 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
   1. Concrete thrust blocks.
   2. Locking mechanical joints.
   3. Set-screw mechanical retainer glands.
   4. Bolted flanged joints.
   5. Heat-fused joints.
   6. Pipe clamps and tie rods.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches in fire-suppression water-service piping according to NFPA 24 and the following:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

2.10 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Install ball drip valves at each check valve for fire-department connection to mains.

B. Install protective pipe bollards on two sides of each freestanding fire-department connection. Pipe bollards are specified in Division 05.

2.11 CONNECTIONS

A. Connect fire-suppression water-service piping to interior fire-suppression piping.

2.12 FIELD QUALITY CONTROL

A. Use test procedure prescribed by The Authority Having Jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described below.

B. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

C. Hydrostatic Tests: Test at not less than one-and-one-half times the working pressure for two hours.
1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to zero psig. Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

D. Prepare test and inspection reports.

2.13 IDENTIFICATION

A. Install continuous underground warning tape during backfilling of trench for underground fire-suppression water-service piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31.

B. Permanently attach equipment nameplate or marker indicating plastic fire-suppression water-service piping or fire-suppression water-service piping with electrically insulated fittings, on main electrical meter panel. Comply with requirements for identifying devices in Section 21 05 53 "Identification for Fire Suppression Piping and Equipment."

2.14 CLEANING

A. Clean fire-suppression water-service piping as follows:

1. Purge new piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging procedure prescribed by the Authority Having Jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
3. Use purging and disinfecting procedure prescribed by the Authority Having Jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
   a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow it to stand for 24 hours.
   b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow it to stand for three hours.
   c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
   d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging activities.

2.15 PIPING SCHEDULE

A. Underground fire-suppression water-service piping NPS 6 to NPS 12 shall be one of the following:
   1. Grooved-end, ductile-iron pipe; grooved-end, ductile-iron pipe appurtenances; and grooved joints.
   2. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile- or gray-iron, standard-pattern fittings; glands, gaskets, and bolts; and gasketed joints.
   3. Push-on-joint, ductile-iron pipe; push-on-joint, ductile-iron compact-pattern fittings; and gasketed joints.
   4. PE, Class 150 or Class 200, fire-service pipe; molded PE fittings; and heat-fusion joints.
   5. PVC, Class 150 or Class 200 pipe listed for fire-protection service; PVC fittings of same class as pipe; and gasketed joints.

B. Underslab fire-suppression water-service piping NPS 6 to NPS 12 shall be one of the following:
   1. Grooved-end, ductile-iron pipe; grooved-end, ductile-iron pipe appurtenances; and grooved joints.
   2. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile- or gray-iron, standard-pattern fittings; glands, gaskets, and bolts; and restrained, gasketed joints.
   3. Push-on-joint, ductile-iron pipe; push-on-joint, ductile-iron compact-pattern fittings; and restrained, gasketed joints.

END OF SECTION

SECTION 211200 - FIRE SUPPRESSION STANDPIPE SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Pipes and fittings.
2. Pipe joint materials.
3. Specialty valves.
4. Hose connections.
5. Fire department valve cabinets.

1.3 DEFINITIONS

A. Standard-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at working pressure 175-psig maximum.

1.4 SYSTEM DESCRIPTIONS

A. Standpipe System: An arrangement of piping, valves, hose connections and associated equipment installed in a building or structure, with the hose connections located in such a manner that water can be discharged in streams or spray patterns through attached hose and nozzles, for the purpose of extinguishing a fire, thereby protecting a building or structure and its contents in addition to protecting the occupants.

B. (Automatic Wet) Standpipe System (West Tower): A standpipe system containing water at all times that is attached to a water supply capable of supplying the system demand at all times and that requires no action other than opening a hose valve to provide water at hose connections.

C. (Automatic Dry) Standpipe System (Concourse Areas): A standpipe system permanently attached to a water supply capable of supplying the water demand at all times, containing air under pressure the release of which (as from the opening of a hose valve) opens a dry-pipe valve to allow water to flow into the piping system and out the opened hose valve.

D. Class I System: A system that provides 2-1/2-inch hose connections to supply water for use by fire department personnel.

1.5 PERFORMANCE REQUIREMENTS

A. Standard-Pressure, Fire-Suppression Standpipe System Component: Listed for 175-psig minimum working pressure.

B. Standpipe system design shall be approved by the Owner's Insurance Underwriter (as applicable) and the Authority Having Jurisdiction.
   1. Design standpipe system(s), including comprehensive engineering analysis by a qualified Professional Engineer, registered in Fire Protection, and/or NICET-certified Level III or Level IV Designer, using performance requirements and design criteria indicated.
   2. The Contractor shall read the Specifications covering all branches of the work with work performed under all other Contracts
   3. Standpipe systems shall be designed and sized hydraulically by this Contractor according to NFPA 14, the rules and regulations of the Owner's Insurance Underwriter (as applicable) and the Building and Fire Codes in-force. Obtain approvals and permits from the Authority Having Jurisdiction. System is to be hydraulically calculated
   4. Flow test shall be performed per NFPA 14 and NFPA 291 by the Fire Suppression Contractor at two (2) fire hydrant locations. The Fire Suppression Contractor shall provide hydraulic calculations required for approvals. Standpipe system piping shall be designed to operate at working pressure of 175-psig maximum.
   5. If the Contractor has any questions concerning the Plans and Specifications, he shall contact the Engineer for clarification PRIOR TO SUBMITTING HIS BID to fully understand the extents and responsibilities of his work.

Standpipe system residual (NPS 2-1/2) hose outlet pressures:
   1. Minimum at each hose-connection outlet: 100-psig.
   2. Maximum at required flow at each hose-connection outlet unless otherwise indicated on the Drawings: 175-psig.

1.6 SUBMITTALS

A. Product Data: Specification sheets on all component parts of the system. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Submittals must bear the Contractor's and the governing agencies stamps of approval prior to the Engineer's final review Submittal.

B. Shop Drawings: Prepare detailed shop drawings approved by the Owner's Insurance Underwriter and the Authority Having Jurisdiction for the Fire Suppression Standpipe System showing the location of piping, etc. for review. All drawings shall be drawn accurately to scale in sheets of uniform size. Contractor must provide the data required by NFPA 14 including plans, elevations, sections, details, and attachments to other work.

C. Delegated-Design Submittal: For standpipe systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified Professional Engineer or NICET-certified Level III or Level IV Designer responsible for their preparation.

D. Coordination Drawings: Fire-suppression standpipes, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Plumbing piping systems.
   2. Mechanical piping systems.
   3. Items penetrating or located on finished ceiling include, but are not necessarily limited to, the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Detectors and alarms.
d. Communications devices.
e. Signage.

E. Qualification Data: For qualified Installer and State-licensed fire suppression designers.

F. Approved Standpipe Drawings: Working plans, prepared according to NFPA 14, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
1. Grooved joint couplings and fittings shall be shown on drawings and product submittals and be specifically identified with the applicable Victaulic style or series number.

G. Welding certificates.

H. Fire hydrant flow test report.

I. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping".

J. Field quality-control reports.

K. Operation and Maintenance Data: For fire-suppression standpipes specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:
1. Installer's responsibilities include designing, fabricating, and installing fire-suppression standpipes and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. NFPA Standards: Fire-suppression standpipe equipment, specialties, accessories, installation, and testing shall comply with NFPA 14, "Installation of Standpipe and Hose Systems."

E. To assure uniformity and compatibility of piping components in grooved end piping systems, all grooved products utilized shall be supplied by Victaulic. Grooving tools shall be supplied by the same manufacturer as the grooved components.

1.8 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 BLACK STEEL PIPE AND ASSOCIATED FITTINGS

A. Schedule 40: ASTM A 53/A 53M, Type E, Grade B; with factory- or field-formed ends to accommodate joining method.

B. Schedule 30: ASTM A 53/A 53M, Type E, Grade B; with factory- or field-formed ends to accommodate joining method.

C. Schedule 10: ASTM A 135/A 135M or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 14-specified wall thickness in NPS 6 to NPS 10, plain end.

D. Uncoated, Steel Couplings: ASTM A 865/A 865M, threaded.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Cast-Iron Flanges: ASME 16.1, Class 125.

G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

H. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

I. Grooved-Joint, Steel-Pipe Appurtenances:
   1. Manufacturer: Subject to compliance with requirements, provide products by the Victaulic Company.
   2. Pressure Rating: 175-psig minimum.
   3. Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
   4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-synthetic rubber gasket, and bolts and nuts.
      a. Rigid Type: Housings shall be cast with offsetting, angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with NFPA 14. Tongue and recess rigid type couplings shall only be permitted if a torque wrench is used for installation. Required torque shall be in accordance with the manufacturer's current listed standards.
         1) 1-1/4-inch through 12-inch: Installation Ready® rigid joints, designed for direct "stab" installation onto grooved end pipe without prior disassembly of the coupling. Victaulic FireLock EZ Style 009N (1-1/4-inch to 4-inch) and Victaulic QuickVic Style 107H (2-inch to 12-inch).
      b. Flexible Type: Use in seismic areas where required by NFPA 14. Victaulic Installation Ready Style 177 and Style 75 or 77.
      c. Gaskets for grooved-end-pipe couplings shall be listed for use with the housings as follows:

GROOVED COUPLING GASKET MATERIAL		
Fire Protection Service	Temperature Range	Gasket Recommendation
Water/Wet-Pipe Sprinkler Systems	Ambient	Grade A EPDM (ASTM D-2000)
Water/Wet-Pipe Sprinkler Systems	Ambient	Grade E EPDM (ASTM D-2000)
Freezer Applications	-40 degrees F to 0 degrees F	FlushSeal, Grade L, Silicone

5. Grooved-End-Pipe Flange Adapters: AWWA C606 and UL 213, ASTM A536, ductile-iron casting, flat faced, for mating directly with ANSI Class 125, 150, and 300 flanged components. Victaulic Style 741, 743 or 744.

J. Stainless Steel Pressure-Seal Fittings: UL 213, FM-approved, 175-psig pressure rating with externally zinc-electroplated stainless steel housing, synthetic rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8-inch thick or ASME B16.21, nonmetallic and asbestos free.
   1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Grooved Joint Lubricants: Lubricate gaskets in accordance with the manufacturer’s recommendations with lubricant supplied by the coupling manufacturer that is suitable for the gasket elastomer and system media.
   1. Standard of Acceptance: Victaulic Vic-Lube.

2.4 HOSE CONNECTIONS

A. Non-adjustable-valve Hose Connections:
   1. Manufacturers: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Elkhart Brass Mfg. Co.
      b. Fire-End & Croker Corporation
      c. Guardian Fire Equipment, Inc.
      d. Kennedy Valve Company; a division of McWane, Inc.
      e. Mueller Co.
      f. NIBCO INC.
      g. Potter Roemer LLC.
      h. Tyco Fire Products LP.
      i. Viking Corporation.
   2. Standard: UL 668 hose valve for connecting fire hose.
   3. Pressure Rating: 300-psig minimum.
   4. Material: Brass or bronze.
   5. Size: NPS 2-1/2.
   6. Inlet: Female pipe threads.
   7. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department requirements.

8. Pattern: Angle.
9. Finish: Smooth brass or bronze.

2.5 FIRE DEPARTMENT VALVE CABINETS

A. Manufacturers: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Potter-Roemer.
2. Elkhart Brass Mfg. Company, Inc.
3. Fire-End & Croker Corporation.
4. Fire Protection Products, Inc.
5. Larsen.
6. Guardian Fire Equipment, Inc.
7. Tyco Fire & Building Products LP.

B. Valve Cabinet:
1. Style: Surface or recessed mounted with outlet valve as indicated on the Drawings.
2. Tub: 20-gage thick steel, prepared for pipe and accessory rough-in.
3. Door: 18-gage thick steel, flush, glazed, with 1/4 inch thick tempered glass full panel, hinged, positive latch device.
4. Finish: Enameled, color as selected with label.
5. Model: 1830/1835 manufactured by Potter-Roemer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 14 and NFPA 291 (as applicable). Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 FIRE SUPPRESSION SERVICE CONNECTION

A. Connect fire suppression piping to facility water service piping for fire suppression service as required.

B. Comply with requirements for interior piping in Division 22 Section "Domestic Water Piping."

C. Install shutoff valve, double detector check valve, pressure gage, drain, and other accessories indicated at connection to facility water service piping for fire suppression service. Comply with requirements for double detector check valves in Section 21 14 30 "Fire Suppression Specialties."

3.4 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements in NFPA 14 for installation of fire-suppression standpipe piping.

C. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install drain valves on standpipes. Extend drain piping to outside of building.

E. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or outside building.

F. Install alarm devices in piping systems.

G. Install hangers and supports for standpipe system piping according to NFPA 14. Comply with requirements in NFPA 14 for hanger materials.

H. Install pressure gages on riser or feed main and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal and install where they will not be subject to freezing.

I. Drain dry-type standpipe system piping.

J. Fill wet-type standpipe system piping with water.

K. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 21 05 17 "Sleeves and Sleeve Seals for Fire Suppression Piping."

L. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 21 05 17 "Sleeves and Sleeve Seals for Fire Suppression Piping."

M. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 21 05 18 "Escutcheons for Fire Suppression Piping."

3.5 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install-Victaulic flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel or groove plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Grooved Joints: Roll groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 and the manufacturer's (Victaulic) guidelines and recommendations. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be supplied by the grooved coupling manufacturer. Grooved end shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove. A manufacturer's factory-trained field representative shall provide on-site training to contractor's field personnel in the installation of grooved piping products. Factory-trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

I. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
   1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

3.6 VALVE INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 14 and the Authority Having Jurisdiction.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

3.7 HOSE CONNECTION INSTALLATION

A. Install hose connections adjacent to standpipes.

B. Install freestanding hose connections for access and minimum passage restriction.

C. Install NPS 2-1/2 hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 reducer adapter and flow-restricting device.

D. Install wall-mounted-type hose connections in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Comply with requirements for cabinets in Division 10 Section "Fire Extinguisher Cabinets."

3.8 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 14 and as specified in Section 21 05 53 "Identification for Fire Suppression Piping and Equipment."

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire alarm tests. Operate as required.
6. Coordinate with fire pump tests. Operate as required.
7. Verify that equipment hose threads are same as local fire-department equipment.

C. Fire-suppression standpipe system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.10 DEMONSTRATION

A. Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

END OF SECTION

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Piping and fittings.
2. Sprinkler pipe specialties.
3. Sprinklers.

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.4 SYSTEM DESCRIPTION

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device.

1.5 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

B. Sprinkler system design shall be approved by the Authority Having Jurisdiction.
1. Design wet-pipe sprinkler system(s), including comprehensive engineering analysis by a registered Professional Engineer in the discipline of Fire Protection and/or NICET-certified Level III or Level IV Designer, using performance requirements and design criteria indicated.
2. The Contractor shall read the Specifications covering all branches of the work with work performed under all other Contracts
3. Sprinkler systems shall be designed and sized hydraulically by this Contractor according to NFPA 13, the rules and regulations of the Owner's Insurance Underwriter (as applicable) and the Building and Fire Codes in-force. Obtain approvals and permits from the Authority Having Jurisdiction. System is to be hydraulically calculated
4. A flow test shall be performed per NFPA 13 and NFPA 291 by the Fire Suppression Contractor at two (2) fire hydrant locations. The Fire Suppression Contractor shall provide hydraulic calculations required for approvals. Wet-pipe sprinkler system piping shall be designed to operate at working pressure of 175-psig maximum

5. If the Contractor has any questions concerning the Plans and Specifications, he shall contact the Engineer for clarification PRIOR TO SUBMITTING HIS BID to fully understand the extent and responsibilities of his work
6. Sprinkler Occupancy Hazard Classifications:
   a. Light Hazard Occupancy
      1) Public Areas and Offices
      2) Other areas as indicated on the Drawings
   b. Ordinary Hazard, Group 1 (OH1) Occupancy
      1) Building Service Areas
      2) Commercial Laundries
      3) Equipment Rooms (Electrical and Mechanical)
      4) Food Service Areas
      5) General Storage Rooms
      6) Janitor's Closets
      7) Other areas as indicated on the Drawings
   c. Ordinary Hazard, Group 2 (OH2) Occupancy:
      1) Concession/Retail Areas
      2) Other areas as indicated on the Drawings
7. Wet-Pipe Sprinkler System Design Criteria: To be provided per schedule below unless noted otherwise on the Drawings.

WET-PIPE SPRINKLKER SYSTEM DESIGN CRITERIA					
Hazard Classification	Density (gpm/sf)	Area of Application (sf)	Maximum Protection Area (sf/head)	Maximum Spacing (feet)	Hose Stream Allowance (gpm)
STANDARD COVERAGE SPRINKLERS					
Light	0.10	1500	225	15	100
OH1	0.15		130		250
OH2	0.20		130		250

1.6 SUBMITTALS

A. Product Data: Specification sheets on all component parts of the system. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Submittals must bear the Contractor's and the governing agencies stamps of approval prior to the Engineer's final review Submittal.

B. Shop Drawings: Prepare detailed shop drawings approved by the Owner's Insurance Underwriter and the Authority Having Jurisdiction for the Fire Suppression System showing the location of piping, etc. for review. All drawings shall be drawn accurately to scale in sheets of uniform size. Contractor must provide the data required by NFPA 13, including plans, elevations, sections, details, and attachments to other work.

C. Delegated Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified Professional Engineer and/or NICET-certified Level III or Level IV Designer responsible for their preparation.

D. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Plumbing piping systems.
   2. Mechanical piping systems.

3. Items penetrating finished ceiling including the following:
   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Detectors and alarms.
   d. Communications devices.
   e. Signage.

E. Qualification Data: For qualified Installer and State-licensed sprinkler designers.

F. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by the Owner, the Owner's Insurance Underwriter and the Authority Having Jurisdiction, including hydraulic calculations if applicable.
   1. Grooved joint couplings and fittings shall be shown on drawings and product submittals and be specifically identified with the applicable Victaulic style or series number.
   2. Sprinklers shall be referred to on drawings, submittals and other documentation, by the sprinkler identification or model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.

G. Welding certificates.

H. Fire hydrant flow test report.

I. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

J. Field quality-control reports.

K. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
      a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. To assure uniformity and compatibility of piping components in grooved end piping systems, all grooved products utilized shall be supplied by Victaulic. Grooving tools shall be supplied by the same manufacturer as the grooved components.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
   1. Notify Construction Manager no fewer than two days in advance of proposed interruption of sprinkler service.
   2. Do not proceed with interruption of sprinkler service without Construction Manager's written permission.

1.9 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment and partition assemblies.

1.10 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS

2.1 PIPING AND PIPE FITTINGS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials and for joining methods for specific services, service locations and pipe sizes.

B. Steel Piping
   1. Standard Weight, Galvanized- and Black-Steel Pipe: ASTM A 53/A 53M, Type E Grade B with threaded or cut-groove ends. Pipe ends may be factory or field formed to match joining method.
   2. Schedule 40, Galvanized- and Black-Steel Pipe: ASTM A 53/A 53M, Type E Grade B with threaded or cut-groove ends. Pipe ends may be factory or field formed to match joining method.
   3. Thin Wall, Galvanized- and Black-Steel Pipe: ASTM A 135A/A 135M or ASTM A 795/A 795M, wall thickness less than Schedule 30 and greater than or equal to Schedule 10 with roll-grooved ends ONLY. Pipe ends may be factory- or field-fabricated.
   4. The use of plain end piping is PROHIBITED.

B. Steel Pipe Fittings:
   1. Black Steel Pipe Nipples: ASTM A 733, made from ASTM A 53/A 53M, standard-weight seamless steel pipe with threaded ends.
   2. Black-Steel Couplings: ASTM A 865/A 865M, threaded.
   3. Malleable- or Ductile-Iron Unions: UL 860.
   4. Cast-Iron Flanges: ASME 16.1, Class 125.
   5. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

C. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

D. Grooved-Joint, Steel-Pipe Appurtenances:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Victaulic Company
   b. Anvil International, Inc.
   c. Corcoran Piping System Co.
   d. National Fittings, Inc.
   e. Shurjoint Piping Products.
   f. Tyco Fire & Building Products LP.
2. Pressure Rating: 175-psig minimum.
3. Grooved-End Fittings for Steel Piping: ASTM A 536, Victaulic FireLock or Installation Ready IGS or standard ductile-iron casting; ASTM A234 forged steel, or ASTM A53 fabricated steel with dimensions matching steel pipe and grooves designed to accept Victaulic couplings.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM rubber gasket, and bolts and nuts.
   a. Rigid Type: Housings shall be cast with offsetting, angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with NFPA 13. Tongue and recess rigid type couplings shall only be permitted if a torque wrench is used for installation. Required torque shall be in accordance with the manufacturer's current listed standards.
      1) 1-1/4 inch through 12-inch: Installation Ready® rigid joints, designed for direct "stab" installation onto grooved end pipe without prior disassembly of the coupling. Victaulic FireLock EZ Style 009N (1-1/4-inch to 4-inch) and Victaulic QuickVic Style 107H (2-inch to 12-inch).
   b. Flexible Type: Use in seismic areas where required by NFPA 13.
      1) 2-inch through 12-inch: Installation Ready® stab-on design, for direct 'stab' installation onto grooved end pipe without prior field disassembly and not loose parts. Victaulic QuickVic Style 177
      2) 10-inch and Larger: Standard flexible coupling. Victaulic Style 75 or 77.
5. Grooved-End-Pipe Flange Adapters: AWWA C606 and UL 213, ASTM A536, ductile-iron casting, flat faced, for mating directly to ANSI Class 125, 150, and 300 flanged components. Victaulic Style 741, 743 or 744.

E. Stainless Steel Pressure-Seal Fittings: UL 213, FM-approved, 175-psig pressure rating with externally zinc-electroplated stainless steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

F. Steel Pressure-Seal Fittings: UL 213, FM-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

G. CPVC Pipe and Fittings
1. CPVC Pipe: ASTM F 442/F 442M and UL 1821, SDR 13.5, for 175-psig rated pressure at 150 degrees F with plain ends. Include "LISTED" and "CPVC SPRINKLER PIPE" markings.
2. CPVC Fittings: UL listed or FM Global approved, for 175-psig rated pressure at 150 degrees F, socket type. Include "LISTED" and "CPVC SPRINKLER FITTING" markings.
   a. NPS 3/4 to NPS 1-1/2: ASTM F438 and UL 1821, Schedule 40, socket type.
   b. NPS 2 to NPS 3: ASTM F 439 and UL 1821, Schedule 80, socket type.
   c. CPVC-to-Metal Transition Fittings: CPVC, one-piece, with dimensions equivalent to pipe; one end with threaded brass insert and one socket end.

d. CPVC-to-Metal Transition Unions: CPVC, with dimensions equivalent to pipe; one end with threaded brass insert and one socket end.
e. Flanges: CPVC, one- or two-pieces.

2.2 PIPE JOINING MATERIALS

A. Steel Pipe and Fittings
1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8-inch thick or ASME B16.21, nonmetallic and asbestos free].
   a. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
   b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised Face Flanges: Ring-type gaskets.
   c. Gaskets for grooved-end-pipe couplings shall be listed for use with the housings as follows:

GROOVED COUPLING GASKET MATERIAL		
Fire Protection Service	Temperature Range	Gasket Recommendation
Water/Wet-Pipe Sprinkler Systems	Ambient	Grade A EPDM (ASTM D-2000)
Water/Wet-Pipe Sprinkler Systems	Ambient	Grade E EPDM (ASTM D-2000)
Freezer Applications	-40 degrees F to 0 degrees F	FlushSeal™, Grade L, Silicone

2. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
3. Grooved Joint Lubricants: Lubricate gaskets in accordance with the manufacturer's recommendations with lubricant supplied by the coupling manufacturer that is suitable for the gasket elastomer and system media.
   a. Standard of Acceptance: Victaulic Vic-Lube.
4. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

B. CPVC Pipe and Fittings
1. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493 solvent cement recommended by pipe and fitting manufacturer and made for joining CPVC sprinkler pipe and fittings. Include cleaner or primer recommended by pipe and fitting manufacturer.
2. Plastic Pipe-Flange Gasket and Bolts and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.3 WET-PIPE SPRINKLER SYSTEM SPECIALTIES

A. Branch Outlet Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Victaulic Company.
   b. Anvil International, Inc.
   c. National Fittings, Inc.
   d. Shurjoint Piping Products.
   e. Tyco Fire & Building Products LP.
2. Standard: UL 213.

3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
4. Type: Mechanical-T and -cross fittings.
5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
7. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Victaulic Company TestMaster/ Riser Manifold.
   b. AGF Manufacturing (Test-N-Drain)
   c. Reliable Automatic Sprinkler Co, Inc
   d. Tyco Fire Protection
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Body Material: Cast- or ductile-iron, or bronze housing with ½" orifice, sight glass, and integral test valve.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded or grooved.

C. Branch Line Testers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Elkhart Brass Mfg. Company, Inc.
   b. Fire-End & Croker Corporation.
   c. Potter Roemer.
   d. None of the manufacturers listed shall be considered as Basis-of-Design.
2. Standard: UL 199.
3. Body Material: Brass.
4. Size: Same as connected piping.
5. Inlet: Threaded.
6. Drain Outlet: Threaded and capped.
7. Branch Outlet: Threaded, for sprinkler.

D. Inspector's Test Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Victaulic Company.
   b. AGF Manufacturing Inc.
   c. Tyco Fire & Building Products LP.
   d. Viking Corporation.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Body Material: Cast- or ductile-iron or bronze housing with sight glass.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded or grooved.

2.4 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Victaulic Company
2. Globe Fire Sprinkler Corporation.
3. Reliable Automatic Sprinkler Co., Inc.

4. Tyco Fire & Building Products LP.
5. Viking Corporation.

B. General Requirements:
1. Shall be listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide".
2. Pressure Rating for Residential Sprinklers: 175-psig maximum.
3. Pressure Rating for Automatic Sprinklers: 175-psig minimum.
4. Sprinklers shall be glass-bulb or fusible-link type rated for specific area hazard. Body shall be die-cast brass with hex-shaped wrench boss cast into the body to facilitate installation and reduce the risk of damage during installation.

C. Sprinklers:
1. Suspended (Drywall or Tile) Ceiling:
   a. Concealed pendant, quick-response type with cover plate (all metal construction).
      1) Sprinkler Finish: Rough or smooth brass.
      2) Cover plate: Two-piece, flat, 1-inch vertical adjustment, white enamel or polyester coating.
      3) Basis-of-Design: Victaulic V31 or V38.
2. Exposed Construction (Areas Without Ceilings):
   a. Standard upright quick-response type.
      1) Head Finish: Rough brass.
      2) Basis-of-Design: Victaulic V27
3. Sidewall Sprinklers:
   a. Provide white, quick-response sidewall quick-sprinklers, rated for 165 degrees F, per UL and NFPA listings.
      1) Basis-of-Design: Victaulic V27
   b. Provide bronze dry horizontal head complete with compressed charge to isolate head from freezing temperatures, minimum 8" into heated area, per UL & NFPA listings.
      1) Basis-of-Design: Victaulic V36

D. Sprinkler Guards:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Same as sprinkler manufacturer
   b. Victaulic Company.
   c. Globe Fire Sprinkler Corporation
   d. Reliable Automatic Sprinkler Co., Inc.
   e. Tyco Fire & Building Products LP.
   f. Viking Corporation.
2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

E. Sprinkler cover plates, escutcheons and guards shall be listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire hydrant flow test according to NFPA 13 and NFPA 291 (as applicable). Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 FIRE SUPPRESSION SERVICE CONNECTION

A. Connect fire suppression piping to facility water service piping for fire suppression service as required. Comply with requirements for fire suppression service piping and accessories in Section 21 12 00 "Standpipe Systems."

3.3 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

J. Install alarm devices in piping systems.

K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

L. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal and install where they will not be subject to freezing.

M. Fill sprinkler system piping with water.

N. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 21 05 17 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

O. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 2 105 17 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

P. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 21 05 18 "Escutcheons for Fire-Suppression Piping."

3.4 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

3.5 VALVE INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and the Authority Having Jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

3.6 SPRINKLER INSTALLATION

A. Coordinate this article with Drawings.

B. Install sprinklers in suspended ceilings in the center (within 1-inch in the x-y direction) of a 24-inch square ceiling panel or in the center of a 24- x 24-inch end section of a 24- x 48-inch ceiling panel.

C. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

D. The sprinkler bulb/fusible link protector must remain in place until the sprinkler is completely installed and before the system is placed in service. Remove protectors carefully by hand after installation. Do not use any tools to remove protectors.

3.7 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and as specified in Section 21 05 53 "Identification for Fire Suppression Piping and Equipment."

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Start and run excess-pressure pumps.
6. Coordinate with fire-alarm tests. Operate as required.
7. Coordinate with fire-pump tests. Operate as required.
8. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.9 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

END OF SECTION

SECTION 211316 - DRY-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Piping and fittings.
2. Pipe joining materials.
3. Dry-pipe alarm valves.
4. Manual control stations
5. Control panels.
6. Sprinkler pipe specialties.
7. Sprinklers.

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Dry-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.4 SYSTEM DESCRIPTIONS

A. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from opened sprinklers.

B. Combined Dry-Pipe and Preaction Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Fire-detection system, located in same area as sprinklers, actuates tripping devices that open dry-pipe valve without loss of air pressure and actuates fire alarm. Water discharges from opened sprinklers.

C. Single-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping which may or may not (as developed by the Contractor) contain low-pressure air. Actuation of fire-detection system, located in same area as sprinklers, opens deluge valve, permitting water to flow into sprinkler piping and to discharge from opened sprinklers.

D. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

E. Sprinkler system design shall be approved by Owner's Insurance Underwriter (as applicable) and the Authority Having Jurisdiction.
1. Design dry-pipe sprinkler system(s), including comprehensive engineering analysis by a qualified Professional Engineer, registered in Fire Protection, or NICET-certified Level III or Level IV Designer, using performance requirements and design criteria indicated.

2. The Contractor shall read the Specifications covering all branches of the work with work performed under all other Contracts
3. Sprinkler systems shall be designed and sized hydraulically by this Contractor according to NFPA 13, the rules and regulations of the Owner's Insurance Underwriter (as applicable) and the Building and Fire Codes in-force. Obtain approvals and permits from the Authority Having Jurisdiction. System is to be hydraulically calculated
4. A flow test shall be performed per NFPA 13 and NFPA 291 by the Fire Suppression Contractor at two (2) fire hydrant locations. The Fire Suppression Contractor shall provide hydraulic calculations required for approvals. Dry-pipe sprinkler system piping shall be designed to operate at working pressure of 175-psig maximum
5. If the Contractor has any questions concerning the Plans and Specifications, he shall contact the Engineer for clarification PRIOR TO SUBMITTING HIS BID to fully understand the extent and responsibilities of his work
6. Sprinkler Occupancy Hazard Classifications:
   a. Light Hazard (LH) Occupancy
      1) Data Processing Rooms (with ordinary-temperature sprinklers)
   b. Ordinary Hazard, Group 1 (OH1) Occupancy
      1) Data Processing Rooms (with high-temperature sprinklers)
      2) Freezers
      3) Loading Docks
      4) Parking Garages
      5) Other areas as indicated on the Drawings
   c. Ordinary Hazard, Group 2 (OH2) Occupancy
      1) Concession/Retail areas
      2) Other areas as indicated on the Drawings
7. Dry-Pipe Sprinkler System Design Criteria: To be provided per schedule below unless noted otherwise on the Drawings.

DRY-PIPE SPRINKLKER SYSTEM DESIGN CRITERIA					
Hazard Classification	Density (gpm/sf)	Area of Application (sf)	Maximum Protection Area (sf/head)	Maximum Spacing (feet)	Hose Stream Allowance (gpm)
STANDARD COVERAGE SPRINKLERS					
LH	0.10	1500	225	15	100
OH1	0.15		130		250
OH2	0.20		130		250

1.5 SUBMITTALS

A. Product Data: Specification sheets on all component parts of the system. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Submittals must bear the Contractor's and the governing agencies stamps of approval prior to the Engineer's final review Submittal.

B. Shop Drawings: Prepare detailed shop drawings approved by the Owner's Insurance Underwriter and the Authority Having Jurisdiction for the Fire Suppression System showing the location of piping, etc. for review. All drawings shall be drawn accurately to scale in sheets of uniform size. Contractor must provide the data required by NFPA 13 including plans, elevations, sections, details, and attachments to other work.

C. Delegated Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified

Professional Engineer and/or NICET-certified Level III or Level IV Designer responsible for their preparation.

D. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Plumbing piping systems.
   2. Mechanical piping systems.
   3. Items penetrating finished ceiling include the following:
      a. Lighting fixtures.
      b. Air outlets and inlets.
      c. Detectors and alarms.
      d. Communications devices.
      e. Signage.

E. Qualification Data: For qualified Installer and State-licensed fire suppression designers.

F. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by the Owner, the Owner's Insurance Underwriter and the Authority Having Jurisdiction, including hydraulic calculations if applicable.
   1. Grooved joint couplings and fittings shall be shown on drawings and product submittals and be specifically identified with the applicable Victaulic style or series number.
   2. Sprinklers shall be referred to on drawings, submittals and other documentation, by the sprinkler identification or model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.

G. Welding certificates.

H. Fire-hydrant flow test report.

I. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

J. Field quality-control reports.

K. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire hydrant flow test.
      a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. NFPA Standards: Fire-suppression standpipe equipment, specialties, accessories, installation, and testing shall comply with NFPA 13, "Installation of Sprinkler Systems."

E. To assure uniformity and compatibility of piping components in grooved end piping systems, all grooved products utilized shall be supplied by Victaulic. Grooving tools shall be supplied by the same manufacturer as the grooved components.

1.7 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment and partition assemblies.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS

2.1 PIPING AND PIPE FITTINGS

A. Comply with requirements for applications of pipe, tube, and fitting materials and for joining methods for specific services, service locations and pipe sizes.

B. Steel Piping
   1. Standard Weight, Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E Grade B with threaded or cut-groove ends. Pipe ends may be factory or field formed to match joining method.
   2. Schedule 30, Galvanized-Steel Pipe: ASTM A 135/A 135M; ASTM A 795/A 795M, Type E; or ASME B36.10M wrought steel, with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.
   3. Thin Wall, Galvanized-Steel Pipe: ASTM A 135A/A 135M or ASTM A 795/A 795M, wall thickness less than Schedule 30 and greater than or equal to Schedule 10 with roll-grooved ends ONLY. Pipe ends may be factory- or field-fabricated.
   4. The use of plain end piping is PROHIBITED.

B. Steel Pipe Fittings:
   1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
   2. Galvanized-Steel Couplings: ASTM A 865/A 865M, threaded.
   3. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern
   4. Malleable- or Ductile-Iron Unions: UL 860.
   5. Cast-Iron Flanges: ASME B 16.1, Class 125.
   6. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

C. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Victaulic Company
   b. Anvil International, Inc.
   c. Corcoran Piping System Co.
   d. National Fittings, Inc.
   e. Shurjoint Piping Products.
   f. Tyco Fire & Building Products LP.
2. Pressure Rating: 175-psig minimum.
3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.2 PIPE JOINING MATERIALS

A. Steel Pipe and Fittings
   1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
      a. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
      b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised Face Flanges: Ring-type gaskets.
      c. Gaskets for grooved-end-pipe couplings shall be listed for use with the housings as follows:

GROOVED COUPLING GASKET MATERIAL		
Fire Protection Service	Temperature Range	Gasket Recommendation
Water/Wet-Pipe Sprinkler Systems	Ambient	Grade A EPDM (ASTM D-2000)
Water/Wet-Pipe Sprinkler Systems	Ambient	Grade E EPDM (ASTM D-2000)
Freezer Applications	-40 degrees F to 0 degrees F	FlushSeal, Grade L, Silicone

   2. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
   3. Grooved Joint Lubricants: Lubricate gaskets in accordance with the manufacturer's recommendations with lubricant supplied by the coupling manufacturer that is suitable for the gasket elastomer and system media.
      a. Standard of Acceptance: Victaulic Vic-Lube.

2.3 DRY-PIPE ALARM VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Victaulic Company FireLock Series.
   2. Globe Fire Sprinkler Corporation.
   3. Reliable Automatic Sprinkler Co., Inc. (The).
   4. Tyco Fire Products LP.
   5. Viking Corporation.

B. Standard: UL 260.

C. Design: Differential-pressure type.

D. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

E. Air Compressor:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Gast Manufacturing, Inc.
      b. General Air Products, Inc.
      c. Viking Corporation.
      d. None of the above manufacturers shall be considered as Basis-of-Design.
   2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
   3. Motor Horsepower: As indicated on the Drawings.
   4. Power: 120-VAC, 60 HZ, single phase.

2.4 MANUAL CONTROL STATIONS

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" for hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve.

B. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.5 CONTROL PANELS

A. Description: Single-area, two-area, or single-area cross-zoned type control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves.
   1. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" when used with thermal detectors and Class A detector circuit wiring.
   2. Electrical characteristics are 120-VAC, 60-HZ, with 24-VDC rechargeable batteries.
   3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application

B. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

C. Manual Control Stations: Hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

D. Panels Components:
   1. Power supply.
   2. Battery charger.
   3. Standby batteries.
   4. Field-wiring terminal strip.
   5. Electrically supervised solenoid valves and polarized fire-alarm bell.
   6. Lamp test facility.

7. Single-pole, double-throw auxiliary alarm contacts.
8. Rectifier.

2.6 DRY-PIPE SPRINKLER SYSTEM SPECIALTIES

A. Branch Outlet Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Victaulic Company.
   b. Anvil International, Inc.
   c. National Fittings, Inc.
   d. Shurjoint Piping Products.
   e. Tyco Fire & Building Products LP.
2. Standard: UL 213.
3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
4. Type: Mechanical-T and -cross fittings.
5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
7. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Victaulic Company TestMaster/ Riser Manifold.
   b. AGF Manufacturing (Test-N-Drain)
   c. Reliable Automatic Sprinkler Co, Inc
   d. Tyco Fire Protection
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Body Material: Cast- or ductile-iron, or bronze housing with ½" orifice, sight glass, and integral test valve.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded or grooved.

C. Branch Line Testers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Elkhart Brass Mfg. Company, Inc.
   b. Fire-End & Croker Corporation.
   c. Potter Roemer.
   d. None of the manufacturers listed shall be considered as Basis-of-Design.
2. Standard: UL 199.
3. Body Material: Brass.
4. Size: Same as connected piping.
5. Inlet: Threaded.
6. Drain Outlet: Threaded and capped.
7. Branch Outlet: Threaded, for sprinkler.

D. Inspector's Test Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Victaulic Company.
   b. AGF Manufacturing Inc.
   c. Tyco Fire & Building Products LP.

d. Viking Corporation.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Body Material: Cast- or ductile-iron or bronze housing with sight glass.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded or grooved.

2.7 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Victaulic Company (Basis of-Design)
2. Globe Fire Sprinkler Corporation.
3. Reliable Automatic Sprinkler Co., Inc.
4. Tyco Fire & Building Products LP.
5. Viking Corporation.

B. General Requirements:
1. Shall be listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide".
2. Pressure Rating for Residential Sprinklers: 175-psig maximum.
3. Pressure Rating for Automatic Sprinklers: 175-psig minimum.
4. Sprinklers shall be glass-bulb or fusible-link type rated for specific area hazard. Body shall be die-cast brass with hex-shaped wrench boss cast into the body to facilitate installation and reduce the risk of damage during installation.

C. Sprinkler Schedule:
1. Suspended (Drywall or Tile) Ceiling:
a. Concealed pendant, quick-response type with cover plate (all metal construction).
1) Sprinkler Finish: Rough or smooth brass.
2) Cover plate: Two-piece, flat, 1-inch vertical adjustment, white enamel or polyester coating.
3) Basis-of-Design: Victaulic V31 or V38.
2. Exposed Construction (Areas Without Ceilings):
a. Standard upright quick-response type.
1) Head Finish: Rough brass.
2) Basis-of-Design: Victaulic V27
3. Sidewall Sprinklers:
a. Provide white, quick-response sidewall sprinklers, rated for 165 degrees F, per UL and NFPA listings.
1) Basis-of-Design: Victaulic V27
b. Provide bronze dry horizontal head complete with compressed charge to isolate head from freezing temperatures, minimum 8-inches into heated area, per UL & NFPA listings.
1) Basis-of-Design: Victaulic V36

D. Sprinkler Guards:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Same as sprinkler manufacturer
b. Victaulic Company.
c. Globe Fire Sprinkler Corporation
d. Reliable Automatic Sprinkler Co., Inc.
e. Tyco Fire & Building Products LP.
f. Viking Corporation.

2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.
4. Finish: Painted Safety Red by the manufacturer.

E. Sprinkler cover plates, escutcheons and guards shall be listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire hydrant flow test according to NFPA 13 and NFPA 291 (as applicable). Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 FIRE SUPPRESSION SERVICE CONNECTION

A. Connect fire suppression piping to facility water service piping for fire suppression service as required. Comply with requirements for fire suppression service piping and accessories in Section 21 12 00 "Standpipe Systems."

3.3 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

J. Connect compressed-air supply to dry-pipe sprinkler piping.

K. Connect air compressor to the following piping and wiring:
   1. Pressure gages and controls.
   2. Electrical power system.
   3. Fire-alarm devices, including low-pressure alarm.

L. Install alarm devices in piping systems.

M. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

N. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal and install where they will not be subject to freezing.

O. Drain dry-pipe sprinkler piping.

P. Pressurize and check dry-pipe sprinkler system piping and air compressors.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 21 05 17 "Sleeves and Sleeve Seals for Fire Suppression Piping."

R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 21 05 17 "Sleeves and Sleeve Seals for Fire Suppression Piping."

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 21 05 18 "Escutcheons for Fire Suppression Piping."

3.4 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

3.5 VALVE INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and the Authority Having Jurisdiction.

B. Install listed fire suppression shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:
   1. Install in vertical position for proper direction of flow, in main supply to system.
   2. Install dry-pipe valves with trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
      a. Install air compressor and compressed-air-supply piping.

3.6 SPRINKLER INSTALLATION

A. Coordinate this article with Drawings.

B. Install sprinklers in suspended ceilings in the center (within 1-inch in the x-y direction) of a 24-inch square ceiling panel or in the center of a 24- x 24-inch end section of a 24- x 48-inch ceiling panel.

C. Install sprinklers using arm-over or flexible drops (as permitted by the Owner).

D. The sprinkler bulb/fusible link protector must remain in place until the sprinkler is completely installed and before the system is placed in service. Remove protectors carefully by hand after installation. Do not use any tools to remove protectors.

3.7 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and as specified in Section 21 05 53 "Identification for Fire Suppression Piping and Equipment."

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections with the assistance of a factory-authorized service representative as required.

B. Tests and Inspections:
   1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
   4. Energize circuits to electrical equipment and devices.
   5. Start and run excess-pressure pumps.
   6. Coordinate with fire-alarm tests. Operate as required.
   7. Coordinate with fire-pump tests. Operate as required.
   8. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.9 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

END OF SECTION

SECTION 211430 – FIRE SUPPRESSION SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Provide fire suppression piping specialties or accessories as required by either the Equipment Manufacturer or the Authority Having Jurisdiction.

B. Section Includes:
1. Automatic ball drip drain valves.
2. Alarm devices.
3. Pressure gages.
4. Access panels.
5. Rapid entry box.

C. Unless noted otherwise, none of the manufacturers listed in this Section shall be considered as Basis-of-Design.

1.3 SUBMITTALS

A. Submit per the provisions of Section 22 05 00 "Common Work Results for Fire Suppression".

B. Product Data: Include rated capacities and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections.

C. Maintenance Data: For plumbing specialties to include in maintenance manuals.

1.4 DELIVERY, STORGAE AND HANDLING

A. Prepare valves for shipping as follows:
1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces and weld ends.
3. Set valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:
1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

D. Protect flanges and specialties from moisture and dirt.

PART 2 – PRODUCTS

2.1 SPECIALTY VALVES

A. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   1. Pressure Rating: 175-psig minimum.
   2. Body Material: Cast or ductile iron.
   3. Size: Same as connected piping.
   4. End Connections: Flanged, grooved or threaded.

2.2 AUTOMATIC BALL DRIP DRAIN VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Reliable Automatic Sprinkler Co., Inc.
   2. Tyco Fire & Building Products LP.

B. Description:
   1. Standard: UL 1726.
   2. Type: Automatic draining, ball check.
   3. Size: NPS 3/4.
   4. End Connections: Threaded.

2.3 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Electrically Operated Alarm Bell
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Fitre-Lite Aalrms, Inc.; a Honeywell International company.
      b. Notifier.
      c. Potter Electric Signal Company, LLC.
   2. Standard: UL 464.
   3. Type: Vibrating, metal alarm bell.
   4. Size: 6-inch minimum- diameter.
   5. Finish: Red-enamel factory finish, suitable for outdoor use.
   6. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Waterflow Indicators:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ADT Security Services, Inc.
      b. Potter Electric Signal Company, LLC.
      c. System Sensor.
      d. Viking Corporation.
      e. Watts; a Watts Water Technologies company.
   2. Standard: UL 346.

3. Waterflow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7-A, 125-VAC and 0.25-A, 24-VDC; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250-psig.
7. Design Installation: Horizontal or vertical.

D. Pressure Switches:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Potter Electric Signal Company.
   b. System Sensor; a Honeywell company.
   c. Tyco Fire & Building Products LP.
   d. United Electric Controls Co.
   e. Viking Corporation.
2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

E. Valve Supervisory Switches:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fire-Lite Alarms, Inc.; a Honeywell company.
   b. Kennedy Valve; a division of McWane, Inc.
   c. Potter Electric Signal Company.
   d. System Sensor; a Honeywell company.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

2.4 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AGF Manufacturing, Inc.
2. AMETEK; U.S. Gauge Division.
3. Ashcroft, Inc.
4. Brecco Corporation.
5. WIKA Instrument Corporation.

B. Description:
1. Standard: UL 393.
2. Dial Size: 3-1/2- to 4-1/2-inch diameter.
3. Pressure Gage Range: 0- to 250-psig minimum
4. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
5. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

2.5 ACCESS PANELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Milnor (Basis-of-Design)
   2. Josam
   3. MIFAB
   4. Jay R Smith
   5. Wade
   6. Watts
   7. Zurn

B. Provide access panels where required for access to concealed equipment, valves and piping. Location of all access panels shall be approved by the Architect.

C. Panel size shall be adequate for service intended. Use fire-rated UL listed access panels in fire-rated ceilings or walls.

D. Access panels shall be Milcor Type M, for masonry walls, Type "K" for plaster ceilings or Type "AT" for non-accessible acoustical tile ceiling and fire rated type for fire rated ceiling and walls.

E. Access panels shall have locks of a manufacturer with cores keyed to master key as selected by the Owner.

2.6 RAPID ENTRY BOX

A. Provide rapid entry box(es) of manufacturer, model number, type and features as required by the Authority Having Jurisdiction. Coordinate specific equipment and ordering requirements with the Authority Having Jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

C. Do not attempt to repair defective valves; replace with new valves.

3.2 GENERAL REQUIREMENTS FOR SPECIALTIES INSTALLATION

A. Comply with requirements in the following Sections for specific specialty installation requirements and applications:
   1. Section 21 12 00 "Standpipe Systems" for application of specialties in fire suppression standpipes.
   2. Section 21 13 13 "Wet-Pipe Sprinkler Systems" for application of specialties in wet-pipe sprinkler systems.
   3. Section 21 13 16 "Dry-Pipe Sprinkler Systems" for application of specialties in dry-pipe sprinkler systems.

C. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or outside building.

D. Install alarm devices in piping systems.

E. Install pressure gages on riser or feed main and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal and install where they will not be subject to freezing.

F. Connect compressed-air supply to dry-pipe standpipe and sprinkler piping.

G. Connect air compressor to the following piping and wiring:
   1. Pressure gages and controls.
   2. Electrical power system.
   3. Fire-alarm devices, including low-pressure alarm.

3.3 SPECIALTIES INSTALLATION

A. Install listed fire protection specialty valves and trim, controls, and specialties according to NFPA 13, NFPA 14, the Owner's material standards and the Authority Having Jurisdiction.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Energize circuits to electrical equipment and devices.
   2. Coordinate with fire-alarm tests. Operate as required.
   3. Coordinate with fire-pump tests. Operate as required. Verify that equipment hose threads are same as local fire-department equipment.

B. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Owner's maintenance personnel to adjust, operate, and maintain specialties.

END OF SECTION

SECTION 220500 – COMMON WORK RESULTS FOR PLUMBING

PART 1 – GENERAL

1.1 DESCRIPTION

A. The General Conditions, Supplementary Conditions, Special Conditions and Divisions 01 through Division 32 as set forth in these Specifications are hereby incorporated into and shall become a part of the Specifications for work under Division 22, insofar as they apply hereto.

B. Furnish material, labor, tools, accessories and equipment to complete and leave ready for operation of the Plumbing fixtures, equipment and systems for this project as described on the Contract Documents, or as required.

C. As it may apply in all Division 22 Specification Sections herein, the term “Owner” shall refer to the Owner and/or his Duly Authorized Representative inclusively.

D. As it may apply to all Division 22 Specification Sections herein, the term "Engineer" shall refer to the Engineer-of-Record and/or the Project Design Professional inclusively.

1.2 REGULATORY REQUIREMENTS

A. Perform all work in strict accordance with all applicable laws, codes, rules, regulations and standards of any Authority Having Jurisdiction. In case of conflict between the Contract Documents and the above requirements, the more stringent requirements shall govern.

B. Conform to all rules and regulations of any utility company/purveyor in the planning and execution of the work as shown by these Contract Documents.

C. Obtain all inspections or additional permits required by 8all laws, ordinances, rules, regulations or standards of any Authority Having Jurisdiction and obtain certificates of such inspections and permits and submit same to the Architect. The Contractor shall pay all fees, charges and other expenses in connection therein for Plumbing work including permits, inspection fees, re-inspection fees (as necessary), etc. associated with the building permit.

D. Unless otherwise noted, the following latest enforced Edition (complete with all local amendments and interim agreements in effect) of the following shall apply to this work:
   1. ANSI International (ANSI)
   2. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
   3. American Society of Mechanical Engineers (ASME)
   4. American Society of Plumbing Engineers (ASPE)
   5. American Society of Sanitary Engineering (ASSE)
   6. American Water Works Association (AWWA)
   7. ASTM International (ASTM)
   8. Authority Having Jurisdiction (AHJ)
   9. Cast Iron Soil Pipe Institute (CISPI)
   10. Environmental Protection Agency (EPA)
   11. International Safety Equipment Association (ISEA)
   12. Manufacturers' Standardization Society of the Valve and Fittings Industry (MSS)
   13. National Electrical Manufacturers Association (NEMA)
   14. National Fire Protection Association (NFPA)
   15. NSF International (NSF)
   16. Occupational Safety and Health Administration (OSHA)

17. Plumbing and Drainage Institute (PDI)
18. State of Ohio
    a. Ohio Building Code (OBC)
    b. Ohio Plumbing Code (OPC)
    c. International Fuel Gas Code (IFGC)
19. Underwriters Laboratories (UL)
20. Owner's material and installation requirements.
21. Other applicable codes, requirements, rules and/or regulations of bodies lawfully empowered and having jurisdiction over this project.

1.3 QUALIFICATIONS

A. Installer: Company specializing in performing work of this Section with minimum three years documented experience on similar projects.

1.4 MATERIALS, MANUFACTURERS AND SUBSTITUTIONS

A. Unless otherwise specifically indicated, furnish materials and equipment which are new.

B. When two (2) or more products are named together in the Specifications, bids shall be based upon any of the products named upon consideration of the requirements herein. Unless noted otherwise, the product listed first shall be considered the Basis-of-Design.

C. The Bidder shall ascertain that the product upon which he chooses to base his bid has the specific features enumerated and is equal; that it will properly fit the space and the adjacent work. Any additional costs, including the cost of work by other Contractors, involved in completing the work with said products and the responsibility for its fitting and operating as a part of the system rests solely with the Bidder.

D. The Specifications permit the Bidder to propose for consideration with his bid and must be indicated on the substitution sheet, any one of a like material that is generally considered to be equal to the manufacturers named in the specifications. However, the Bidder shall base his bid on the name or make of any article, device, material, form of construction, fixture, etc., named on the Contract Documents.
    a. At the request of the Engineer, the Bidder shall provide manufacturer's specification sheets/documentation for review and consideration. The determination of the acceptance of the substitution by the Engineer shall be at his/her discretion and shall be final.

1.5 WARRANTIES

A. In addition to requirements of Division 01, the Contractor shall turn over to the Owner all certificates of equipment guarantee and/or warranty covering remaining guarantee and/or warranty periods at end of his guarantee period.

B. In addition to requirements of Division 01, provide all services necessary to assure the proper operation of all systems installed under this Section of the Specifications for one year after final acceptance. Completely inspect the systems at least twice during that time and make any necessary adjustments in the systems. Two (2) weeks before the date for beginning each of the inspections, inform the Engineer in writing. The requirement for inspections is not intended to, nor is the Contractor obligated to perform any work during the one (1) year period which, in the opinion of the Engineer, is normal maintenance. However, if faulty or defective parts are found during the inspections repair or replace them in accordance with the guarantee provisions of these specifications.

C. In addition to compliance with the Conditions of the Contract, the Contractor is hereby made aware that certain manufacturer's equipment guarantees are valid only for a period of one year from the date of shipment or installation and will, therefore, not be valid until the date of guarantee set forth herein. The Contractor will, therefore, be responsible for all material, labor, and equipment for the full guarantee period as set forth herein.

D. Furnish labor and material required to fulfill the requirements of this guarantee at no additional cost to the Owner.

1.6 QUALITY ASSURANCE

A. The Plumbing Contractor shall be responsible for all costs associated with changes to pipe sizes, pipe fittings, trim and accessories, etc. caused by the change of equipment from the Basis-of-Design specified to other named manufacturers. The Contractor is responsible to ensure the other manufacturer-named supplied equipment will fit within space allocated, with appropriate clearances for maintenance, operation, service, code requirements, etc. Any Contractor utilizing a manufacturer other than the Basis-of-Design shall be responsible for any additional requirements for electrical service, concrete pad size, physical space limitations, and capacities at no additional cost to Owner. If manufacturers are listed, no other manufacturers except those listed within the Sections of this Division, that are in turn able to comply with the Contract Document requirements and minimum standards of these Specifications, will be acceptable.

B. Work provided or performed by the Contractor shall be guaranteed to be replaced and made good at his own expense any defects which may develop, within one (1) year after final payment and acceptance by the Owner, due to faulty workmanship or material, upon receipt of written notification of the defect from the Owner.

1.7 SUBMITTALS

A. Submit under provisions of Division 01.

B. Proposed Products List: Include Products specified in Division 22 and/or the Drawings.

C. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.

D. Mark dimensions and values in units to match those specified.

E. Submit prior to any shop drawing submittals for the Engineer's review: a proposed list of equipment to be submitted seven (7) days after letter of intent or award of Contract, whichever is first.

F. In addition to provisions of Division 01, one (1) set of shop drawings and one (1) electronic set having each sheet (except pages bound in a brochure) and each brochure marked with identification, and containing information described below. To facilitate coordination, submit all drawings in logical order. Submit mechanical assembly drawings, where possible, complete with all related subassembly drawings, wiring diagrams and necessary data.

G. Identification to Include:
   1. Project name.
   2. Identification by Specification heading number under which equipment or material is described and by name, fixture/drain/equipment number, and intended use as designated by the Contract Documents.
   3. Information: Include the following data:

a. Manufacturer's model number or catalog number, size and performance curves and data. Indicate operating points on curves and tabular data, for each piece of equipment that curves or data represent.
b. Indication of all performance data, construction materials, finishes and modifications to manufacturer's standard design called for in specifications.
c. Roughing in, foundation and support points dimensions.
d. Electrical information, including elementary diagrams, connection diagrams and nameplate data.

4. In addition to the above, provide shop drawings for the following items:
   a. Coordination drawings.
   b. Maintain one copy of approval documents on site.

H. Any submittal(s) not in compliance with the above criteria or are incomplete will be returned to the Contractor, without review, for correction and re-submittal or discarded at the Engineer's discretion.

1.8 COORDINATION DRAWINGS

A. General:
1. The Construction Manager or the General Trades Contractor (as designated) shall be in charge of the coordination drawing process and shall be responsible to resolve all conflicts and settle any disputes resulting from the coordination drawing process.
2. Contract Drawings are diagrammatic. Included in the base bid shall be all offsets, fittings, etc. for a completed project. Only if major rerouting of piping is required, with significant cost increases, as approved by the Owner, Architect and Engineer, will additional money be warranted.
3. Field discrepancies shall be resolved by the field foreman. When discrepancies cannot be resolved, the signed-off coordination drawings shall be re-examined for rights.
4. Documented, coordinated, dimensioned work will have precedence. The Owner will not pay for rework of a particular trade. Uncoordinated work will not be tolerated.
5. Coordination drawings shall be a phased process with the General Trades Contractor, MEP Contractors, Architect and/or Engineer determining the sequence of work.
6. Each Contractor shall coordinate the exact location of his work with the work of other trades prior to fabrication or installation of same. Verify all dimensions and elevations. Provide additional offsets and sections of material as may be required to meet the applicable job condition requirements. Coordinate with and review all related Construction Drawings and Shop Drawings of all equipment suppliers prior to start of work.

B. Process
1. The Mechanical Contractor shall have precedence for the allotment of available space for the routing of his ductwork.
2. The Mechanical Contractor shall be responsible for all trades, pre-coordinating their layouts and shop drawings with each other.
3. The Mechanical Contractor shall prepare drawings in Revit (most current release). He shall be responsible for the base drawings to be used by all other Contractors. Base drawings shall include architectural, structural and reflected ceiling plan information.
4. The Mechanical Contractor shall prepare ductwork drawings, at a minimum scale of 1/4" = 1'-0", in Revit (most current release). After he has finished a compact disc or USB mass storage device with base drawing and ductwork, it shall be circulated in the following order:
   a. Plumbing Contractor
   b. Mechanical (HVAC) Contractor (piping systems)
   c. Fire Suppression Contractor
   d. Electrical Contractor
   e. General Trades Contractor
5. Each Contractor shall use the compact disc or USB mass storage device for preparation of their installation drawings.

6. After all trades have completed the coordination process, the Construction Manager or General Trades Contractor shall hold a coordination meeting to resolve conflicts. Each Contractor shall have available a drawing of his layout to be used with a light table for overlaying purposes. A representative of each Contractor, the Architect and the Engineer shall attend. All conflicts shall be resolved at the coordination meeting. The Architect and Engineer shall resolve all major conflicts as to the degree each Contractor shall alter their layout in order to allow for sufficient space for installation of the work.
7. When all coordination is complete, the Mechanical Contractor shall distribute two (2) sets of prints of the coordination drawings to each of the trades involved in the project, one (1) set for the owner's representative and one (1) set for as-built drawings.

C. Plumbing, Mechanical (HVAC) Piping, Fire Suppression and Electrical Contractors:
1. Piping and conduits shall be located and dimensioned from column center lines. Size, center line elevation and required pitch shall be clearly noted.
2. Long drain lines shall have center line elevations indicated at 20-foot intervals.

D. General Trades Contractor:
1. All furring and holes shall be clearly noted.
2. All ceiling heights shall be clearly noted.

E. Service Areas: Contractors shall indicate service areas for all equipment by shaded areas on drawings.

1.9 RECORD DRAWINGS

A. In addition to Division 01, the Contractor shall keep on the project site one complete set of working drawings on which he shall record any deviation or changes made from contract drawings made during construction. Record drawings shall show changes in:
1. Size, type, capacity, etc. of any materials, device, or piece of equipment.
2. Location of any device or piece of equipment.
3. Location of any outlet or source in building service systems.
4. Routing of any piping, conduit, ducts, sewers, or other building services.

B. Record drawings shall also record the location of all concealed water and electric service, water piping, building and horizontal drains, stacks and leaders, vents, ducts, conduit and other piping by identification of measured dimensions to each such line from readily identifiable and accessible walls or corners of the building. Drawings also show invert elevation of sewers and top of water lines.

C. Record drawings shall be kept clean and undamaged and shall not be used for any purpose other than recording deviations from working drawings and exact locations of concealed work.

D. Record drawings shall be continuously kept up-to-date and be available for inspection anytime during normal working hours.

E. After the project is completed, the record drawings shall be delivered to the Engineer in good condition, as a permanent record of the installation as actually constructed.

1.10 ELECTRONIC FILES

A. Drawings for this project were prepared using Revit software. Electronic files are available upon request for use by the successful contractor(s) for planning, coordination and installation.

B. There will be no charge for projects prepared using Revit that must be converted to AutoCAD or Navisworks format. However, Revit model files will NOT be available.

C. The Drawings Request form can be obtained from the Architect's office, completed and submitted to his attention.

1.11 OPERATING INSTRUCTIONS

A. Instruct the Owner's personnel in the details of operation and maintenance of all Contractor-furnished equipment. Instructions shall be based on operating manuals furnished for the equipment and shall demonstrate procedures and methods described in manuals.

B. Arrange and pay for the services of qualified personnel from the manufacturers of various major equipment for instruction. Provide this operating instruction for three working days of not less than eight hours, starting from the time that the entire system (or if sections are to be started at various times, from the time that each section) is in satisfactory operation. Time spent in making trial runs, changes, or major adjustments not to be included in the instruction time.

C. Provide Plumbing Booklet and Operations Instructions: Submit three (3) manuals in one of the following formats per the requirements of the Owner:
   1. Bound in the best grade hardback, loose-leaf, 3-ring binders.
   2. Placed on compact discs.
   3. Placed on USB mass storage devices (flashdrives).

D. All operating and maintenance instructions shall present, in English, full details for care and maintenance of all Plumbing systems and equipment installed. The operating instructions shall include the following information:
   1. Operating Instructions Manuals:
      a. Provide written instructions for each system with submittal of invoice for 75% of total contract.
      b. Submit one copy for approval before releasing to the Owner.
      c. Upon receipt of the approval, submit three copies to the Engineer.
      d. If providing three-ring hard-backed binders, bind the written operating instructions, shop drawings, equipment catalog cuts and manufacturer's instructions where they can be accommodated into a size 8-1/2- x 11-inches.
   2. Provide multiple binders where one cannot accommodate information.
      a. First Page - Title of job, Owner, address, date of submittal, name of Contractor and name of Engineer.
      b. Second Page - Index or Table of Contents.
      c. Third Page - Introduction to first section containing a complete written description of systems.
      d. First Section - Written description of system contents, where actually located in the building, how each part functions individually, and how system works as a whole. Conclude with a list of items requiring service and either state the service needed or refer to the manufacturer's data in the binder that described the proper service.
      e. Second Section - A copy of each shop drawing with an index at the beginning of the section.
      f. Third Section - A copy of each manufacturer's installation instructions.
      g. Fourth Section - A copy of each manufacturer's operating instructions and parts lists along with recommended spare parts lists with index at the beginning of the section.
      h. Fifth Section - A copy of each manufacturer's maintenance instructions
      i. Sixth Section - A list of all equipment used on the job, Contractor's purchase order numbers, supplier's name (including postal, email and website addresses), date of start-up of each piece of equipment.
      j. Seventh Section - Copies of all control wiring and flow diagrams, valve charts, pertaining to the work including automatic temperature control diagrams.

1.12 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification sections.

B. Deliver to the Owner to location as directed; obtain receipt prior to final payment.

1.13 CONTRACT DOCUMENTS

A. It is intended that work covered by these Contract Documents include everything requisite and necessary to make the various systems complete and operative, irrespective of whether or not every item is specifically provided for. Any omission of direct reference herein to any essential item shall not excuse the Contractor from complying with the above intent.

B. Figured dimensions supersede scaled ones. The Contractor shall take no advantage of and shall promptly call the attention of the Owner to any error, omission or inconsistency in the Specifications and the Drawings.

C. Special attention is directed to requirements that equipment and materials stated in the Specifications and/or indicated on the Drawings shall be furnished, except if otherwise noted, completely installed, adjusted and left in safe and satisfactory operating condition. Accessories, appliances and connections necessary for operation of equipment shall be provided to satisfaction of the Owner.

D. Materials, apparatus or equipment specified or otherwise provided for on Drawings, Addenda, Bulletins or Change Orders issued subsequent to Award of Contract shall be same brand, type, quality and character originally specified unless otherwise provided.

E. Layout of equipment, accessories, specialties and suspended, concealed or exposed piping systems are diagrammatic unless dimensioned. In preparing shop drawings, contractor shall check project conditions before installing work. If there are any interferences or conflicts, they shall be called to attention of the Engineer immediately for clarification.

F. The Drawings indicate required size and points of termination of piping and suggest proper routes to conform to structure avoid obstructions and preserve clearances. However, it is not intended that the Drawings indicate all necessary offsets, and it shall be the work of this Contractor to make the installation in such a manner as to conform to structure, avoid obstructions, preserve headroom and keep openings and passageways clear, without further obstruction or cost to the Owner.

G. Shop Drawings shall be furnished by the Contractor, indicating all changes to meet space requirements, code requirements and as necessary to resolve all space conflicts.

H. It is intended that all apparatus be located symmetrical with architectural elements and shall be installed at exact height and locations as shown on the architectural drawings. Refer to architectural details in completing and correlating work.

I. The Contractor shall fully inform himself regarding any and all peculiarities and limitations of the spaces available for the installation of all work and materials furnished and installed under this Contract. He shall exercise due and particular caution to determine that all parts of his work are made quickly and easily accessible.

J. It cannot be too strongly emphasized that, except for work specifically excluded herein, every system shall be turned over to Owner installed completed, with components, ready for normal operation.

K. Concealment: Unless otherwise specified, all work aboveground to be above suspended ceilings and in walls except in the Mechanical Equipment Room(s) and areas without ceiling work to be as high as possible.

PART 2 - NOT APPLICABLE

2.1 NOT USED

PART 3 – EXECUTION

3.1 PROJECT CONDITIONS

A. Install Work in locations shown on Drawings, unless prevented by Project conditions.

B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of the Owner before proceeding.

C. Drawings indicate desired position of equipment and routing of pipe and ductwork. Coordinate routing of pipes, ductwork and all other installations with installations of other trades prior to making installations.

D. Replace and restore to their original undamaged condition, facilities of every description damaged or disturbed during progress of this work. Such replacement or restoration applies to both surface and subsurface installations and materials. This includes fences for security, access routes, sidewalks, etc.

E. Where cutting of building structure such as floors, walls, roof, or framing is necessary, perform cutting operations only as authorized by the Owner as specified in Division 02. Cutting and patching of existing and new facilities shall be included in this Contract. Patch and finish all such openings in accordance with the applicable requirements given in other sections of the Specifications.

F. Patching shall be done by workmen skilled in the trade involved. Holes cut in structural steel must be initially coordinated with the Structural Engineer and shall be drilled or punched, not burnt with torch.

G. Patch, close and seal all openings used by this Contractor. Where openings are used by more than one trade, each trade to be responsible for an equal share of patching, closing and sealing openings.

3.2 SEQUENCING AND SCHEDULING

A. Construct Work in sequence under provisions in Division 01.

B. Coordinate completely all phases of and scheduling of work with the Owner and with other trades. Obtain approval from the Owner prior to execution of any work.

3.3 PRODUCT DELIVERY, STORAGE AND HANDLING

A. In addition to Division 01, protect piping and equipment at all times against entrance of dirt and injury to pipe joints, sheet metal, sheet metal acoustical lining and equipment surfaces during construction by means of caps, plugs, canvas, mounting on skids or plastic covers.

B. During shipment and before and during erection, protect materials and equipment from weather damage and possible theft. Keep materials and equipment off ground by means of wood

blocks or skids. Follow manufacturer's suggested procedure for protection of equipment which will be idle for an extended period of time prior to start-up.

3.4 EXCAVATION AND BACKFILL

A. Perform all excavation and backfill required to complete the work in accordance with Division 32 "Earthwork". Protect excavations, barricade walkways and minimize pedestrian disruption.

3.5 CONCRETE WORK

A. Provide all poured concrete bases and do all concrete work in accordance with Division 03.

B. Refer to Drawings for overall concrete base size. Concrete base shall be minimum 4-inches high with 1/2-inch 45-degree chamfer on top edge.
   1. EXCEPTION: Chamfer may be omitted on top edge(s) of concrete base(s) located adjacent to wall(s).

C. Install dowel rods to connect concrete base to concrete floor. Unless indicated otherwise, install dowel rods on maximum 18-inch centers around the full perimeter of concrete base.

D. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

E. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.6 PROTECTION AND DAMAGE

A. In addition to the provisions and stipulation of the General Conditions, provide various types of protection as follows:
   1. Protect finished floors from chips and cutting oil by the use of metal drip receiving pan and oil proof floor cover.
   2. Protect equipment and finished surfaces from welding and cutting splatters with baffles and splatter blankets.
   3. Protect equipment and finished surfaces from paint droppings, insulation adhesive and sizing droppings, etc. by use of drop cloths.

B. All equipment shall be stored at the site with openings, bearings, etc., covered to exclude dust and moisture. All stock piled pipe shall be placed on dunnage and protected from weather and from entry of foreign material. All material shall be stored to prevent the possibility of theft.

C. Piping and construction openings and excavations required for Plumbing work shall be covered when work is not in progress as follows:
   1. Cap pipe openings with fittings or plugs.
   2. Cover wall and ceiling openings with plywood, or canvas covered framing.
   3. Cover floor openings and excavations with structural material of adequate strength to support traffic.

D. The Owner’s property and the property of other Contractors shall be scrupulously respected at all times (including damage from leaks). Provide drop cloths and visqueen or similar barriers where dust and debris is generated, to protect adjacent area.

E. The Contractor shall be held responsible for damage caused by his work or through neglect of his workmen. Repairing of damaged work shall be done by Contractor as directed by the Architect. Cost of repairs shall be paid by Contractor.

F. The Owner reserves the right to make emergency repairs as required to keep equipment in operation without voiding the Contractor's guarantee bond not relieving the Contractor of his responsibilities during the bonding period.

3.7 TESTING AND ADJUSTING

A. Furnish all necessary temporary equipment and instruments required for adjustments and for operating tests. Submit list of instruments which will be used, including data of most recent calibration of each instrument.

B. When a test is to be made, notify the Owner not less than 48-hours before the test is scheduled to start, so that he may witness the test, or any part of it, if he elects to do so. The start of any test or handling system may also be deferred by not more than two working days if the proposed date conflicts with other commitments of the personnel assigned to witness the tests.

C. Piping tests: Test piping by the procedures as listed in their respective Specification Section.

D. Pipe Cleaning and Disinfection: Clean and disinfect (as required) piping systems as listed in their respective Specification Sections.

E. Equipment:
1. After satisfactory testing and cleaning of all piping as specified herein, placement all equipment in operation. Pressure test equipment to rated pressure for a period of two (2) hours.
2. Take all necessary reading to determine that equipment is operating satisfactorily. This includes temperatures in and out as well as ampere readings and voltage readings of all phases.

F. Adjusting and Operation:
1. After satisfactory testing and cleaning of all piping as specified hereinbefore, place all equipment in operation and adjust as required for proper operation.
2. For starting-up and adjusting of Contractor-furnished equipment except as specified hereinafter, which is not within the normal function of the Contractor's personnel, arrange and pay for the services of employees of the manufacturers of various major items of equipment to supervise such adjustment and initial operation.
3. If the Contractor elects to provide such service for any equipment with his own personnel, and this proves unsatisfactory in the opinion of the Owner, the Contractor shall, upon notification of such dissatisfaction, arrange immediately for services of manufacturer's employees as specified above.
4. Contractor shall add to systems any devices required for proper operation.

G. Test Reports: After all tests have been completed, or at intervals during the testing if requested by the Owner, submit data on motor load readings on each phase and simultaneous voltage readings across each phase with motor nameplate data.

3.8 OPERATION OF SYSTEM

A. After the entire system has been adjusted, operate it for not less than three working days of not less than eight hours each to demonstrate that performance is satisfactory and that each item of equipment has the capacity specified. If the Engineer agrees or directs major portions of the system may be so operated at different times in lieu of operations of the entire system at once. Correct all operating deficiencies observed during the test runs.

B. When excessive vibration of equipment is noted during this operation, have the manufacturer's

representative check shafts, motors, motor supports, fan wheels, sheaves, equipment mountings, bearings and couplings and other components of the equipment which are vibrating.

C. Make all corrections necessary to eliminate the vibration to the satisfaction of the Engineer.

D. When the Engineer deems it to be necessary to do so, make another test after corrective work is completed for the full period specified above.

E. After replacement or repair, test work again as specified. Repeat until satisfactory.

F. Keep complete and accurate record of test data. Submit to the Owner, in triplicate, typewritten report(s) of all test data.

G. Provide restraints to eliminate all excess pipe movement.

3.9 FINISH

A. Prime piping and structural and/or supporting steel members or parts that are exposed with one coat of Porter gray primer, or equal, after work is in place.
   1. Clean and re-paint any factory or shop painted surfaces that are damaged, scarred or with signs of corrosion. Painting to match original factory paint.
   2. Clean surfaces to remove all dirt, oil, grease dust, scale and foreign matter before applying paint. Designate all piping with temporary removal markings for guidance during priming and painting.
   3. All primer and paint shall be as manufactured by:
      a. Gildden Co., a division of PPG Industries, Inc.
      b. Martin-Senour Paints.
      c. PPG Industries, Inc.
      d. The Sherwin-Williams Co.
      e. None of the manufacturers listed for products under this Paragraph shall be considered as Basis-of-Design.

B. Shop fabricated or Manufactured Equipment and Materials:
   1. Unless factory finished is specified, prime, prior to shipment to job. If prior painting is not part of manufacturer's standard procedure, paint equipment and materials immediately after they are put in place, as specified for field painted items.
   2. Items not to be painted:
      a. Galvanized or similarly treated surfaces unless furnished as part of unitary assembly.
      b. Non-ferrous surfaces
      c. Non-metallic surfaces
      d. Plated surfaces
      e. Inside of pipes, conduits and electrical devices
      f. Gearing and machine finished surfaces
      g. Underground piping, unless otherwise specified.

C. Painting:
   1. Refer to Division 01 for requirements.
   2. Clean surfaces to remove all dirt, oil, grease, dust, scale and foreign matter before applying paint.
   3. Finish painting to be done per Division 09 Section "Finishes" or as specified within individual sections of this Specification.

D. Permanent Identification: After piping has been insulated and finish painted identify all exposed

piping with painted stencils. See Section 22 05 53 – Identification for Plumbing Piping and Equipment.

3.10 FINAL CLEANING

A. In addition to the requirements of Division 01, the Contractor shall provide final cleaning of the work consisting of cleaning each surface or unit of work to normal "clean" condition expected for a first-class building cleaning and maintenance program. Comply with the manufacturer's instructions for cleaning operations. The following are examples, but not by way of limitation, of cleaning levels required:
   1. Remove labels which are not required as permanent labels.
   2. Clean transparent materials, including mirrors and window/door glass, to a polished condition, removing\substances which are noticeable as vision-obscuring materials. Replace broken glass.
   3. Clean exposed exterior and interior hard-surfaced finishes, including metals, masonry, concrete, painted surfaces, plastics, tile, wood, special coatings and similar surfaces, to a dirt-free condition, free of dust, stains, films and similar noticeable distracting substances. Except as otherwise indicated, avoid disturbance of natural weathering of exterior surfaces. Restore reflective surfaces to original reflective quality.
   4. Clean concrete floors broom clean.
   5. Clean project site, including landscape, development areas, of litter and foreign substances. Sweep paved areas to a broom-clean condition; remove stains, petro chemical spills and other foreign deposits. Rake grounds which are neither planted nor paved, to a smooth, even-textured surface.
   6. The Contractor shall responsibly remove from the premises all debris, dust and dirt generated by his Tradesmen or Subcontractors during their activities as directed by the Owner.

3.11 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, to permit valve and regulator servicing, at indicated slopes and free of sags and bends.

F. Install fittings for changes in direction and branch connections.

G. Select system components with pressure rating equal to or greater than system operating pressure.

H. Sleeves are not required for core-drilled holes.

I. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2-inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   3. Install sleeves in new walls and slabs as new walls and slabs are constructed.
   4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

J. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stop materials. Refer to Division 07 Section "Through-Penetration Firestop Systems" for materials.

K. Verify final equipment locations for roughing-in.

L. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.12 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations.

D. Install equipment to allow right of way for piping installed at required slope.

3.13 SUPERFLUSH PROCEDURE

A. Introduction
   1. The following is the procedure for conducting a “Superflush” test on the domestic water system for the facility.
   2. This exercise is meant to simulate an event-day situation by testing the sequencing of the packaged booster pumps and the integrity of the supply and waste systems under full load conditions. As with any successful commissioning process, it is anticipated the testing team may uncover unforeseen problems that can be identified and subsequently corrected.
   3. It is mandatory that a representative of the booster pump manufacturer be present to make adjustments to the system as necessary.
   4. To ensure a thorough test, it is recommended that 1 or 2 people be present in each tested restroom to operate the flush-valves. It is important to instruct the people not to simply hold the valve open, but to flush the valve properly.
   5. It is strongly suggested that radios be provided for every team to make sure that everyone is coordinated especially if there are problems. In lieu of radios, the facility Public Address system may be used.

B. Procedure
   1. Summary

a. At a designated time, each person will begin to flush a water closet every 10 seconds, a urinal every 15 seconds and continue to flush until told to stop. It is very important that people actually flush the fixtures. DO NOT JUST HOLD THE HANDLE DOWN.
b. A list of restrooms included in the test shall be developed and provided by the Construction Manager.
c. Teams on the Main Concourse will begin. It should take a minimum of 10 minutes to ramp the system up to full flow to simulate a design condition. Full flow will be held for 5 minutes. At this point we will begin to ramp the system back down. The Press Level will stop first.
d. Although the main objective is to test the booster pump system, each team should keep track of any other problems that occur. These would include a loss of pressure in any area, drainage or venting problems and leeks in the fixture seals or sanitary lines. All teams should keep track of fixtures that stick open or do not flush properly and report back to the design team. The Construction Manager shall provide each team with tags they can affix to any fixtures that have problems. These tags should have space for notes so the teams can write down a quick description of each problem.
e. If multiple tests are performed, wait at least 10 minutes between tests to allow the system to fully sequence off. More time will be required if a high percentage of valves are stuck open due to debris in the supply lines, or other factors.
f. Record the operating pressure in several of the restrooms and concession stands.
g. Record the booster pump discharge pressure throughout the sequence.

2. Sequence
a. Start operating flush valves on the Main Concourse. Note how many booster pumps, if any, are operating at this point.
b. After 1-2 minutes begin operating valves on the Suite Levels. The flow should increase. Note which booster pumps are running.
c. After another 1-2 minutes begin operating flush valves on the Press Level. The flow should now be near the design maximum and all pumps may be operating.
d. This process shall continue for the Locker Areas and the West Tower.
e. Operate the system at full flow for a minimum of 5 minutes, and then ramp the system down in reverse order.

C. Results: After the test, the design and construction teams will meet to review the results.
D. For additional information, see Section 23 90 00 "Project Closeout."

3.14 PROJECT SITE SAFETY

A. The Engineer claims no expertise in and assumes no responsibility for any and all safety procedures and protocols associated with the Contractor's work. The Contractor shall exercise due diligence and comply with all established safety standards and regulations as listed by OSHA and any equipment manufacturers' requirements as they may relate to personal safety. The Contractor shall ensure that all of his Subcontractor(s) and/or Tradesmen are apprised of all safety-related standards and procedures as they may relate to their work and immediately correct any violation of OSHA standards and regulations or equipment manufacturers' safety recommendations.

END OF SECTION

SECTION 220517 - SLEEVES AND SLEEVE SEALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 as set forth in these Specifications are hereby incorporated into and shall become a part of this Section.

1.2 SUMMARY

A. Section Includes:
1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.
6. Silicone sealants.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Unless noted otherwise, none of the manufacturers listed for products under this Section shall be considered as Basis-of-Design.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.

B. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, anticorrosion coated or galvanized, with plain ends and integral welded waterstop collar.

2.2 STACK-SLEEVE FITTINGS

A. Product: Subject to compliance with requirements, provide product by one of the following:
1. Josam
2. MIFAB
3. Jay R Smith
4. Wade
5. Watts
6. Zurn

B. Description: Manufactured, Dura-coated or Duco-coated or galvanized cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Product: Subject to compliance with requirements, provide product by one of the following:
   1. Advance Products & Systems, Inc.
   2. CALPICO, Inc.
   3. Metraflex Company (The).
   4. Pipeline Seal and Insulator, Inc.
   5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
   1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
   2. Designed to form a hydrostatic seal of 20-psig minimum.
   3. Sealing Elements: EPDM-rubber, High-temperature-silicone or Nitrile (Buna-N) interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   4. Pressure Plates: Carbon steel, Composite plastic or Stainless steel.
   5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B 633 or Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Product: Subject to compliance with requirements, provide products by one of the following:
   1. Presealed Systems.
   2. Advance Products & Systems, Inc.
   3. CALPICO, Inc.
   4. Metraflex Company (The).
   5. Pipeline Seal and Insulator, Inc.
   6. Proco Products, Inc.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

C. Plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Description: Non-shrink, for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.6 SILICONE SEALANTS

A. Product: Subject to compliance with requirements, provide products by one of the following:
   1. Dow Corning Corporation
   2. GE Construction Sealants, Momentive Performance Materials, Inc.
   3. May National Associates, a subsidiary of Sika Corporation
   4. Ploymeric Systems, Inc.
   5. Proco Products, Inc.
   6. Schnee-Morehead, Inc., an ITW Company
   7. Sherwin-Williams Company
   8. Smooth On

B. Silicone, S, NS, 25, NT: Single-component, non-sag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C 920, Type S, Grade NS, Class 25, Use NT.

C. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

D. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
   1. Sleeves are not required for core-drilled holes.
   2. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

C. Install sleeves in concrete floors, concrete roof slabs and concrete walls as new slabs and walls are constructed.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2-inches above finish floor level.
   2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

D. Install sleeves for pipes passing through interior partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth and location of joint.

E. Fire Resistance-Rated and Smoke-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.
   1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."
   3. Install section of cast-iron soil pipe to extend sleeve to 2-inches above finished floor level.
   4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 SLEEVE AND SLEEVE SEALS SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:
   1. Exterior Concrete Walls above Grade:
      a. Piping Smaller than NPS 6: Cast-iron wall sleeves, galvanized-steel wall sleeves or galvanized-steel-pipe sleeves
      b. Piping NPS 6 and Larger: Cast-iron wall sleeves, galvanized-steel wall sleeves or galvanized-steel-pipe sleeves.
   2. Concrete Slabs-on-Grade:
      a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system, galvanized-steel wall sleeves with sleeve-seal system, galvanized-steel-pipe sleeves with sleeve-seal system.
         1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
      b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system, galvanized-steel wall sleeves with sleeve-seal system or galvanized-steel-pipe sleeves with sleeve-seal system.
         1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
   3. Concrete Slabs above Grade:
      a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves, stack-sleeve fittings or sleeve-seal.
      b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves or stack-sleeve fittings.
   4. Interior Partitions:
      a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
      b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION

SECTION 22 05 18 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 as set forth in these Specifications are hereby incorporated into and shall become a part of this Section.

1.2 SUMMARY

A. Section Includes: Escutcheons.

1.3 SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to complying with the requirements of this Section, provide products from one of the following:
1. BrassCraft Manufacturing
2. Dearborn Brass
3. Jones Stephens Corp
4. Keeney Manufacturing
5. Mid-American Fittings
6. ProFlo, a Ferguson Enterprise

B. None of the manufacturers listed for products in this Section shall be considered as Basis-of-Design.

2.2 ESCUTCHEONS

A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

C. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel or brass with polished, chrome-plated finish and spring-clip fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
   1. Escutcheons for New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
      b. Bare Piping at Wall and Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
      c. Bare Piping at Wall and Ceiling Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
      d. Bare Piping in Unfinished Service Spaces: One-piece steel with polished, chrome-plated finish.
      e. Bare Piping in Unfinished Service Spaces: One-piece cast brass with polished, chrome-plated finish.
      f. Bare Piping in Equipment Rooms: One-piece steel with polished, chrome-plated finish.
      g. Bare Piping in Equipment Rooms: One-piece cast brass with polished, chrome-plated finish.

3.2 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 as set forth in these Specifications are hereby incorporated into and shall become a part of this Section.

1.2 SUMMARY

A. This Section includes the following meters and gages for mechanical systems:
   1. Thermometers.
   2. Gages.
   3. Test plugs.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated; include performance curves.

B. Shop Drawings: Schedule for thermometers and gages indicating manufacturer's number, scale range and location for each.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements provide products by one (1) of the manufacturers specified.
   2. Unless noted otherwise, none of the manufacturers listed for products under this Section shall be considered as Basis-of-Design.

2.2 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

A. Manufacturers:
   1. Palmer - Wahl Instruments Inc.
   2. Trerice, H. O. Co.
   3. Weiss Instruments, Inc.

4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Type: Liquid-in-glass type, 9-inch long of chrome plated brass construction or self-powered digital type with glass passivated thermistor and internal potentiometer.

C. Tube: Red reading, liquid filled with magnifying lens. The use of mercury shall be prohibited.

D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.

E. Window: Clear acrylic held in place with removable stainless steel cap.

F. Connector: Adjustable type, 180-degrees in vertical plane, 360-degrees in horizontal plane with locking device.

G. Stem: Brass for thermowell installation and of length to suit installation.

H. Accuracy: Plus or minus one (1) scale division to maximum of 1.5-percent of range.

2.3 THERMOWELLS

A. Manufacturers: Same as manufacturer of thermometer being used.

B. Description: Pressure-tight, socket-type brass or stainless steel fitting made for insertion into piping and of type, diameter and length required to hold thermometer. Thermowell to have a 2-inch extension with threaded cap nut and cap for all insulated piping.

2.4 PRESSURE GAGES

A. Manufacturers:
1. Palmer - Wahl Instruments Inc.
2. Trerice, H. O. Co.
3. Weiss Instruments, Inc.
4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
1. Case: Dry or Glycerin filled type, 4-1/2-inch diameter.
2. Pressure-Element Assembly: Stainless Steel, Bourdon tube.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Black metal.
7. Window: Glass.
8. Ring: Stainless Steel.
9. Accuracy: Grade 2A, plus or minus 0.5-percent of scale range.
10. Range for Fluids under Pressure: Two (2) times operating pressure.
11. Provide gauges without back mounting plate.

12. Vacuum Range: 30 inches HG of vacuum to 15-psig of pressure.

2.5 TEST PLUGS

A. Manufacturers:
1. Peterson Equipment Co., Inc.
2. Sisco Manufacturing Co.
3. Trerice, H. O. Co.
4. Watts Industries, Inc.; Water Products Div.

B. Description: 1/2-inch NPT, Corrosion-resistant brass body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 1000-psig at 350 degrees F.

D. Core Inserts: Two (2) self-sealing rubber valves. Insert material for air, water, oil or gas service at 20 degrees F to 350 degrees F shall be Nordel.

E. Test Kit: Furnish one (1) test kit containing one (1) pressure gage and adaptor, two (2) thermometers and a carrying case. Pressure gage, adapter probes and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.
1. Pressure Gage: Small bourdon-tube insertion type with 2-inch to 3- inch diameter dial and probe. Dial range shall be 0-psig to 200-psig.
2. Low Range Thermometer: Small bimetallic insertion type with 2-inch diameter dial and tapered-end sensing element. Dial ranges shall be 0 degrees F to 220 degrees F.
3. Carrying case shall have formed instrument padding.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install liquid-in-glass thermometers in the following locations:
1. Where indicated on the Drawings.
2. Outlet of each domestic water heater.
3. Outlet of master mixing valve assemblies.

B. Provide the following temperature ranges for thermometers:
1. Domestic Hot Water: 30 degrees F to 200 degrees F with 2-degree scale divisions.
2. Domestic Cold Water: 0 degrees F to 100 degrees F with 2-degree scale divisions.

3.2 GAGE APPLICATIONS

A. Install liquid-filled-case-type pressure gages at inlet of domestic water service and outlet of hot water heaters.

3.3 TEST PLUG APPLICATIONS

A. Install test plugs at the inlet and outlet of each of the following:
   1. Domestic water heater.
   2. Calibrated balancing valves.
   3. Temperature regulating valves.
   4. Pressure regulating valves.

3.4 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.

C. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

D. Install needle-valve and snubber fitting in piping for each pressure gage for fluids.

E. Install test plugs and tees in piping. Install test plugs with sufficient clearance to permit installation of test gauges and thermometers.

3.5 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines and equipment.

3.6 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION

SECTION 220523 - GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 as set forth in these Specifications are hereby incorporated into and shall become a part of this Section.

1.2 SUMMARY

A. Provide valves to facilitate maintenance and isolation of piping systems.

1.3 QUALITY ASSURANCE

A. Standards
1. American National Standards Institute (ANSI), American Society of Mechanical Engineers (ASME), American Society for Testing and Materials (ASTM) and the Manufacturers' Standardization Society of the Valve and Fittings Industry (MSS).
2. MSS SP-70-90 Cast Iron Gate Valves, Flanged or Threaded Ends.
3. MSS SP-78-92 Cast Iron Plug Valves Flanged and Threaded.
4. MSS SP-80-87 Bronze Gate, Globe, and Check Valves.
5. MSS SP-85-85 Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.
6. MSS SP-110-92 Ball Valves Threaded, Socket-Welded, Solder Joint, Grooved and Flared Ends.

1.4 DEFINITIONS

A. The following are standard abbreviations that may be used in this Section:
1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. NBR: Acrylonitrile-butadiene rubber.
4. PTFE: Polytetrafluoroethylene plastic.
5. SWP: Steam working pressure.
6. TFE: Tetrafluoroethylene plastic.

1.5 SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Block check valves in either closed or open position.

B. Use the following precautions during storage:
1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. All similar valves used on the project shall be by the same manufacturer.

B. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements provide products by one (1) of the manufacturers specified.
2. Unless noted otherwise, none of the manufacturers listed for products under this Section shall be considered as Basis-of-Design.

2.2 VALVES, GENERAL

A. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

B. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

C. Valve Actuators:
1. Chain wheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
2. Gear Drive: For quarter-turn valves NPS 6 and larger and on discharge of all pumps without VFD's.
3. Hand wheel: For valves other than quarter-turn types.
4. Lever Handle: For quarter-turn valves NPS 5 and smaller, except plug valves.
5. Wrench: For plug valves with square heads. Furnish Owner with one (1) wrench for every ten (10) plug valves, for each size square plug head.

D. Extended Valve Stems: On insulated valves.

E. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves; and ASME B16.24 for bronze valves.

F. Valve Grooved Ends: AWWA C606.
1. Solder Joint: With sockets according to ASME B16.18.
a. CAUTION: Use lead free solder with melting point below 840 degrees F for angle,

check, gate and globe valves; below 421 degrees F for ball valves.

2. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

H. See Specification Section 22 11 23, "Natural Gas Piping" for valves used in natural gas systems.

2.3 BALL VALVES – 150-PSIG

A. Manufacturers
1. Watts (Basis-of-Design)
2. Apollo
3. Hammond
4. Nibco

B. 2-inches and smaller: 2-piece body design, 600-psig CWP, 150-psig SWP, cast bronze (ASTM B584 alloy C844) body, PTFE or TFE seats, blowout-proof stem, adjustable packing gland, chrome-plated full-port bronze ball, with screwed ends, and vinyl-covered steel handle. Provide solder ends. Provide extended valve stems for valves used on insulated lines.

2.4 BUTTERFLY VALVES – 150-PSIG

A. Manufacturers.
1. Watts (Basis-of-Design)
2. Centerline
3. Demco
4. Grinnell
5. Hammond
6. Keystone

B. 3-inches and larger: Valves shall have lug-style, ASTM A536 ductile iron body, rated at not less than 200-psig CWP. Body shall have 2-inch extended neck for insulating. Valve shall have aluminum bronze disc with EPDM rubber seat and seals. Stem shall be stainless steel and shall not have exposed stem to disc fasteners. Sizes 4-inches to 6-inches shall be lever operated with 10-position throttling plate; sizes 8-inches and larger shall have gear operators.

2.5 GATE VALVES – 150-PSIG

A. Manufacturers.
1. Powell (Basis-of-Design)
2. Hammond
3. Nibco
4. Stockham

B. 3-inches and larger: Class 125, OS&Y, Cast Iron Gate Valve. The gate valve shall meet MSS SP-70 Type I standard. The gate valve shall have a CWP rating of 150-psig. The valve materials shall meet ASTM A126, grey iron with bolted bonnet, flanged ends, bronze trim, and positive-seal resilient solid wedge disc. The gate valve shall be gear operated for sizes under 8-inches and crank operated for sizes 8-inches and above.

2.6 SWING CHECK VALVES – 150-PSIG

A. Manufacturers.
1. Powell (Basis-of-Design)
2. Hammond
3. Nibco
4. Stockham
5. Watts

B. Class 125, cast bronze (ASTM B62) body and cap, Y-pattern horizontal flow with an ASTM B61 bronze disc, and having threaded or solder ends. Provide solder ends for Domestic Hot and Cold Water service.

2.7 CALIBRATED BALANCING VALVES (FOR DOMESTIC HOT WATER AND 140 DEGREE F WATER RETURN PIPING)

A. Manufacturers.
1. Bell and Gossett "Circuit-Setter" (Basis-of-Design)
2. Apollo
3. Milwaukee
4. Nibco
5. Watts

B. Bronze body/brass ball construction with glass and carbon filled TFE seat rings. Valves to have differential pressure read-out ports across valve seat area. Read-out ports to be fitted with internal EPT inserts and check valves. Valve bodies to have 1/4-inch NPT tapped drain/purge port. Valves to have memory stop feature to allow valve to be closed for service and then reopened to set point without disturbing balance position. All valves to have calibrated nameplates to assure specific valve settings. Valves shall be designed for positive shut-off. Valves to be designed to allow installing contractor to pre-set balance points for proportional system balance prior to system start-up in accordance with pre-set balance schedule.

C. Furnish a portable flow measuring instrument for verifying and determining flow. Furnish carrying case, gage, valve block and color-coded hoses for low and high-pressure connections, and connectors for connection to read-out valves.

2.8 DRAIN VALVES

A. Manufacturers.
1. Apollo
2. Milwaukee
3. Nibco
4. Watts

B. Angled body drain valves to be 3/4-inch threaded or sweat inlet, short nipple outlet with garden-hose thread, all cast bronze body, vinyl-covered steel handle, 200-psig minimum working pressure and maximum temperature of 200 degrees F.

2.9 CHAIN WHEEL ACTUATORS

A. Manufacturer: Same as valve manufacturer.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
   1. Sprocket Rim with Chain Guides: Cast iron, of type and size required for valve.
   2. Brackets: Type, number, size and fasteners required to mount actuator on valve.
   3. Chain: Hot-dip, galvanized steel of size required to fit sprocket rim.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service and that it is free from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Shutoff Duty: Use bronze ball valves for piping NPS 2 and smaller. Use cast-iron gate or butterfly valves with flanged ends for piping NPS 3 and larger.
   2. Throttling/Flow Control Duty: Use balancing valves for piping NPS 2 and smaller.
   3. Drain Duty: Hose-end drain valves.

B. Install shutoff valves close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment and on each water supply to plumbing fixtures that do not have supply stops.

C. Install swing check valves on all Domestic Water piping serving Janitors Sinks, commercial kitchen faucets (with hose sprays) and mixing valves that are not supplied with integral check stops.

D. Install drain valves for equipment at base of water riser, at low points in horizontal piping and where required to drain water piping.
   1. Install hose-end drain valves at low points in water mains, risers and branches.
   2. Install stop-and-waste drain valves where indicated.

3.3 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment and specialties as required arranged to allow service, maintenance and removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full stem movement.

F. Install chain wheel operators on valves NPS 3 and larger and more than 96 inches above floor. Extend chains to 78-inches above finished floor elevation.

G. Provide sufficient space to allow adjustment of calibrated balancing values.

H. Install drain valves in piping at low points and trapped areas to provide complete drainage of all systems.

3.4 JOINT CONSTRUCTION

A. See Specification Section 22 11 16 "Domestic Water Piping" for joint construction requirements.

3.5 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 as set forth in these Specifications are hereby incorporated into and shall become a part of this Section.

1.2 SUMMARY

A. This Section includes hangers and supports for mechanical system piping and equipment.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for the valve and fittings industry.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design channel support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents and test water.

B. Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents and test water.

1.5 SUBMITTALS

A. Product Data: For each type of pipe hanger, channel support system component and thermal-hanger shield insert indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer for multiple piping supports and trapeze hangers. Include design calculations and indicate size and characteristics of components and fabrication details.

C. Welding Certificates: Copies of certificates for welding procedures and operators.

1.6 QUALITY ASSURANCE

A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements provide products by one (1) of the manufacturers specified.
   2. Unless noted otherwise, none of the manufacturers listed for products under this Section shall be considered as Basis-of-Design.

2.2 MANUFACTURED UNITS

A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.
   1. Manufacturers.
      a. Grinnell Corp.
      b. Michigan Hanger Co., Inc.
      c. National Pipe Hanger Corp.
      d. PHD Manufacturing, Inc.
   2. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.
   3. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.
   1. Manufacturers.
      a. Cooper Industries; B-Line Products
      b. Grinnell Corp.; Power-Strut Unit.
      c. Michigan Hanger Co., Inc.; O-Strut Div.
      d. National Pipe Hanger Corp.
      e. Unistrut Corp.
   2. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
   3. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

C. Thermal-Hanger Shield Inserts
   1. Manufacturers.
      a. Michigan Hanger Co., Inc.
      b. Pipe Shields, Inc.
      c. Rilco Manufacturing Co., Inc.
      d. Value Engineered Products, Inc.
   2. 100-psi minimum compressive-strength insulation; encased in sheet metal shield.
      a. Material for Cold Piping: ASTM C 552, Type I cellular glass with vapor barrier.
      b. Material for Hot Piping: ASTM C 552, Type I cellular glass.
      c. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
      d. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
      e. Insert Length: Extend 2-inches beyond sheet metal shield for piping operating below ambient air temperature.

2.3 MISCELLANEOUS MATERIALS

A. Powder-Actuated Drive-Pin Fasteners
   1. Manufacturers.
      a. Gunnebo Fastening Corp.
      b. Hilti, Inc.
      c. ITW Ramset/Red Head.
      d. Masterset Fastening Systems, Inc.
   2. Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

C. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.

D. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, non-shrink and nonmetallic, dry, hydraulic-cement grout.
   1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
   2. Properties: Nonstaining, noncorrosive, and nongaseous.
   3. Design Mix: 5000-psi 28-day compressive strength.

2.4 ROOF PIPE SUPPORT

A. Manufacturers.
   1. Advanced Support Products
   2. C-Port
   3. Clearline Technologies
   4. IPS Roof Top Blox
   5. MAPA
   6. Mifab
   7. Miro

B. Molded recycled rubber support, UV resistant, maximum 500-pound load, accepts screw fasteners thru pipe clamps, 4-inch high unit, 2-inch and smaller pipe minimum base size 6-inches x 9-inches, for 2-1/2-inch and larger pipe minimum base size 6-inches x 22-inches, maximum support spacing 8-foot or 10-foot. Provide rigid pipe clamps and stainless steel screws (pipe clamp to be one size larger than piping)

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger requirements are specified in Sections specifying equipment and systems.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.

C. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
   1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or

insulated stationary piping, NPS 2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 degrees F piping, NPS 4 to NPS 16, requiring up to 4-inches of insulation.
3. Carbon-or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of piping, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4-inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot piping, NPS 1/2 to NPS 24, if little or no insulation is required.
5. Adjustable Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated stationary piping, NPS 3/4 to NPS 2.
6. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated stationary piping, NPS 1/2 to NPS 2.
7. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of non-insulated stationary piping, NPS 3/8 to NPS 2.
8. U-Bolts (MSS Type 24): For support of heavy piping, NPS 1/2 to NPS 30.
9. Clips (MSS Type 26): For support of insulated piping not subject to expansion or contraction.
10. Pipe Saddle Supports (MSS Type 36): For support of piping, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
11. Single Pipe Rolls (MSS Type 41): For suspension of piping, NPS 1 to NPS 30, from two (2) rods if longitudinal movement caused by expansion and contraction might occur.
12. Adjustable Roller Hangers (MSS Type 43): For suspension of piping, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
13. Pipe Roll and Plate Units (MSS Type 45): For support of piping, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.

D. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6-inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 degrees F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 degrees F piping installations.

E. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to

structural steel.

12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750-pounds.
    b. Medium (MSS Type 32): 1500-pounds.
    c. Heavy (MSS Type 33): 3000-pounds
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where head room is limited.

F. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification Sections, install thermal-hanger shield Inserts for supporting insulated pipe, 360-degree insert of high-density, 100-psi minimum compressive-strength, cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.

G. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
    1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
    2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4-inches.

3.2 HANGER AND SUPPORT INSTALLATION

A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
    1. Field assemble and install according to manufacturer's written instructions.

C. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.
    1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
    2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.

D. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

E. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

F. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

H. Install hangers and supports to allow controlled thermal of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.

K. Insulated Piping: Comply with the following:
1. Attach clamps and spacers to piping.
   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert. Include steel weight distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   c. Do not exceed pipe stress limits according to ASME B31.9.
2. Shield Dimensions for Pipe: Not less than the following:

SHIELD DIMENSIONS		
NPS Pipe Size	Length (inches)	Thickness (inches)
1/2 to 3-1/2	12	0.048
4	12	0.060
5 and 6	18	0.060
8 to 14	24	0.075

3. Pipes NPS 8 and Larger: Include wood inserts.
4. Insert Material: Length at least as long as protective shield.
5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

L. Supports from roof decking systems are not permitted.

M. Install hangers for cast iron piping with the following maximum horizontal spacing and minimum rod diameters:

CAST-IRON PIPING HANGER SPACING			
NPS Pipe Size	Maximum Horizontal Spacing (feet)	Hanger Rod Diameter (inches)	Maximum Vertical Spacing (feet)
4 or smaller	5	5/8	15
6 and 8	5	3/4	15
10 and 12	5	7/8	15

NOTE: The maximum horizontal spacing of cast-iron pipe hangers shall be increased to 10-feet where 10-foot lengths of pipe are installed.

N. Install hangers for copper or copper-alloy piping or tubing with the following maximum horizontal spacing and minimum rod diameters:

COPPER/COPPER-ALLOY PIPING/TUBING HANGER SPACING

NPS Pipe Size	Maximum Horizontal Spacing (feet)	Hanger Rod Diameter (inches)	Maximum Vertical Spacing (feet)
Copper or copper-alloy pipe, 4 or smaller	12	3/8	10
Copper or copper-alloy pipe, 5 or larger	12	1/2	10
Copper or copper-alloy tubing, 1-1/4 or smaller	6	3/8	10
Copper or copper-alloy tubing, 1-1/2 or larger	10	1/2	10

O. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:

CPVC PIPING HANGER SPACING			
NPS Pipe Size	Maximum Horizontal Spacing (feet)	Hanger Rod Diameter (inches)	Maximum Vertical Spacing (feet)
1 or smaller	3	3/8	10
1-1/4 to 2	4	3/8	10
2-1/2 to 3-1/2	4	1/2	10
4 and 5	4	5/8	10
6	4	3/4	10
8	4	7/8	10

NOTE: Provide mid-story guides for NPS 2 and smaller.

P. Install vinyl-coated hangers for PEX piping with the following maximum spacing and minimum rod diameter:
1. Horizontal PEX Piping: 32-inches with 3/8-inch rod.
2. Vertical PEX Piping: 10-feet.

Q. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

PVC PIPING HANGER SPACING			
NPS Pipe Size	Maximum Horizontal Spacing (feet)	Hanger Rod Diameter (inches)	Maximum Vertical Spacing (feet)
2 or smaller	4	3/8	10
2-1/2 to 3-1/2	4	1/2	10
4 and 5	4	5/8	10
6	4	3/4	10
8	4	7/8	10

NOTE: Provide mid-story guides for NPS 2 and smaller.

R. Install vinyl-coated hangers for vertical PVC piping every 10-feet. Provide mid-story guides for NPS 2 and smaller.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

3.4 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.

B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedure for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

A. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 220533 - HEAT TRACING FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes a UL Listed, CSA Certified, or FM Approved complete pipe freeze protection system that consists of a self-regulating trace heater, connection kits, accessories, and electronic controller for insulated pipes exposed to risk of freezing.

B. Related Requirements:
   1. Section 21 05 33 "Heat Tracing for Fire Suppression Piping."
   2. Section 23 05 33 "Heat Tracing for HVAC Piping."

1.3 SYSTEM DESCRIPTION

A. System includes a complete pipe freeze protection system for insulated pipes exposed to the risk of freezing or flow maintenance. System consists of a self-regulating heating cable, connection kits, accessories, and energy efficient control, monitoring, and Building Management System (BMS) communication capabilities. The heating cable shall have a Polyolefin jacket for above ground piping.
   1. Pipe freeze protection of aboveground Domestic Cold Water Piping.
   2. Pipe freeze protection of aboveground Domestic Hot Water and Hot Water Return Piping.
   3. Pipe flow maintenance for aboveground horizontal Storm Water Drain Piping (provide a single line dropped down the downspouts 5-feet from gutter).
   4. Pipe flow maintenance for aboveground horizontal Sanitary Waste piping (provide maintenance from fixture to P-trap, P-trap and 5-feet downstream of P-trap.
   5. Pipe flow maintenance for aboveground horizontal FOG Waste Piping and Traps.

B. As used in this Section, the terms “Domestic Water” and “Domestic Hot Water” shall also refer to 140 Degree F Water Systems inclusively unless noted otherwise.

1.4 SUBMITTALS

A. Product Data: For each type of product.
   1. Heating cable data sheet
   2. UL Listed, CSA Certified, or FM Approved certificates for freeze protection or flow maintenance systems.
      a. Pipe Freeze Protection above ground
      b. Pipe Temperature Maintenance above ground
      c. Pipe Flow Maintenance above ground
   3. Pipe Freeze Protection, Temperature Maintenance and Flow Maintenance design guide

4. System installation and operation manual
5. System installation details
6. Connection kits and accessories data sheet
7. Controller data sheet
8. Controller wiring diagram

B. Shop Drawings
1. Provide heat tracing circuit layout drawings indicating power connections, tees, end seal, cable length and circuit cable length.
2. The system shall be capable of being designed within a BIM model and the manufacturer shall provide a BIM add-in for Autodesk Revit MEP to automate the design process.

C. Field quality-control reports.

D. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: All system components shall be sourced from a single manufacturer, under no circumstances shall any components be installed other than those supplied by the cable manufacturer, to ensure system integrity and meet warranty requirements.

B. Qualifications
1. Manufacturers
a. Manufacturer to show minimum of forty (40) years' experience in manufacturing electric self-regulating heating cables and components.
b. Manufacturer shall be ISO-9001 registered.
c. Manufacturer to provide products consistent with UL 515 and IEEE 515.1 requirements.
d. The self-regulating heating cable shall be qualified and tested to demonstrate a useful lifetime in excess of twenty (20) years.
2. Installers
a. System installer shall have complete understanding of product and product literature from manufacturer or authorized representative prior to installation. Electrical connections shall be performed by a licensed electrician.

C. Certifications
1. The system (heating cable, connection kits and controller) shall be UL Listed and FM Approved for:
a. Freeze protection of aboveground Domestic Water Piping.
b. Flow maintenance of aboveground Storm Water Drain Piping (primary and secondary).
c. Flow maintenance of aboveground FOG Waste Piping.

1.6 WARRANTY

A. Manufacturer Warranty
1. Manufacturer’s warranty that warrants all goods listed below for two (2) years from date of purchase against faulty workmanship and use of defective materials when such goods are properly installed, operated, and maintained according to product documentation.
a. Heating cables, connection kits & accessories

b. Thermostats, controllers, panels contactors, sensors and accessories

B. Special Warranty
1. Contractor shall provide the owner an extended product warranty for the heat tracing products listed below. The contractor must complete and forward to owner the Installation, Inspection or Commissioning Record(s), and complete the online warranty registration form within thirty (30) days from the date of installation, otherwise only standard limited warranty applies.
   a. Heating Cable & Components: Ten (10) Years from Date of Purchase
2. Heating cables, connection kits and accessories not automatically offered with a ten (10) year manufacturer's warranty, as a standard matter, will not be allowed. Warranty information must be published on the manufacturer's website.

PART 2 - PRODUCTS

2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

A. Manufacturers: Subject to complying with the requirements of this Section, provide products from one of the following:
1. Raychem; a brand of nVent
2. Chromalox, Inc.
3. Delta-Therm Corporation
4. Easy Heat; a division of Emerson Electric Company
5. Nelson Heat Trace; a division of Emerson Electric Company
6. Pyrotenax, a brand of nVent
7. Thermon Americas, Inc.

B. Comply with IEEE 515.1.

C. Heating cables shall be self-regulating heating cables specifically designed for the intended application, tested and approved to UL 515, CSA 22.2 No 130- 03 and IEEE 515.1 requirements.
1. The construction of the self-regulating heating cable shall consist of a continuous core of conductive polymer that is radiation crosslinked, extruded between two (2) 16 AWG nickel-plated copper bus wires that varies its power output in response to pipe temperature changes.
2. The heating cable shall have a modified polyolefin inner jacket for dielectric integrity long life expectancy.
3. The heating cable shall have a thicker gauge (5/24) tinned copper braid with minimum 70% coverage for ground path and mechanical ruggedness.
4. The heating cable shall have a self-regulating factor of at least 50 percent for XL-Trace. The self-regulating factor is defined as the percent reduction of the heating cable power output going from a 40°F pipe temperature to 150°F pipe temperature. The heating cable shall have an outer jacket that is approved and clearly marked for the install conditions.
   a. For above ground Domestic Water piping applications, the heating cable shall have a modified polyolefin outer jacket printed with cable model #, agency listings, batch number and meter marks (for ease of installation within maximum circuit length).
5. The heating cable shall be designed for the following voltage/wattage, outer jacket, and install conditions.
   a. Application: Domestic Hot Water
   b. Located: Aboveground
   c. Jacket: Flame-retardant polyolefin

d. Minimum maintain temperature: 40-degrees F
e. Heating cable voltage wattage: 208-277 VAC - 5 watts/foot

6. The heating cable shall be included in a UL Listed, CSA Certified, or FM Approved system.
7. Constant wattage cables are not acceptable.

D. Heating Cable Connection Kits
1. Heating cable connection kits shall be heating cable manufacturer.
2. Contractor shall provide power connections, splices/tees, and end seal kits to properly connect & terminate the heating cable circuit along the specified length of the piping.
3. All splices, tees and crosses shall be installed underneath the pipe insulation with service loops installed to allow for future service of the piping.
4. Connection kits shall be rated NEMA 4X to prevent water ingress and corrosion. All components shall be UV stabilized and shall not require the installing contractor to cut into the heating-cable core to expose the bus wires.
5. Connection kits be UL Listed, CSA Certified and FM Approved.

E. Attachment of Heating Cable
1. Attachment method of heating cable to the piping shall by general purpose, high temperature, glass filament tape for installation @ 40°F and above. Contractor to fix the heating cable to the pipe every 12” by wrapping the GT-66 tape around the pipe & over the heating cable with minimum 6-inches of overlap.
2. Metal cable ties are not permitted

F. Identification of Heating Cable System
1. Contractor shall provide & install “Electric Heat Traced” labels on exterior of pipe insulation every ten (10) feet on opposite sides of the pipe for the entire length of heat traced piping.
2. In addition, all splices, tees, crosses and power connections shall be labeled on the exterior of the pipe insulation indicating that presence of a connection kit.

2.2 CONTROLS

A. Single Circuit Local Digital Controller

1. All self-regulating heating cable shall be controlled via an energy saving, programmable single circuit controller to provide adjustable maintained temperatures in the range of –40°F to 140°F.
2. Contractor shall provide one (1) controller for each heat tracing circuit as indicated on heat tracing schedule (above).
3. Controller shall include a self-test function to verify heat tracing integrity at least once every 24 hrs.
4. See table below for complete list of required controller capabilities:
5. Temperature Sensors (Line Sensing Control): Contractor shall provide one (1) 100 Ω, platinum 3-wire RTD for pipe temperature sensing for each heat tracing controller.

Supply Voltage	100 VAC to 277 VAC		
Enclosure	NEMA4X FRP		
Operating Temp Range	−40°F - 140°F		
Display	6 character alphanumeric LED		
Control	Relay Type: DP, mechanical	Voltage: 277 VAC max	Current: 30 A @ 104°F
Control Algorithms	On/Off		
	Proportional Ambient Sensing Control for energy saving		
Monitoring			
	Temperature	Low Alarm: 0°F to 180°F	High Alarm: 0°F to 200°F
	Ground Fault	Alarm Range: 20 mA -100 mA	Trip Range: 20 mA -100 mA
	Current	Low alarm range: .3 A to 30 A or off	
	Autocycle Test	Interval: 1-240 minutes or 1-240 hours	
Temp Sensor Inputs	Quantity: Two (2)	Type: 100 Ω, platinum 3 wire	
Alarm Outputs			
	AC Relay: Isolated solid state triac, SPST, 0.75A max, 100 VAC to 277 VAC nominal		
	Dry Contact Relay: Pilot duty, 48 VAC/DC, 500 mA maximum, 10 VA max. resistive switching		
	Outputs: Normally Opened or Normally Closed		
Stored Parameters			
	Minimum Temperature	Maximum Temperature	Max. ground fault current
	Maximum Heater current	Contactor cycle count	Time in Use
Alarm Conditions			
	Low & high temperature	Low current	Ground fault alarm & trip
	RTD failure	Loss of programmed values	EMR failure
Communications			
	Protocol: Modbus RTU	Topology: daisy chain	26 AWG shielded twisted pair

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Prior to installation of heating cable system, verify that all piping which will be heat traced has passed all hydrostatic/pressure tests and is signed off by the Authority Having Jurisdiction.

B. Pre-Installation Testing: Prior to installing heating cable on the piping an insulation resistance test shall be performed by the installing contractor to ensure integrity of heating cable as describe in the installation & maintenance manual.

3.2 PREPARATION

A. All heating cable ends shall be protected from moisture ingress until cable is terminated.

3.3 INSTALLATION

A. Comply with the manufacturer's recommendations contained in their heating cable system installation and operation manual.

B. All heat tracing components including power connections, splices, tees, crosses or end seal must be installed above grade and protected from abuse or damage.

C. Temperature sensor shall be installed inside of ¾" plastic conduit and pushed all the way to the closed end. Contractor to wire temperature sensor to the controller and be responsible for extended temperature sensor wiring as required by the site conditions.

D. Install electric heating cable according to the drawings and the manufacturer's instructions. The installer shall be responsible for providing a complete functional system, installed in accordance with applicable national and local requirements.

E. Interface with Other Work
   1. Connection of all electrical wiring shall be according to Section 26.
   2. Grounding of controller shall be according to Section 26.
   3. Pipe insulation shall be according to Section 220700 "Insulation for Plumbing Piping" and is required for a properly operating system.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Field Tests and Inspections
   1. The system shall be commissioned in accordance to the Manufacturer's Installation and Operation manual.
   2. The following test shall be performed after the heat cable has been installed but before the insulation and after insulating the piping. The results of both sets of tests shall be recorded as detailed in the Manufacturer's Installation and Maintenance Manual and included in submittals to owner:
      a. Continuity Test
      b. Insulation Resistance – 2500 VDC
      c. Capacitance Check – Circuit Length Verification
      d. Power Check
      e. Ground-fault Test
   3. The technician shall verify the insulation schedule is in compliance with the Manufacturer's Installation and Operation manual.
   4. The technician shall verify that the control parameters are set to the application requirements.
   5. The technician shall verify that the alarm contacts are corrected connected to the BMS.
   6. The technician shall verify that the control panel is configured correctly with the BMS.

3.5 SYSTEM STARTUP

A. Provide a factory-certified technician or manufacturer's representative for startup & commissioning of the heat tracing system and controller.

B. Coordinate all controller settings prior to programming the controller with the Engineer for Domestic Water, Storm Drain and FOG Waste piping.

C. Provide commissioning report in submittals package to owner.

END OF SECTION

SECTION 220548 - SEISMIC CONTROLS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Restraint channel bracings.
2. Restraint cables.
3. Seismic expansion joints.
4. Seismic-restraint accessories.
5. Mechanical anchor bolts.
6. Adhesive anchor bolts.

B. Related Requirements:
1. Section 21 05 48 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
2. Section 23 05 48 "Vibration and Seismic Controls for HVAC" for devices for HVAC equipment and systems.

C. None of the manufacturers listed for products under this Section shall be considered as Basis-of-Design.

1.3 SUBMITTALS

A. Product Data: For each type of product.
1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
   a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to the Authority Having Jurisdiction.
   b. Annotate to indicate application of each product submitted and compliance with requirements.
3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings: Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.

C. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.
1. Include design calculations and details for selecting vibration isolators and seismic restraints complying with performance requirements, design criteria, and analysis data

signed and sealed by the qualified professional engineer responsible for their preparation.

2. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, due to seismic forces required to select vibration isolators, and due to seismic restraints.
3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
4. Seismic-Restraint Details:
   a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
   b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
   c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
   d. Preapproval and Evaluation Documentation: By an agency acceptable to the Authority Having Jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For professional engineer and testing agency.

C. Welding certificates.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to the Authority Having Jurisdiction.

B. Comply with seismic-restraint requirements in the OBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum

seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:
   1. Site Class as Defined in the OBC: D.
   2. Assigned Seismic Use Group or Building Category as Defined in the OBC: II.
      a. Component Importance Factor: 1.5.
      b. Component Response Modification Factor: 1.25.
      c. Component Amplification Factor: 1.0.
   3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 0.32.
   4. Design Spectral Response Acceleration at 1.0-Second Period: 0.18.
   5. Rated strengths, features, and applications shall be as defined in report by an agency acceptable to the Authority Having Jurisdiction.
      a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they are subjected.

2.2 RESTRAINT CHANNEL BRACINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. B-Line, an Eaton business
   2. CADDY; a brand of nVent
   3. Hilti, Inc.
   4. Unistrut; part of Atkore International

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.3 RESTRAINT CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. CADDY; a brand of nVent
   2. Vibration Mountings & Controls, Inc.

B. Restraint Cables: ASTM A 492 stainless-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.4 SEISMIC EXPANSION JOINTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. The Metraflex Co. (Basis-of-Design)
   2. Flexonics
   3. U.S. Bellows, Inc.

B. Expansion Joints:
   1. Flexible hose expansion loops shall be manufactured complete with two parallel sections of corrugated metal house, compatible braid, 180-degree return bend with inlet and outlet connections. Field fabricated loops shall not be permitted.
   2. For fuel gas service up to 4-inches, flexible loops shall be AGA certified.
   3. Corrugated Hose, Stainless Steel, Type 304.
   4. Braid: Type 304 Stainless Steel braid shall be used for any Series 300 Stainless Steel hose.
   5. Fittings Materials of construction and end fitting type shall be consistent with pipe material and equipment/ pipe connection fittings. Copper fittings shall not be attached to stainless steel hose.
   6. Flexible hose expansion loops shall have a factory-supplied, hanger / support lug located at the bottom of the 180-degree return.
   7. Flexible hose expansion loop(s) shall be furnished with a plugged FPT to be used for a drain or air release vent.

LOOP SIZE SCHEDULE	
Loop Size	FPT Size
1" to 6"	3/8"
8" and Larger	1/2"

   8. Flexible hose expansion loops mounted in a horizontal position shall be provided with seismic breakaway hangers as required by the manufacturer.
   9. Flexible hose expansion loop(s) shall be rated with an operating pressure in accordance with the table below. The operating pressure shall be based on burst pressure with a 4 to 1 safety factor.

FLEXIBLE EXPANSION LOOP WITH STAINLESS STEEL HOSE		
Size	Working Pressure at 70-degrees F single braid (psi)	Working Pressure at 70-degrees F double braid (psi)
1/2"	1100	1525
3/4"	792	1267
1"	571	914
1-1/4"	531	850
1-1/2"	472	755
2"	500	750
3"	288	431
4"	232	371
6"	170	300
8"	212	260

2.5 SEISMIC-RESTRAINT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. B-Line, an Eaton business
   2. CADDY; a brand of nVent
   3. Mason Industries, Inc.

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.6 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. B-Line, an Eaton business
   2. Hilti, Inc.
   3. Mason Industries, Inc.
   4. Powers Fasteners
   5. Simpson Strong-Tie Co., Inc.
   6. Unistrut; part of Atkore International

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.7 ADHESIVE ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. B-Line, an Eaton business
   2. Hilti, Inc.
   3. Mason Industries, Inc.
   4. Powers Fasteners
   5. Simpson Strong-Tie Co., Inc.
   6. Unistrut; part of Atkore International

B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to the Authority Having Jurisdiction.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Division 03.

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Comply with requirements in Division 07 for installation of roof curbs, equipment supports, and roof penetrations.

D. Piping Restraints:
   1. Comply with requirements in MSS SP-127.
   2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.

3. Brace a change of direction longer than 10 feet.

E. Install cables so they do not bend across edges of adjacent equipment or building structure.

F. Install seismic-restraint devices using methods approved by an agency acceptable to the Authority Having Jurisdiction that provides required submittals for component.

G. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

H. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

I. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

J. Drilled-in Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 22 11 16 "Domestic Water Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 as set forth in these Specifications are hereby incorporated into and shall become a part of this Section.

1.2 SUMMARY

A. This Section includes the following Plumbing identification materials and their installation:
   1. Equipment nameplates.
   2. Equipment markers.
   3. Pipe markers.
   4. Stencils.
   5. Valve tags.
   6. Valve schedules.
   7. Warning tags.

B. Identify by labels and tags the following:
   1. Equipment such as domestic water heaters, pumps, etc.
   2. Piping and valves exposed in equipment rooms and accessible service areas.
   3. Piping and valves running above accessible ceiling construction and near access panels in non-accessible construction areas.

C. Install laminated plastic markers and metal stamped nameplates for equipment. Provide color banding, flow arrows and contents identification for piping and ductwork.

D. For labeling requirements pertaining to Plumbing Piping with Electric Heat Trace, see Section 22 05 33.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated

B. Valve numbering scheme.

C. Valve Schedules: For each piping system. Furnish three extra copies (in addition to mounted copies) to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, “Scheme for the Identification of Piping Systems,” for letter size, length of color field, colors and viewing angles of identification devices for piping.

1.5 COORDINATION

A. Coordination installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. All trades shall use the same type, style and appearance of identification.

E. Coordinate with the Owner for data on tags and identification with a unique numbering system. The tags and identification shall have the number in both an alpha/numeric font and a bar code font (as applicable). The number and font shall be obtained from Owner prior to ordering. The Owner's requirements will supersede those of this Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering plumbing fixtures and trim which may be incorporated in the work include:
   1. Brady Corp.
   2. Brimar Industries
   3. Craftamark
   4. National Marker Co.
   5. Seton Nameplate Corp.

B. Unless noted otherwise, none of the manufacturers listed for products under this Section shall be considered Basis-of-Design.

2.2 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
   1. Data:
      a. Manufacturer, product name, model number and serial number.
      b. Capacity, operating and power characteristics and essential data.
      c. Labels of tested compliances.
   2. Location: Accessible and visible.
   3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, laminated plastic, white lettering on black background. Markers shall be screw on, except where screws might damage equipment, use a contact-type permanent adhesive.
   1. Terminology: Match schedules as closely as possible.
   2. Size: Sized for 3/4-inch lettering.

2.3 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service and showing direction of flow.
   1. Colors: As indicated in specification schedule.
   2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
   3. Pipes with OD, including insulation, less than 6-inches: full wrap around pipe labels extending minimum 360-degrees around pipe at each location.
   4. Pipes with OD, including insulation, 6-inches and larger: Either full-band or full wrap around pipe label pipe markers at least three (3) times letter height and of length required for label.
   5. Arrows: A separate full wrap around pipe labels with flow direction on each pipe marker to indicate direction of flow (arrows may be part of labels above).

2.3 VALVE TAGS

A. Valve Tags: 2-inch diameter tag stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme, approved by Engineer. Provide 5/32-inch hole for fastener.
   1. Material: 16-gauge brass.
   2. Valve-Tag Fasteners: Brass beaded chain.

2.4 VALVE SCHEDULES

A. Valve Schedules: For each piping system, on standard-size, bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulation), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
   2. Frame: Extruded aluminum.
   3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.5 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
   1. Size: Approximately 4-inches by 7-inches.
   2. Fasteners: Brass grommet and wire.
   3. Nomenclature: Large-size primary caption such as DANGER, CAUTION or DO NOT OPERATE.
   4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 22 Sections. If more than single-type material, device or label is specified for listed applications, selection is Contractor's option.

B. Contractor is responsible for valve tagging, equipment markers and pipe identification of all valves, equipment and piping on packaged pumping skids.

3.2 EQUIPMENT IDENTIFICATION

A. Install equipment markers with screws. If screws might damage equipment, use permanent adhesive on or near each major item of Plumbing equipment.
   1. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
      a. Main control and operating valves, including safety devices.
      b. Pumps.
      c. Domestic water heaters.
      d. Tanks and pressure vessels.
      e. Water-treatment systems and similar equipment.

3.3 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service of each piping system. Install with flow indication arrows showing direction of flow.

B. Install manufactured pipe markers on new piping systems in the area of work.

C. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior non-concealed locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures. Where flow pattern is not obvious, mark each pipe at branch.
   3. Near each side of penetrations through walls, floors, ceilings and non-accessible enclosures.
   4. At access doors, manholes and similar access points that permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   6. Spaced at maximum intervals of 50-feet along each run. Reduce intervals to 25-feet in areas of congested piping and equipment.
   7. On piping above removable acoustical ceilings.

D. Pipe Identification

PIPE IDENTIFICATION SCHEDULE			
Type of Service	Band Color	Lettering Color	Designation
Domestic Cold Water	Green	White	Domestic Cold Water
Domestic Cold Water - 100 psig	Green	White	Domestic Cold Water 100 PSIG
Domestic Hot Water	Yellow	Black	Domestic Hot Water
Domestic Hot Water Return	Yellow	Black	Domestic Hot Water Return
140 Degree F Water	Yellow	Black	140 Hot Water
140 Degree F Water Return	Yellow	Black	140 Hot Water Return
Non-Potable (Irrigation) Water	Yellow	Black	Non-Potable Water
Sanitary Waste	Green	White	Sanitary Drain
Sanitary Vent	Green	White	Sanitary Vent
FOG Waste	Green	White	FOG Drain
Storm Drain	Green	White	Storm Drain

Natural Gas	Yellow	Black	Natural Gas
Natural Gas - 5 psig	Yellow	Black	Natural Gas 5 PSIG

NOTE: “Storm Drain” includes Primary and Secondary (Emergency) Drain piping inclusively.

3.4 VALVE TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves with captions similar to those indicated in the following:

VALVE TAG SCHEDULE	
Type of Service	Valve Tag Designation
Domestic Cold Water	DCW
Domestic Cold Water - 100 psig	DCW100
Domestic Hot Water	DHW
Domestic Hot Water Return	DHWR
140 Degree F Water	140
140 Degree F Water Return	140R
Non-Potable (Irrigation) Water	NPW
Natural Gas	GAS
Natural Gas - 5 psig	GAS5

3.5 VALVE SCHEDULE INSTALLATION

A. Mount valve schedule on wall in accessible location where directed by Owner or his Duly Authorized Representative. Provide aluminum frame with plexiglass cover for valve chart.

3.6 WARNING TAG INSTALLATION

A. Write required message on and attach warning tags to equipment and other items where required with beaded brass chain.

3.7 ADJUSTING

A. Relocate Plumbing identification materials and devices that have become visually blocked by other work. Stencils, name tags, etc. must be readable from a standing position.

B. When arrows and letters cannot be stenciled on pipe, stencil identification on 16-gauge aluminum metal panels in correct color and hang panel on piping with key chains.

3.8 CLEANING

A. Clean faces of Plumbing identification devices and glass and frames of valve schedules.

END OF SECTION

SECTION 220700 - INSULATION FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The General Conditions, Special Conditions and Division 1 through Division 32 as set forth in these specifications are hereby incorporated into and shall become a part of the specifications for work under this Section.

1.2 SUMMARY

A. This Section includes pre-formed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

1.3 SUBMITTALS

A. Product Data: Identify thermal conductivity, thickness and jackets (both factory and field applied, if any) for each type of product indicated.

B. Shop Drawings: Show fabrication and installation details for the following:
   1. Application of protective shields, saddles and inserts at pipe hangers for each type of insulation and hanger.
   2. Insulation application at elbows, fittings, flanges, valves and specialties for each type of insulation.
   3. Removable insulation at piping specialties and equipment connections.
   4. Application of field-applied jackets.

1.4 QUALITY ASSURANCE

A. Installer: Company specializing in performing work of this Section with minimum three years documented experience.

B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
   1. Insulation Installed Indoors: Flame-spread rating of 25 or less; and smoke-developed rating of 50 or less.
   2. Insulation installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. ASHRAE Standards: Comply with performance efficiencies prescribed for ASHRAE 90.1,

"Energy Efficient Design for New Buildings, Except Low Rise Residential Buildings" for pipe insulation.

D. No damaged or water-soaked insulation shall be used.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers and insulation shields.

B. Coordinate clearance requirements with piping installer for insulation application.

1.7 SCHEDULING

A. Schedule insulation application after testing piping systems. Insulation application may begin on segments of piping that have satisfactory test results.

B. Complete insulation and concealment of all plastic materials as rapidly as possible in each area of construction.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.
   1. Glass Fiber Insulation:
      a. CertainTeed Manson.
      b. Johns Manville.
      c. Knauf Fiberglass GmbH.
      d. Owens-Corning Fiberglass Corp.
   2. Flexible Elastomeric/Cellular Foam Insulation:
      a. Armstrong Model AP.
      b. Halsted Mitchell.
      c. Rubatex.
   3. Elastomeric Foam Adhesive:
      a. Armstrong 520.
      b. Foster.
      c. Halstead 950.

d. Rubatex R-373.
4. Mineral-Fiber, Preformed Pipe Insulation:
a. CertainTeed Manson.
b. Johns Manville.
c. Knauf Fiberglass GmbH.
d. Owens-Corning Fiberglass Corp.

B. Unless noted otherwise, none of the manufacturers listed for products under this Section shall be considered as Basis-of-Design.

2.2 INSULATION MATERIALS

A. Glass Fiber Insulation w/ ASA jacket: Glass fibers bonded with a thermosetting resin complying with the following:
1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
2. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:
a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
3. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
4. Glass Fiber Insulating Cements: Comply with ASTM C 195.
5. Glass Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

B. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials rated 25/50 fire smoke spread. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
1. Adhesive: As recommended by insulation material manufacturer.

C. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in performing insulation to cover valves.

D. Mineral-Fiber, Pre-Formed Pipe Insulation: Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

E. Cellular Foam Insulation
1. ASTM C534; flexible, cellular elastomeric, molded or sheet
1. 'K' Value: ASTM C177 or C518; 0.28 at 75 degrees F.
b. Minimum Service Temperature: -40 degrees F.
c. Maximum Service Temperature: 220.
d. Maximum Moisture Absorption: ASTM D1056; 1.0 percent (pipe) by volume, 1.0 percent (sheet) by volume.
e. Moisture Vapor Transmission: ASTM E96; 0.20 perm inches.

f. Maximum Flame Spread: ASTM E84; 25.
g. Maximum Smoke Developed: ASTM E84; 50.
h. Connection: Waterproof vapor barrier adhesive.

2. Elastomeric foam adhesive: Air dried, contact adhesive, compatible with insulation.

2.3 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perm when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
5. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

2.4 FIELD-APPLIED JACKETS.

A. General: ASTM C 921, Type 1, unless otherwise indicated.

B. Standard PVC Fitting Covers for all interior insulated fittings: Factory-fabricated fitting covers manufactured from 20-mil thick, high-impact, ultraviolet-resistant PVC.
1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps and mechanical joints.
2. Cover fittings with insulation prior to fitting cover installation.
3. Adhesive: As recommended by insulation material manufacturer.
4. Rated for 25/50 fire smoke spread if used in return air ceiling plenums.

C. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to indicated sizes for all exterior insulation. Comply with ASTM B 209, 3003 alloy, H-14 temper.
1. Finish and Thickness: Stucco-embossed finish, 0.020-inch thick.
2. Cover fittings with insulation prior to fitting cover installation
3. Moisture Barrier: 1-mil thick, heat-bonded polyethylene and kraft paper.
4. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish and thickness as jacket.

D. Glass Cloth Covering: Self-adhesive, mastic impregnated, rewettable cloth on exposed insulation and fittings in all occupied areas.
1. Thickness: 0.028 inches
2. Maximum Service Temperature: 450 degrees F.
3. Density: 14.3 oz/sq yd
4. Surface Burning Characteristic: 25/50 per ASTM E84

2.5 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Width: 3 inches.
   2. Thickness: 11.5 mils.
   3. Adhesion: 90 ounces force/inch in width.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch in width.
   6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. SK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Width: 3 inches.
   2. Thickness: 6.5 mils.
   3. Adhesion: 90 ounces force/inch in width.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch in width.
   6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
   1. Width: 2 inches.
   2. Thickness: 6 mils.
   3. Adhesion: 64 ounces force/inch in width.
   4. Elongation: 500 percent.
   5. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
   1. Width: 2 inches.
   2. Thickness: 3.7 mils.
   3. Adhesion: 100 ounces force/inch in width.
   4. Elongation: 5 percent.
   5. Tensile Strength: 34 lbf/inch in width.

2.6 SECUREMENTS

A. Bands:
   1. Stainless Steel: ASTM A 167 or ASTM A 240, Type 304; 0.015-inch thick, 1/2-inch wide with wing seal.
   2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020-inch thick, 1/2-inch wide with wing seal.

B. Insulation Pins and Hangers:
   1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
      a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030-inch thick by 2 inches square.
      b. Spindle: Aluminum or Stainless steel, fully annealed, 0.106-inch-diameter shank,

length to suit depth of insulation indicated.

c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

2. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
   a. Baseplate: Galvanized carbon-steel sheet, 0.030-inch thick by 2 inches square.
   b. Spindle: Aluminum or Stainless steel], fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
   c. Adhesive-backed base with a peel-off protective cover.
3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, aluminum or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

2.7 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040-inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024-inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
   1. Verify that systems and equipment to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.
   1. Carbon Steel: Coat carbon steel operating at a service temperature between 32- and 300-degrees F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves and specialties.

B. Refer to schedules at the end of this Section for materials, forms, jackets and thicknesses required for each piping system.

C. Install accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.

E. Apply multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

H. Keep insulation materials dry during application and finishing. Should insulating materials become wet during application and finishing, they shall be removed, discarded and replaced with new material at the Contractor’s expense.

I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

J. Apply insulation with the least number of joints practical.

K. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

L. Hangers and Anchors:
1. Apply insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support and shield.

M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.

O. Apply insulation with integral jackets as follows:
1. Pull jacket tight and smooth.
2. Circumferential Joints: Cover with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.
3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
   a. EXCEPTION: Do not staple longitudinal laps on insulation having a vapor retarder.
4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.

P. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.

Q. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.

R. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions. Firestopping and fire-resistive joint sealers are specified in Division 7 Section "Fire Stopping."

S. Floor Penetrations: Apply insulation continuously through floor assembly. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor

retarder.

3.4 GLASS FIBER INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:
   1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
   2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet to form a vapor retarder between pipe insulation segments.
   3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches on center.
   4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
   5. All exposed ends for mineral fiber insulation shall be neatly trimmed and beveled. All exposed insulation material shall be covered with mastic.

B. Apply insulation to flanges as follows:
   1. Apply preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
   4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch and seal joints with vapor-retarder mastic.

C. Apply insulation to fittings and elbows as follows:
   1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions and cover with insulating cement troweled smooth.
   2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with tape and cover with insulating cement troweled smooth.
   3. Cover fittings with standard PVC fitting covers.

D. Apply insulation to valves and specialties as follows:
   1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
   2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.

3.5 GLASS FIBER INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:
   1. Secure each layer of insulation to pipe with wire, tape, or bands without deforming insulation materials.
   2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic.
   3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
   4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
   5. All exposed ends for cellular-glass insulation shall be neatly trimmed and beveled. All exposed insulation material shall be covered with mastic.

3.6 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and applicable insulation joint sealant.
   3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
   4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
   4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
   3. Arrange insulation to permit access to packing and to allow valve operation without

disturbing insulation.

4. Install insulation to flanges as specified for flange insulation application.

3.6 FIELD-APPLIED JACKET APPLICATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
   1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

B. Apply aluminum metal jacket for all exterior water piping, with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal joints with weatherproof sealant recommended by insulation cover manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

C. Glass Cloth Covering: Self-adhesive, mastic impregnated, rewettable cloth on exposed insulated pipe and fitting covering in all occupied areas.

D. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to pipe sizes on insulated pipe and fitting covering in all exterior exposed areas.

3.7 INTERIOR PIPING INSULATION SCHEDULES

A. Piping Systems, materials and thicknesses are specified in Schedules within this section.

B. Items Not Insulated: Unless indicated otherwise, do not apply insulation to the following systems, materials and equipment:
   1. Below-grade piping.
   2. Chrome-plated piping and fittings, unless potential for personnel injury.
   3. Valves and specialties.
   4. Flexible connectors and vibration-control devices.
   5. Fire-suppression piping.

C. Minimum Insulation Thickness for Interior Piping Systems and Pipe Sizes

GLASS FIBER INSULATION SCHEDULE			
Piping System	Fluid Temperature	Pipe sizes	
		1½” or Less	2” or More
Domestic Cold Water	All	½”	1”
Domestic Hot Water	All	½”	1”
Tempered Water	All	½”	1”
140 Degree F Water	140 Degrees F	½”	1”
Landscape Irrigation Supply Loop and Related Branches	All	½”	1”
Exposed Floor Drain Traps and Piping 10 Feet Downstream	All	N/A	1”
Horizontal FOG Drains and Traps (Above Grade)	All	½”	1”

NOTE:

1. The minimum listed thickness is based on a minimum R valve of 4.6. The thickness may vary if the insulation R value is different than 4.6. The minimum thickness shall be increased as required to meet ASHRAE 90.1-Table 6.8.3.
2. For all piping provided with electric heat trace, the insulation thicknesses listed above shall be increased by a factor of 2. Coordinate locations with Electrical Contractor.

UNICELLULAR FOAM INSULATION SCHEDULE			
Piping System	Fluid Temperature	Pipe Sizes	Thickness
Domestic Cold Water	All	All	½”
Domestic Hot Water	All	All	½”
140 Degree F Water	140 Degrees F	All	½”
Individual Plumbing Fixture Run-outs	All	All	½”
Landscape Irrigation Supply Loop and Related Branches	All	All	½”

NOTE:

1. The above Schedules includes Supply and Return piping where applicable.
2. For all piping provided with electric heat trace, the insulation thickness listed above shall be increased by a factor of 2. Coordinate locations with Electrical Contractor.

D. Insulation at fire walls: All insulated piping penetrating walls with a fire resistive rating shall be insulated with molded foamglass; ASJ-SSL covering with a dual purpose fireproof, kraft aluminum foil, laminated white jacket. Insulation to be of same thickness as adjoining insulation.

3.8 EXTERIOR PIPING INSULATION SCHEDULE

A. Exterior Domestic Water Piping and all Horizontal Sanitary Waste and Storm Drain Piping:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Cellular Glass: 2 inches thick.
      b. Flexible Elastomeric: 2 inches thick.
      c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

3.9 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Outdoor Exposed Piping:
   1. PVC: 20 mils thick.
   2. Painted Aluminum, Smooth or Corrugated with Z-Shaped Locking Seam: 0.016 inch thick.
   3. Stainless Steel, Type 304, Smooth 2B Finish or Corrugated with Z-Shaped Locking Seam: 0.010 inch thick.

3.10 PIPE INSULATING SUPPORT

A. On insulated piping with pipe supports around outside of covering provide galvanized steel formed bearing plates. Plates to be lined with length of foam glass insulation.
   1. 8" and smaller pipe: 12" long, 12-gauge plate
   2. 10" and larger pipe: 24" long, 10-gauge plate

3.11 FIELD QUALITY CONTROL

A. Insulation applications will be considered defective if sample inspection reveals noncompliance with requirements. Remove defective Work and replace with new materials according to these Specifications.

END OF SECTION

SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes water-distribution piping and related components outside the building for water service, fire-service mains, and combined water service and fire-service mains.

1.3 DEFINITIONS

A. DIP: Ductile Iron Pipe, Class 54 unless otherwise indicated

B. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of pipe, fitting, and/or appurtenance indicated.

B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, components, and certification that vault and appurtenances conform to City of Hagerstown DPW specifications and standard details.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Material and Installation Specifications: City of Hagerstown Department of Public Works, Utilities Division, Standards and Specifications for Construction and Materials, latest edition, as amended to date and Standard Details for Construction, latest edition, as amended to date, collectively referred to as City of Hagerstown DPW. Delete references to “Measurement and Payment’.

B. Regulatory requirements
   1. Comply with specifications of City of Hagerstown DPW for potable-water-service piping, including materials, installation, testing, and disinfection.

2. Comply with standard details and specifications of City of Hagerstown DPW for fire-suppression water main piping, including the hydrants, hose threads, installation, and testing.
3. Comply with City of Hagerstown Plumbing Code, as amended to date.

C. Piping materials shall bear label, stamp, or other markings of specified testing agency.

D. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

F. NSF Compliance: Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.9 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
1. Notify Owner no fewer than ten days in advance of proposed interruption of service.
2. Do not proceed with interruption of water-distribution service without Owner's written permission.

1.10 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Available Products: All products shall be in accordance with referenced City of Hagerstown DPW.

2.2 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
   1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
   2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
   1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
   2. Gaskets: AWWA C111, rubber.

C. Flanges: ASME 16.1, Class 125, cast iron.

D. All pipe shall be Class 54.

2.3 SPECIAL PIPE FITTINGS

A. Ductile-Iron Rigid Expansion Joints: in accordance with referenced City of Hagerstown DPW

B. Ductile-Iron Flexible Expansion Joints: in accordance with referenced City of Hagerstown DPW

C. Ductile-Iron Deflection Fittings: in accordance with referenced City of Hagerstown DPW

2.4 JOINING MATERIALS

A. Refer to Section 33 0500 "Common Work Results for Utilities" for commonly used joining materials.

B. Brazing Filler Metals: AWS A5.8, BCuP Series.

2.5 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Tubular-Sleeve Pipe Couplings: in accordance with referenced City of Hagerstown DPW

C. Split-Sleeve Pipe Couplings: in accordance with referenced City of Hagerstown DPW

D. Flexible Connectors: in accordance with referenced City of Hagerstown DPW

E. Dielectric Fittings: in accordance with referenced City of Hagerstown DPW

2.6 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:
   1. Available Manufacturers: Subject to compliance City of Hagerstown DPW, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. American AVK Co.; Valves & Fittings Div.
      b. American Cast Iron Pipe Co.
      c. Crane Co.; Crane Valve Group; Stockham Div.
      d. McWane, Inc.; Tyler Pipe Div.; Utilities Div.
      e. Mueller Co.; Water Products Div.
      f. NIBCO INC.
      g. U.S. Pipe and Foundry Company.
   2. Nonrising-Stem, Resilient-Seated Gate Valves:
      a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
         1) Standard: AWWA C509.
         2) Minimum Pressure Rating: 250 psig.
         3) End Connections: Mechanical joint.
         4) 2” square operating nut – clockwise to open
         5) Interior Coating: Complying with AWWA C550.

2.7 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:
   1. Available Manufacturers: Subject to compliance City of Hagerstown DPW, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
      b. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
      c. McWane, Inc.; Kennedy Valve Div.
      d. McWane, Inc.; M & H Valve Company Div.
      e. Mueller Co.; Water Products Div.
      f. U.S. Pipe and Foundry Company.
   2. Description: Sleeve and valve compatible with drilling machine.
      a. Standard: MSS SP-60.
      b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
      c. Valve: AWWA, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.

B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.
   1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.8 BACKFLOW PREVENTER

A. ASEE 1013 reduced pressure principle backflow preventer complying with AWWA C-511-92. Include shutoff valves on inlet and outlet, and strainer on inlet; test cocks; and pressure-differential relief valve with ASME A112.2 air-gap finning located between two positive check valves.

B. Lead free bronze body material certified compliant with the Safe Water Drinking Act requirements for low lead in potable water

C. Pressure rating: 175 psi

D. Temperature range: 33 degrees to 140 degrees F

E. Watts Model LF909M1-QT or approved equal

2.9 FIRE HYDRANTS

A. Fire Hydrants shall be in accordance with City of Hagerstown DPW specifications and standard details.

2.10 FROST-PROOF YARD HYDRANTS

A. Lockable lever-type, adjustable flow setting, 4’ bury, galvanized steel riser; Woodford Y34-4 or approved equal.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Section 31 2000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

C. Do not use flanges or unions for underground piping.

D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

E. Underground Fire-Service-Main Piping NPS 4 to NPS 12 shall be the following:
1. Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.

F. Underground Combined Water-Service and Fire-Service-Main Piping NPS 6 to NPS 12 shall be the following:
1. Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

A. See Section 33 0500 "Common Work Results for Utilities" for piping-system common requirements.

3.4 PIPING INSTALLATION

A. Water-Main Connection: Tap water main according to requirements City of Hagerstown DPW and of size and in location indicated.

B. Make connections larger than NPS 2 with tapping machine according to the following:

1. Install tapping sleeve and tapping valve according to MSS SP-60.
2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.

C. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

D. Bury piping with depth of cover over top at least 48 inches.

E. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

F. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

G. Sleeves are specified in Section 22 0517 "Sleeves and Sleeve Seals for Plumbing Piping."

H. Mechanical sleeve seals are specified in Section 22 0517 "Sleeves and Sleeve Seals for Plumbing Piping."

I. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports in accordance with City of Hagerstown DPW specifications and standard details.

J. See Section 21 1200 "Fire-Suppression Standpipes," Section 21 1313 "Wet-Pipe Sprinkler Systems," and Section 21 1316 "Dry-Pipe Sprinkler Systems" for fire-suppression-water piping inside the building.

K. See Section 22 1116 "Domestic Water Piping" for potable-water piping inside the building.

3.5 JOINT CONSTRUCTION

A. See Section 33 0500 "Common Work Results for Utilities" for basic piping joint construction.

B. Make pipe joints according to the following:
1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
3. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
   a. Dielectric Fittings for NPS 4 and Larger: Use dielectric flange kits.

3.6 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
1. Concrete thrust blocks.
2. Locking mechanical joints.
3. Set-screw mechanical retainer glands.
4. Bolted flanged joints.
5. Pipe clamps and tie rods.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
2. Fire-Service-Main Piping: According to NFPA 24.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.7 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.

C. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

3.8 FIRE HYDRANT INSTALLATION

A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.

B. Installation shall be in accordance with City of Hagerstown DPW specifications and standard details

3.9 CONNECTIONS

A. See Section 33 0500 "Common Work Results for Utilities" for piping connections to valves and equipment.

B. Connect water-distribution piping to existing water main. Use tapping sleeve and tapping valve.

C. Connect water-distribution piping to interior domestic water and fire-suppression piping.

D. Ground equipment according to Section 26 0526 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

3.10 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests per City of Hagerstown DPW specifications before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: in accordance with City of Hagerstown DPW specifications

C. Prepare reports of testing activities.

3.11 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 31 2000 "Earth Moving."

3.12 CLEANING

A. Clean and disinfect water-distribution piping in accordance with City of Hagerstown DPW specifications.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 as set forth in these Specifications are hereby incorporated into and shall become a part of this Section.

1.2 SUMMARY

A. Provide piping to fixtures and equipment, complete with (but not limited to) all necessary fittings and trim, for the following Systems:
   1. Domestic Cold Water
   2. Domestic Hot Water (Supply and Return)
   3. As used in this Section, the terms “Domestic Water” and “Domestic Hot Water” shall also refer to 140 Degree F Water Systems inclusively unless noted otherwise.

B. Provide make-up water to Mechanical Equipment. Service(s) shall consist of ball valves, strainer, (reduced pressure) backflow preventer and capped connection by this Contractor. Additional piping, fittings, accessories and final connection(s) shall be by the Mechanical Contractor.

C. Provide Domestic Water service to the Playing Field Irrigation System(s). Service(s) shall consist of ball valves, TAB (deduct) water meter, strainer, reduced pressure backflow preventer and capped connection by this Contractor. Additional piping, fittings, accessories and final connection(s) shall be by the designated Landscape Irrigation Contractor.

D. Make connections to the following complete with, but not necessarily limited to, all rough-in, final connections, fittings, trim and accessories required for a fully-functioning installation:
   1. All Kitchen Equipment as specified by the Food Service Consultant.
   2. All Commercial Laundry Equipment as specified by the Laundry Equipment Consultant.
   3. All Owner-furnished Fixtures and Equipment.

E. Clean and sterilize complete Domestic Water System.

F. See the following Specification Sections for additional Domestic Water Piping requirements:
   1. Section 22 05 23 “General Duty Valves for Plumbing Piping” for Domestic Water System valves.
   2. Section 22 14 30 “Plumbing Specialties” for additional Domestic Water Piping specialties and accessories.

G. Unless indicated otherwise, none of the manufacturers listed for products under this Section shall be considered Basis-of-Design.

1.3 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing domestic water piping systems with 150-psig.

1.4 SUBMITTALS

A. Product Data: For piping, tubing, fittings and couplings.

B. Field quality-control test reports.

C. Operating and maintenance data.

D. Submit complete drain down written procedure and drain-down diagrams with the Operation and Maintenance Manuals.
   1. Diagrams shall indicate each valve, and its location, used for facility drain down. Diagram shall be based on installed condition.
   2. The written procedure shall reference the diagrams and include dedicated procedures for:
      a. Main Concourse
      b. Suite Levels
      c. Press Levels
      d. Locker Level
      e. West Tower
      f. Complete Facility

1.5 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacturer of piping products of types, materials and sizes required, whose products have been in satisfactory use in similar service for not less than 5-years.

B. Piping materials shall bear label, stamp or other markings of specified testing agency.

C. NSF Compliance:
   1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
   2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

D. Codes and Standards: Comply with all applicable codes, rules, regulations and/or standards (edition in force; complete with all interim agreements and local amendments in effect) pertaining to products, materials and/or installation of Domestic Water Systems as follows:
   1. Authority Having Jurisdiction (AHJ)
   2. ANSI International (ANSI)
   3. American Society of Mechanical Engineers (ASME)
   4. American Society of Plumbing Engineers (ASPE)
   5. American Society of Sanitary Engineers (ASSE)
   6. ASTM International (ASTM)
   7. American Water Works Association (AWWA)
   8. International Association of Plumbing and Mechanical Officials (IAPMO)
   9. NSF International (NSF)
   10. Plumbing and Drainage Institute (PDI)
   11. State of Ohio
      a. Ohio Building Code (OBC)
      b. Ohio Plumbing Code (OPC)
   12. Owner’s construction and/or material standards
   13. Other applicable codes, requirements, rules or regulations of bodies lawfully empowered and having jurisdiction over this project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements provide products by one (1) of the manufacturers specified.
   2. Unless noted otherwise, none of the manufacturers listed for products under this Section shall be considered Basis-of-Design.

2.2 DOMESTIC WATER SERVICE PIPING, BELOW GRADE

A. General: Provide piping and fittings in accordance with the Authority Having Jurisdiction from 5-feet beyond the building envelope to 6-inches above finish floor. If the Authority Having Jurisdiction has no applicable standard, the Contractor shall install Domestic Water Service Piping from one of the following:

B. CPVC Plastic Pipe and Tubing:
   1. Manufacturer: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.
      1. Charlotte Pipe
      2. Crestline
      3. J-M Eagle
      4. Spears
   2. Pipe and Tubing: Schedule 80 CPVC conforming to ASTM D2486, ASTM F441 or ASTM F442.
   3. Fittings: Schedule 80 CPVC conforming to ASSE 1061, ASTM D2846, ASTM F437, ASTM F438 or ASTM F439 or ASME B16.29, pressure type.

C. Ductile Iron Piping
   1. Manufacturer: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.
      1. AB&I Foundry
      2. Charlotte Pipe
      3. McWane
      4. U.S. Pipe
   2. Piping: Ductile iron, cement mortar lined in accordance with AWWA C104, conforming to AWWA C151/A21.51, AWWA C115/A21.15.
   3. Fittings: Ductile or gray iron conforming to ASTM F1476, ASTM F1548, AWWA C110/A21.10, AWWA C153/A21.53.

2.3 DOMESTIC WATER DISTRIBUTION PIPING, BELOW GRADE

A. Copper or Copper-Alloy Tubing:
   1. Tubing: Conforming to ASTM B75, ASTM B88 or ASTM B251 or ASTM B447; Type K.
   2. Fittings: Cast copper alloy or wrought copper and bronze conforming to ASME B16.15, ASME B16.18, ASME B16.22, ASME B16.23, ASME B16.26 or ASME B16.29, brazed joint, pressure type
   3. Copper or copper-alloy tubing installed below grade shall be encased in ½-inch flexible unicellular insulation to a minimum 1-inch above finish floor slab.

B. CPVC Plastic Pipe and Tubing:
   1. Manufacturer: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.
      1. Charlotte Pipe
      2. Crestline
      3. J-M Eagle
      4. Spears
   2. Pipe and Tubing: Schedule 80 conforming to ASTM D2486, ASTM F441 or ASTM F442.
   3. Fittings: Schedule 80 CPVC conforming to ASSE 1061, ASTM D2846, ASTM F437, ASTM F438 or ASTM F439 or ASME B16.29, pressure type.

2.4 DOMESTIC WATER DISTRIBUTION PIPING, ABOVE GRADE

A. Copper or Copper-Alloy Tubing:
   1. Tubing: Conforming to ASTM B75, ASTM B88 or ASTM B251 or ASTM B447; Type L (for sizes 4-inches and smaller).
   2. Fittings: Cast copper alloy or wrought copper and bronze conforming to ASME B16.15, ASME B16.18, ASME B16.22, ASME B16.23, ASME B16.26 or ASME B16.29, pressure type.

E. B. CPVC Plastic Pipe and Tubing (for all Landscape Irrigation Piping):
   1. Manufacturer: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.
      1. Charlotte Pipe
      2. Crestline
      3. J-M Eagle
      4. Spears
   2. Pipe and Tubing: Schedule 80 CPVC conforming to ASTM D2486, ASTM F441 or ASTM F442.
   3. Fittings: Schedule 80 CPVC conforming to ASSE 1061, ASTM D2846, ASTM F437, ASTM F438 or ASTM F439 or ASME B16.29, pressure type.

C. PEX Piping System (for all in-wall domestic water piping/headers 2-inches and smaller):
   1. Summary: Domestic hot and cold water piping system, crosslinked polyethylene piping and including the following:
      a. Crosslinked polyethylene (PEX) piping.
      b. Distribution manifold(s) with balancing and flow control valves where required.
      c. Cold-expansion fittings.
      d. Pipe fasteners as approved by the manufacturer of the PEX piping.
      e. Listing of Flame Spread Index and Smoke Developed Index to ASTM E 84, minimum of 25 fire /50 smoke spread. Encase with ½-inch glass fiber or 1/2-inch flexible unicellular insulation as required by the manufacturer's listing.
   2. Piping:
      a. All pipe shall be high-density crosslinked polyethylene manufactured using the high-pressure peroxide method of crosslinking (PEXa). Pipe shall conform to ASTM F876, ASTM F877 CSA B137.5, NSF/ANSI 14 and NSF/ANSI 61.
      b. Supplier shall provide pipe in sizes 3/8-inch through 2-inches.
      c. Pipe shall be rated for continuous operation of 100-psig pressure at 180 degrees F temperature and 80-psig pressure at 200 degrees F temperature.
      d. Pipe shall be certified by PPI to standard TR-3, with applicable plumbing code certifications.

e. Pipe to be manufactured using a high-pressure peroxide method with a minimum degree of crosslinking of 70-percent to 89-percent when tested in accordance with ASTM D2765, Method B.
f. Pipe to be tested for resistance to hot chlorinated water in accordance with ASTM F2023. Pipe to have a minimum extrapolated time-to-failure of 50-years, calculated in accordance with section 13.3 of F2023 and listed as “3306” per the ASTM F876 standard.
g. When required, PEX pipe to have a co-extruded red, white or blue UV shield made from UV-resistant polyethylene providing a minimum UV resistance of six months when tested according to ASTM F2657.
h. Pipe to be manufactured in an ISO 9001 certified production facility.
i. Pipe to have a Flame Spread Index and a Smoke Developed Index listing to ASTM E84.

3. Fittings:
   a. All fittings used with crosslinked polyethylene (PEX) water distribution pipe intended for plumbing applications shall be certified to the respective fitting standard listed in Section 1.02B.
   b. All fittings shall be third-party certified to applicable standards ASSE 1061, ASTM BF877, ASTM F1807, ASTM F1960, ASTM F2080, ASTM F2908, ASTM F2519, ASTM F2434 or ASTM F2735 and approved for use on the manufacturer’s PEX piping system.
4. Markings: Pipe shall carry the following markings every three (3) feet: Manufacturer’s name or trademark, nominal size, PEX 3306 (material designation) SDR9 (standard dimension ratio), ASTM F876/F877, F2080, NSF-pw, UP Code, 160 psi @ 73.4 degrees F / 100 psi @ 18 degrees F / 80 psi @ 200 degrees F, POTABLE TUBING, manufacturing date and footage mark.
5. Packaging: Straight lengths shall be packed in plastic bags.

F. Stainless Steel Piping
1. Potable-water piping and components shall comply with NSF 61 Annex G.
2. Piping: Stainless steel pipe, Type 304/304L, ASTM A312 or A778.
3. Fittings:
   a. Stainless steel fittings, Type 304/304L, ASTM A312, A778, F1476 or A1548.
   b. Fittings for Grooved-End, Stainless-Steel Pipe: Stainless-steel casting with dimensions matching stainless-steel pipe.
   c. Mechanical Couplings for Grooved-End, Stainless-Steel Pipe:
      i. AWWA C606 for stainless-steel-pipe dimensions.
      ii. Stainless-steel housing sections.
      iii. Stainless-steel bolts and nuts.
      iv. EPDM-rubber gaskets suitable for hot and cold water.
      v. Minimum Pressure Rating: NPS 8 and Smaller: 600 psig.

2.5 FLANGES, UNIONS AND COUPLINGS

A. Ferrous Piping:
1. Size 2-inches and under: 150-psig malleable iron threaded unions.
2. Size Over 2-inches: 150-psig forged steel slip-on flanges; 1/16-inch thick preformed neoprene gaskets.

B. Dielectric Connections:
1. Copper or copper-alloy tubing to galvanized steel pipe: Joints between copper or copper-alloy tubing and galvanized steel pipe shall be made with a brass fitting or dielectric fitting

or a dielectric union conforming to ASSE 1079. The copper tubing shall be soldered to the fitting in an approved manner, and the fitting shall be screwed to the threaded pipe.

2. Plastic pipe or tubing to other piping material: Joints between different grades of plastic pipe or between plastic pipe and other piping material shall be made with an approved adapter fitting.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Excavating, trenching, and backfilling are specified in Division 31.

B. Flanges may be used on above grade piping, unless indicated otherwise.

3.2 PIPING INSTALLATION

A. Provide piping materials as listed in Part 2 of this Specification Section.

B. Install copper tubing located beneath finished floor slab according to Copper Development Association's "Copper Tube Handbook."

C. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight.

D. Install shutoff valve, hose-end drain valve, strainer, (reduced pressure) backflow preventer and pressure gage inside the building at each Domestic Water Service entrance. Install all valves in accessible locations. Coordinate size and location of access panels with the Architect.

E. Install Domestic Water Piping level.

F. Rough-in Domestic Water Piping for building water meter installation according to the Water Purveyor's requirements.

G. Where Domestic Water lines are located in outside walls, install piping so that the wall insulation is between the piping and the outside wall.

H. Coordinate installation height of faucets, hose bibbs and wall hydrants with the Architect and the Owner.

I. Unless otherwise noted, install shock absorbers at the end of each main Domestic Cold Water branch and at the end of all Domestic Cold Water branches supplying water closets and/or urinals complete with access panel. Coordinate size and location with the Architect.

J. Install dielectric unions between piping of dissimilar metals.

K. Install a union between valves and final connections to all items of equipment.

L. All soldering shall be done with propane torch. The use of Oxy-Acetylene is PROHIBITED.

M. Nipples shall be of the material as the pipe with which they are used.

N. Install a check valve on all Domestic Water Piping supplying mixing valves (if not provided with integral check stops), janitor sink faucets and kitchen sink faucets (if provided with a spray valve).

O. Place plugs in ends of uncompleted piping at end of day and when work stops.

P. All pipes to be protected from debris entry.

3.3 PEX PIPING INSTALLATION

A. Install in accordance with manufacturer's published installation manual and/or technical guidelines and final drawings. Technical guidelines are the most current and applicable versions of all the technical literature, including but not limited to technical manuals, installation guides, technical bulletins, training presentations and submittals.

B. Route piping in an orderly manner, according to layout and spacing shown in final drawings. All installation notes shown on the drawings shall be followed.

C. At connections and fittings, use a plastic pipe cutter to ensure square (90-degrees) and clean cuts, and join pipes immediately or cap ends of pipe to seal from contaminants.

D. Piping that passes through expansion joints or walls shall be covered in protective polyethylene convoluted sleeving (flexible conduit) extending 15-inches on each side of the joint. Sleeving shall be secured on pipe to prevent movement during installation.

E. Where piping enters or exits a wall, a protective conduit shall be placed around the pipe, with the conduit extending a minimum of six (6) inches into the wall and exiting by a minimum of six (6) inches. For penetrations at manifolds, use rigid PVC bend guides secured in place to prevent movement.

3.4 JOINT CONSTRUCTION

A. Copper Piping/Tubing:
   1. Flared joints: Flared joints shall be made by a tool designed for that operation and shall be used in conjunction with plumbing fixture supply stops ONLY.
   2. Soldered joints. Solder joints shall be made in accordance with the methods of ASTM B828. All cut tube ends shall be reamed to the full inside diameter of the tube end. All joint surfaces shall be cleaned. A flux conforming to ASTM B813 shall be applied. The joint shall be soldered with a solder conforming to ASTM B32. The joining of water supply piping shall be made with lead-free solders and fluxes. "Lead free" shall be defined as a chemical composition equal to or less than 0.2-percent lead.
   3. Press joints:
      a. Manufacturer: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.
         1) Viega ProPress (Basis-of-Design)
         2) Mueller Streamline PRS
         3) Nibco Press System
      b. Wrought copper press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS117 or ASME B16.51. Operating pressure shall be a maximum of 200-psig CWP. Operating temperature range shall be -20 degrees F to 250 degrees F. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an

alternative supplied by fitting manufacturer. Press ends of the fittings shall incorporate a feature to assure leakage of liquids from inside the system past the sealing element of an unpressed connection in 1/2-inch to 4-inch pipe sizes.

c. The Contractor and his tradesmen shall be fully trained by a Factory Representative on the proper installation techniques. On request by the Owner or the Engineer, the Contractor shall submit Factory-issued certifications that he and his tradesman have successfully passed this training.

B. CPVC Piping/Tubing: Solvent cemented. Surfaces shall be clean and free from moisture, and an approved primer shall be applied. Solvent cement, orange in color and conforming to ASTM F493, shall be applied to all joint surfaces. The joint shall be made while the cement is wet, and in accordance with ASTM D2846 or ASTM F493.
EXCEPTION: A primer is not required where all of the following conditions apply:
1. The solvent cement used is third-party certified as conforming to ASTM F493.
2. The solvent cement used is yellow in color.
3. The solvent cement is used ONLY for joining 1/2-inch through 2-inch diameter CPVC pipe and fittings.
4. The CPVC pipe and fittings are manufactured in accordance with ASTM D2846.

The Contractor and his tradesmen shall be fully trained by a Factory Representative on the proper installation techniques. On request by the Owner or the Engineer, the Contractor shall submit Factory-issued certifications that he and his tradesman have successfully passed this training.

C. Ductile Iron Piping: Shall comply with AWWA C111/A21.11 and shall be installed in accordance with the manufacturer’s instructions.

D. PEX Piping:
1. Flared joints: Flared joints for water pipe shall be made by a tool designed for that operation.
2. Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's instructions. Fittings for cross-linked polyethylene (PEX) plastic tubing shall comply with ASSE 1061, ASTM BF877, ASTM F1807, ASTM F1960, ASTM F2080, ASTM F2908, ASTM F2519, ASTM F2434 or ASTM F2735 and shall be installed in accordance with the manufacturer's instructions. PEX tubing shall be factory marked with the appropriate standards for the fittings that the PEX manufacturer specifies for use with the tubing.

E. Stainless Steel Piping:
1. Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer’s instructions.
2. Welded joints. All joint surfaces shall be cleaned. The joint shall be welded autogenously or with an approved filler metal as referenced in ASTM A312.
3. Grooved and shouldered mechanical joints. Grooved and shouldered mechanical joints shall comply with ASTM F 1476, shall be made with an approved elastomeric seal and shall be installed in accordance with the manufacturer’s instructions. Such joints shall be exposed or concealed.

3.5 HANGER AND SUPPORT INSTALLATION

A. Pipe hanger and support devices are specified in Division 230529 Section "Hangers and Supports for HVAC Piping and Equipment." Install the following:
1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, and Horizontal Piping Runs: According to the following:

a. 100-feet and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer Than 100-feet: MSS Type 43, adjustable roller hangers.

3. Multiple, Straight, Horizontal Piping Runs 100-feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one (1) size for double-rod hangers, to a minimum of 3/8".

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

COPPER PIPING/TUBING HANGER SCHEDULE			
NPS Pipe Size	Maximum Horizontal Spacing (feet)	Minimum Hanger Rod Size (inches)	Maximum Vertical Spacing (feet)
3/4 and Less	5	3/8	10
1 and 1-1/4	6	3/8	10
1-1/2 and 2	8	3/8	10
3 and 4	10	1/2	10
6 and Larger	10	3/4	10

E. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:

CPVC PIPING HANGER SCHEDULE			
NPS Pipe Size	Maximum Horizontal Spacing (feet)	Minimum Hanger Rod Size (inches)	Maximum Vertical Spacing (feet)
1 and Less	3	3/8	5
1-1/4 to 2	4	3/8	6
3	4	1/2	6
4	4	5/8	6

NOTE: Provide mid-story guides for sizes 2-inch and smaller.

F. Install vinyl-coated hangers for PEX piping with the following maximum spacing and minimum rod diameter:
1. Horizontal PEX Piping: 32-inches with 3/8-inch rod.
2. Vertical PEX Piping: 10-feet.

G. Install hangers for Stainless Steel piping with the following maximum spacing and minimum rod diameter:
1. Horizontal Stainless Steel Piping:
a. Sizes 2-inches and smaller: 10-feet with 3/8-inch rod.
b. Sizes 3- and 4-inches: 10-feet with 1/2-inch rod.
c. Sizes 6-inches and larger: 10-feet with 3/4-inch rod.
2. Vertical Stainless Steel Piping: 15-feet.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials. Extend and connect to the following:
   1. Domestic Water Heaters: Domestic Hot and Cold Water piping in sizes indicated, but not smaller than sizes of Domestic Water Heater connections.
   2. Plumbing Fixtures: Domestic Hot and Cold Water supply piping in sizes indicated, but not smaller than required by the Plumbing Code in-force.
   3. Equipment: Domestic Hot and Cold Water piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.7 FIELD QUALITY CONTROL

A. Inspect Domestic Water Piping as follows:
   1. Do not enclose, cover or put piping into operation until it has been inspected and approved by the Authority Having Jurisdiction.
   2. During installation, notify the Authority Having Jurisdiction at least 24-hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
      b. Final Inspection: Arrange final inspection for the Authority Having Jurisdiction to observe tests specified below and to ensure compliance with requirements.
   3. Reinspection: If the Authority Having Jurisdiction find that piping will not pass test or inspection, the Contractor shall make required corrections and arrange for reinspection at his expense.
   4. Reports: Prepare inspection reports and have them signed by the Authority Having Jurisdiction.

B. Test Domestic Water Piping as follows:
   1. Upon completion of a section of or the entire Domestic Water System, the system, or portion completed, shall be tested to verify the integrity of the system as prescribed by the Authority Having Jurisdiction or, in the absence of a prescribed method, the Ohio Plumbing Code or the method as described below.
      a. A water pressure test at not less than the working pressure under which the system is to be used shall be performed to prove the system watertight. This pressure shall be held for at least 15-minutes. The water utilized for tests shall be obtained from a potable source of supply.
      b. When permitted by the manufacturer of the piping, fittings, and solvent cement (if part of the plumbing system), an air test of not less than 50-psig shall be performed to prove the system airtight. This pressure shall be held for at least 15-minutes.
   2. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
   3. Prepare reports for tests and any required corrective action.

C. Drain-Down Provisions
   1. Piping at Main Concourse concession spaces and toilet rooms is to be drainable. Slope piping to hose bib to allow complete drain down. Provide isolation valves and additional hose bibbs as required to allow for drain down.
   2. Contractor to provide drain down service during construction. First season drain down after construction to be supervised by Plumbing Contractor. Provide instruction for drain down process to be performed by maintenance staff in following years.
   3. Include written procedures and diagrams in Operation and Maintenance Manuals.

3.8 ADJUSTING

A. Perform the following adjustments before operation:
   1. Close drain valves, hydrants and hose bibbs.
   2. Open shutoff valves to fully open position.
   3. Open throttling/balancing valves to proper setting.
   4. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
   5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
   6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
   7. Check plumbing specialties and verify proper settings, adjustments and operation.

3.9 STERILIZATION OF DOMESTIC WATER PIPING

A. After Domestic Water Piping is complete and fixtures have been installed, flush piping clean and sterilize all new hot and cold water piping. The sterilization shall be done by a Water Testing Laboratory regularly engaged in the service. All fees for testing and use of testing equipment shall be paid by this Contractor.

B. New potable water systems shall be purged of deleterious matter and disinfected prior to utilization. The method to be followed shall be that prescribed by the Authority Having Jurisdiction or, in the absence of a prescribed method, the procedure described in AWWA C651, AWWA C652 or the Ohio Plumbing Code (as described below). This requirement shall apply to “on-site” or “in-plant” fabrication of a system or to a modular portion of a system.
   1. The pipe system shall be flushed with clean, potable water until dirty water does not appear at the points of outlet.
   2. The system or part thereof shall be filled with a water/chlorine solution containing at least 50 parts per million of chlorine, and the system or part thereof shall be valved off and allowed to stand for 24-hours; or the system or part thereof shall be filled with a water/chlorine solution containing at least 200 parts per million of chlorine and allowed to stand for 3-hours.
   3. Following the required standing time, the system shall be flushed with clean potable water until the chlorine is purged from the system.
   4. The procedure shall be repeated where shown by a bacteriological examination that contamination remains present in the system.

C. After final flushing, all aerators shall be removed, cleaned and replaced.

D. Chlorination of the system may be performed at same time the pressure test is conducted.

E. Sterilization procedures shall be witnessed by the Architect, the Authority Having Jurisdiction and the Owner.

F. After sterilization of system is complete, provide the Owner with written certification from an outside testing agency certified in this manner of testing of sterility and confirmation that piping is clean and safe to transmit water for human consumption.

END OF SECTION

SECTION 22 11 23 - DOMESTIC WATER BOOSTER PUMP

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes multiplex, variable-speed booster pumps.

1.3 DEFINITIONS

A. PID: Proportional Integral Derivative.

B. VFC: Variable-frequency controller.

1.4 SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, and dimensions of individual components and profiles.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For booster pumps.
   1. Include plans, elevations, sections, and [**mounting**] [**attachment**] details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For domestic-water packaged booster pumps.
   1. Include design calculations for selecting vibration isolators.

D. Operation and Maintenance Data: For booster pumps to include in emergency, operation, and maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Retain protective coatings and flange's protective covers during storage.

1.6 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2: PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements provide products by one (1) of the manufacturers specified.
1. V-C Systems and Controls, Inc.
2. Armstrong Pumps, Inc.
3. Patterson Pump Company; a Gorman-Rupp Company
4. QuantumFlo, Inc.
5. Syncroflo, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

2.3 MULTIUPLEX, VARIABLE-SPEED BOOSTER PUMPS

A. Furnish and install Pacemaker Series/PMP model, 3VC-PMP-V-7.5-425-460, manufactured by VC Systems & Controls in Tampa, FL. The system shall be rated for a system capacity of 317 GPM at a system pressure of 78 PSI when supplied with a minimum suction pressure of 40 and a maximum suction pressure of 53. The entire system will be UL Listed and third party certified lead free. The system voltage will be 480, 60, 3 phase.

B. Pumps: Pumps shall be VC ES Series, close coupled end suction with ductile iron, 304 SS fitted, 304 stainless steel impeller and stainless steel trim & sleeve. Motor shall be a Baldor Premium Efficiency suitable for Inverter Duty. Motors shall be supplied with a 1.15 service factor. The impeller shall be warranted for 5 years from system manufacture date.

1. P1 – 6A2525-7.5 – 158 GPM at 99 TDH – 7.5 HP – 3500 RPM – 33% Each.

2. P2 – 6A2525-7.5 – 158 GPM at 99 TDH – 7.5 HP – 3500 RPM – 33% Each.

3. P3 – 6A2525-7.5 – 158 GPM at 99 TDH – 7.5 HP – 3500 RPM – 33% Each.

C. Pipe, Valves, Fittings, and Accessories: All pipes, valves, and fittings 2” and over shall be

flanged, full lug, or grooved design. The pump and discharge components shall be rated for the maximum working pressure of the system, shut off pressure plus maximum suction pressure.

1. Headers:

a. Manifold piping shall be 6” 304L stainless steel. Headers shall be double ended for flow in either direction. Connections shall be flanged or grooved. Headers shall be sized not to exceed 10 FPS velocity.

2. Suction Isolation Valves: Full lug butterfly valves with 316 stainless disc. Suitable for 250 PSI.

3. Discharge Isolation Valves: Class 150 - Full lug butterfly valves with 316 stainless disc. Suitable for 250 PSI. 4. Check Valves: Class 150 – Flanged CLA-VAL 81-12 non-slam epoxy coated ductile iron suitable for 240 PSI.

D. Control Panel: The control panel shall be UL508A listed for industrial control panels and of the same manufacturer of the pump system. All programming shall be written and supported by the pump system manufacturer. The controller can handle 1 to 9 pumps, in any combination of variable speed, jockey, across the line, or VFD/bypass controlled pumps and sequence them independently for the most efficient operation. The panel enclosure shall be powder coated steel, UL Type 4, and carry a NEMA 4 rating as an assembly.

6. Power Structure: Single Point Connection (A) - The control panel will have main disconnect with individual branch fuse blocks for single point connection. The entire panel as an assembly shall have a 5K IAC rating if fed from circuit breaker or 100K AIC if fed from fused disconnect.

7. Human Machine Interface: The HMI will be a full color 7” touch screen with USB input and allow for backing up parameters and downloading the event log and trend data. The HMI & software shall have the following features:

a. Meter Bar – Display of suction pressure, system pressure, PID speed, estimated flow, and alternation on ALL screens.

b. Status Bar – Displayed on the Home screen to show what the system is currently doing and display any active changes in operation.

c. Pump Status – Display for all pumps with run timers, run lights, and status indicator.

d. Alarm Bar – Display on ALL screens if any alarms are present.

e. X-Y Trend – Display an X-Y trend of suction pressure, discharge pressure, and PID speed for no less than 60 days and retained if power is lost.

f. Event Log – Display and date alarms, user log ins, and parameter changes for no less than 180 days and retained if power is lost.

g. Alternation – Automatic and manual alternation. Alternation available for all control types from 1 to 3 pumps in any combination of variable speed, constant speed, jockey, or VFD with bypass and sequence them in groups running the most efficient pumps first always.

h. Dynamic Speed Control – Automatic configuration of all operational settings based on the incoming suction pressure to eliminate hunting, over shoot, and improper operation based on in coming suction pressure fluctuations.

i. PLC & Transducer Failure Circuit – In the event of a PLC failure, or transducer failure, the system shall remain operational and automatically run at a default safe speed until repairs can be made.

j. Password Protection – All parameters and settings are password protected and has default levels of users with the ability to add more by the owner.

k. Sleep Mode – The system shall detect and shut the system down once no flow is confirmed.

l. ASHRAE 90.1 Compliant – The system is configured for either local or remote sensor. When using the local sensor, the system will automatically adjust for friction loss by increasing the set point pressure in relationship to the flow demand.

m. Pressure Recovery Mode – In the event of a power outage where system pressure

drops substantially, the system will soft start and slowly fill the building and bring up to pressure before activating the PID.

n. BAS Interfaces – The controller shall come with BACnet MSTP, BACnet IP, and Modbus RS485 interfaces and offer 30 individual data points. BACnet device profile shall be minimum of B-AAC. All BACnet configuration shall be available at the HMI, including selecting either IP or MSTP.

o. Remote Disable/Generator Interlock – The panel will come with two contacts. Remote disable will allow the BAS to disable the system from running. The generator interlock can be used to limit the number of pumps that can run when on emergency power.

p. Alarms

1) High System Alarm

2) Low System Alarm

3) Low System Pressure

4) Pump Failed to Start Alarm

5) Sensor Failure Alarm

6) Form C Dry Contact for Common Alarm

E. System Options:

1. Pressure Transducers – The system shall come with three, all 316 stainless steel, 420ma, pressure sensors and mounted on the (1) suction and (2) discharge header. The discharge sensors shall be completely redundant for operation and alarms. Discharge transducers can be mounted locally, remotely, or both if specified.

2. Thermal Relief Valve – Each pump shall have an individual stainless steel mechanical temperature relief valve. The valve shall modulate open at 105 degrees and close at 95 degrees.

3. System Gauges – System shall be supplied with all 316 stainless steel gauges on each manifold. All gauges to have individual isolation for service.

4. Vibration Isolation – On systems under 200 PSI max working pressure, system will be supplied with rubber flexible connectors on each manifold and rubber vibration isolation. Individual Pump Gauges – System shall be supplied with a 2.5” stainless steel gauge on the discharge of each pump, between the pump and check valve.

F. Variable Speed Drives: The drives shall be a microprocessor controlled PWM output drive for variable torque duty and supplied for the maximum full load amps produced by the motor. The drive shall be Series ACH550, UL Listed, and in a NEMA 1 self-contained enclosure. Each drive shall be furnished with a removable, digital keypad, to allow the operator flexibility and control. The keypad shall have a 32 character, English alpha-numeric display. The keypad shall allow the operator to individually control each motor manually from digital keypad, without entering the control panel. Drive must be supplied with input line reactors. The drives shall be mounted external from the control panel to keep heat outside the panel cabinet and extend life cycle of electrical equipment. Drives shall be rated for a minimum of 100K AIC.

G. Fabrication: The base and frame shall be constructed of structural steel and coated with enamel primer and enamel paint. The panel stand shall be bolt-on and removable. The base shall extend to support the suction and discharge header.

H. Bladder Tank: Provide a bladder tank with the pumping system and mount it remotely at the highest fixture nearest to a floor drain. The tank shall be 185 gallons, ASME, and suitable for 200 PSI working pressure and domestic water.

I. Factory Test & Start up: The system shall be tested with the package and control panel as a complete system together, and run to the designed voltage and jobsite parameters. The startup shall be done by a factory authorized representative. The package shall be UL listed as a system for its intended use as required by OSHA and National Electric Code (NEC) Article 907.

J. Warranty: The entire skid shall be warranted for two years from manufacturing date against defects in materials and workmanship. .

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for booster pumps to verify actual locations of piping connections before booster-pump installation.

3.2 INSTALLATION

A. Booster-Pump Mounting:
   1. Install booster pumps on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
   2. Comply with requirements for vibration isolation and seismic-control devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
   3. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."

B. Support connected domestic-water piping so weight of piping is not supported by booster pumps.

3.3 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 22 11 16 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Booster-Pump Piping Connections: Connect domestic-water piping to booster pumps. Install suction and discharge pipe equal to or greater than size of system suction and discharge header.
   1. Install shutoff valves on piping connections to booster-pump suction and discharge headers. Install ball, butterfly, or gate valves same size as suction and discharge headers. Comply with requirements for general-duty valves specified in Section 22 05 23 "General Duty Valves for Plumbing Piping."
   2. Install union, flanged, or grooved-joint connections on suction and discharge headers at connection to domestic-water piping. Comply with requirements for unions and flanges specified in Section 22 11 16 "Domestic Water Piping."
   3. Install valved bypass, same size as and between piping, at connections to booster-pump suction and discharge headers. Comply with requirements for domestic-water piping specified in Section 22 11 16 "Domestic Water Piping."
   4. Install flexible connectors, same size as piping, on piping connections to booster-pump suction and discharge headers. Comply with requirements for flexible connectors specified in Section 22 11 16 "Domestic Water Piping."
   5. Where installing piping adjacent to booster pumps, allow space for service and maintenance.

3.4 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

3.5 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.6 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

B. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
   1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Division 26.
   2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch (13 mm) high.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections with the assistance of a factory-authorized service representative.
   1. Perform visual and mechanical inspection.
   2. Leak Test: After installation, charge booster pump and test for leaks. Repair leaks and retest until no leaks exist.
   3. Operational Test: After electrical circuitry has been energized, start booster pumps to confirm proper motor rotation and booster-pump operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Pumps and controls will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.8 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.

3.9 ADJUSTING

A. Adjust booster pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust pressure set points.

C. Occupancy Adjustments: When requested within **12 months** of date of Substantial Completion, provide on-site assistance in adjusting booster pump to suit actual occupied conditions. Provide up to three visits to Project during other-than-normal occupancy hours for this purpose.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain booster pumps.

END OF SECTION

SECTION 221313 - FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Pipe and fittings.
2. Nonpressure and pressure couplings.
3. Expansion joints and deflection fittings.
4. Backwater valves.
5. Cleanouts.
6. Encasement for piping.
7. Manholes.

1.3 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:
1. Pipe

B. Shop Drawings: For manholes. Include plans, elevations, sections, details, frames and covers, and certification that manholes and appurtenances conform to City of Hagerstown Department of Public Works specifications and standard details.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of pipe and fitting, from manufacturer.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Material and Installation Specifications: City of Hagerstown Department of Public Works, Utilities Division, standards and specifications for construction and materials as amended to date, hereafter referred to as City of Hagerstown DPW.

B. Regulatory requirements
1. Comply with specifications and standard details of City of Hagerstown DPW for sanitary sewer piping, including materials, installation, and testing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic parts, pipe, and/or fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
   1. Notify Owner no fewer than ten days in advance of proposed interruption of service.
   2. Do not proceed with interruption of service without Owner's written permission.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON, GRAVITY SEWER PIPE AND FITTINGS

A. Pipe: ASTM A 746, for push-on joints, Class 54.

B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.

C. Compact Fittings: AWWA C153, ductile iron, for push-on joints.

D. Gaskets: AWWA C111, rubber.

2.2 PVC Type PSM Sewer Piping:

A. Pipe: ASTM D 3034, SDR 35 and SDR 26, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.

B. Fittings: ASTM D 3034, PVC with bell ends.

C. Gaskets: ASTM F 477, elastomeric seals.

2.3 NONPRESSURE-TYPE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:
   1. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
   2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
   3. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Dallas Specialty & Mfg. Co.
b. Fernco Inc.
c. Logan Clay Pipe.
d. Mission Rubber Company; a division of MCP Industries, Inc.
e. NDS.
f. Plastic Oddities; a division of Diverse Corporate Technologies, Inc.

2. Description: Elastomeric sleeve with corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Ring-Type, Flexible Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Fernco Inc.
b. Logan Clay Pipe.
c. Mission Rubber Company; a division of MCP Industries, Inc.
d. .

2. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.4 CLEANOUTS

A. Cast-Iron Cleanouts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Josam Company.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.
d. Tyler Pipe.
e. Watts Water Technologies, Inc.
f. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

2. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
3. Top-Loading Classification(s): Heavy Duty and Extra-Heavy Duty.
4. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. PVC Cleanouts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Canplas LLC.
b. IPS Corporation.
c. NDS.
d. Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
e. Sioux Chief Manufacturing Company, Inc.
f. Zurn Light Commercial Products Operation; Zurn Plumbing Products Group.

2. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.5 MANHOLES

A. Standard Precast Concrete Manholes in accordance with City of Hagerstown DPW specifications and standard details.

1. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

2. Frame and Cover: in accordance with City of Hagerstown DPW specifications and standard details
3. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
4. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
5. Steps: Individual FRP steps wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls in accordance with City of Hagerstown DPW standard details.

B. PIPE INSULATION
1. Basis of design: Gilsulate®500XR manufactured by Gilsulate International, Inc.
2. Product shall consist of insulating minerals (sodium potassium aluminum silicate) and dielectric mineral filler (coated calcium carbonate). Material shall be dry, free-flowing, inert, inorganic, non-toxic, non-flammable, and completely free of asbestos and fibers. Material to be chemically treated to render it hydrophobic,

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 31 2000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

F. Install gravity-flow, nonpressure, drainage piping according to the following:
1. Install piping pitched down in direction of flow, at minimum slope of 0.60 percent unless otherwise indicated.
2. Install ductile-iron, gravity sewer piping according to ASTM A 746.
3. Install PVC gravity sewer piping according to ASTM D 2321 and ASTM F 1668.

G. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure, drainage piping according to the following:
1. Join ductile-iron, gravity sewer piping according to AWWA C600 for push-on joints.

2. Join PVC gravity sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
3. Join dissimilar pipe materials with nonpressure-type, flexible couplings.

B. Pipe couplings, expansion joints, and fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

a. Unshielded flexible couplings for pipes of same or slightly different OD.
b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.4 MANHOLE INSTALLATION

A. General: Install manholes complete with appurtenances and accessories indicated in accordance with City of Hagerstown DPW specifications and standard details.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Form continuous concrete and/or sewer brick channels and benches between inlets and outlet.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 1 inch above finished surface elsewhere unless otherwise indicated.

3.5 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.6 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use ductile iron soil pipe fittings in sewer pipes at branches for cleanouts, and use ductile iron pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
1. Use Heavy-Duty, top-loading classification cleanouts in all non-traffic areas.
2. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads and other areas where exposed to vehicular traffic.

B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches deep. Set with top surface of concrete block and cleanout top even with surrounding finish grade when cleanout is located in lawn or landscape area.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.7 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Section 22 1316 "Sanitary Waste and Vent Piping."

B. Make connections to existing piping and underground manholes.
1. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

2. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.8 INSULATION INSTALLATION

A. Pouring of insulation: Pour insulation in short sections along the pipe axis and fill trench to centerline of pipe. Consolidate insulation using a rod-type concrete vibrator pulled along the sides and between the pipes. Pour and consolidate additional layers of insulation until the design coverage has been achieved. Proper consolidation is achieved when the insulation can be walked on with foot prints less than 1" deep. No wood or other foreign matter is to remain in contact with pipe(s) or left in insulation envelope.

B. Backfill first 6" of soil (no stones) by hand. Complete backfilling and mechanically compact in uniform layers with suitable excavated soil to subgrade level.

C. Refer to manufacturer’s design and installation manual for installation procedures.

3.9 CLOSING ABANDONED SANITARY SEWER SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
   1. Close open ends of piping with at least 12” thick, brick masonry bulkheads or flowable fill.

B. Abandoned Manholes: Excavate around manhole as required and use either procedure below:
   1. Remove manhole and close open ends of remaining piping.
   2. Remove top of manhole down to at least 48 inches below final grade. Fill to within 12 inches of top of remaining portion with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

C. Backfill to grade according to Section 31 2000 "Earth Moving."

3.10 IDENTIFICATION

A. Comply with requirements in Section 31200 "Earth Moving" for underground utility identification devices. Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.
   1. Use detectable warning tape over all piping.

3.11 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
   1. Submit separate report for each system inspection.
   2. Defects requiring correction include the following:
      a. Alignment: Less than full diameter of inside of pipe is visible between structures.
      b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
      c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
      d. Infiltration: Water leakage into piping.
      e. Exfiltration: Water leakage from or around piping.
   3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
   4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
   1. Do not enclose, cover, or put into service before inspection and approval.
   2. Test completed piping systems according to requirements of authorities having jurisdiction.
   3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
   4. Submit separate report for each test.
   5. Hydrostatic Tests: Test sanitary sewerage in accordance with City of Hagerstown DPW specifications and the following:

      a. Fill sewer piping with water. Test with pressure of at least 10-foot head of water, and maintain such pressure without leakage for at least 15 minutes.
      b. Close openings in system and fill with water.
      c. Purge air and refill with water.
      d. Disconnect water supply.
      e. Test and inspect joints for leaks.
   6. Manholes: Perform hydraulic test according to ASTM C 969.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.12 CLEANING

A. Clean dirt and superfluous material from interior of piping. Flush with potable water.

END OF SECTION

SECTION 221316 – SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED STANDARDS

A. The Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 as set forth in these Specifications are hereby incorporated into and shall become a part of this Section.

1.2 SUMMARY

A. Provide a complete system of Sanitary Waste and Vent piping to fixtures and equipment including traps, floor drains and cleanouts within the building.

B. As used in this Section, the term “Sanitary Waste” shall also apply to “FOG (Fats, Oils and Greases) Waste” *and "Condensate Drain"* inclusively unless noted otherwise.

1.3 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing Sanitary Waste and Vent piping systems with a minimum working pressure rating of 10-foot head of water unless noted otherwise.

1.4 SUBMITTALS

A. Product Data: For piping, tubing, fittings and couplings.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp or other markings of specified testing agency. All cast iron sanitary waste and vent pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components.

C. Codes and Standards: Comply with all applicable codes, rules, regulations and/or standards (edition-in-force; complete with all interim agreements and local amendments in effect) pertaining to products, materials and/or installation of Sanitary Waste and Vent Systems as follows:
   1. Authority Having Jurisdiction (AHJ)
   2. ANSI International (ANSI)
   3. American Society of Mechanical Engineers (ASME)
   4. American Society of Plumbing Engineers (ASPE)
   5. American Society of Sanitary Engineers (ASSE)
   6. ASTM International (ASTM)

7. American Welding Society (AWS)
8. International Association of Plumbing and Mechanical Officials (IAPMO)
9. NSF International (NSF)
10. Plumbing and Drainage Institute (PDI)
11. State of Ohio
    a. Ohio Building Code (OBC)
    b. Ohio Plumbing Code (OPC)
12. Owner's construction and/or material standards
13. Other applicable codes, requirements, rules or regulations of bodies lawfully empowered and having jurisdiction over this project.

PART 2 - PRODUCTS

2.1 SANITARY WASTE BELOW GRADE

A. Cast Iron Piping
1. Piping: ASTM A74, ASTM A888 or CISPI 301 hub and spigot, service weight.
2. Fittings: Cast iron, ASME B16.4, ASME B16.12, ASTM A74, ASTM A888, CISPI 301.

B. PVC Piping
1. Piping: ASTM D 2665, DWV Schedule 40, solid-wall drain, waste and vent.
2. Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain patterns.
3. The use of PVC Piping is NOT approved on any FOG or commercial laundry waste system.

C. PVC Piping
1. Piping: ASTM D 3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. The use of PVC Piping is NOT approved on any FOG or commercial laundry waste system.

2.2 SANITARY WASTE AND VENT ABOVE GRADE

A. Cast Iron Piping
1. Piping: ASTM A74, ASTM A888 or CISPI 301, hubless, service weight
2. Fittings: Cast iron, ASME B16.4, ASME B16.12, ASTM A74, ASTM A888, CISPI 301.

B. Copper Tubing
1. ASTM B 306, DWV tubing, drawn temper.
2. Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. PVC Piping (Provide Deduct Pricing if Used in Lieu of Cast Iron)
1. *Piping in visible areas: ASTM D 2665, DWV Schedule 80, solid-wall drain, waste and vent.*
2. *Piping in non-visible areas: ASTM D 2665, DWV Schedule 40, solid-wall drain, waste and vent.*
3. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain and vent patterns.
4. PVC Piping to be used on all urinal waste piping to main in chases and walls only and as

approved by the Engineer for all other systems
5. The use of PVC Piping is NOT approved on any FOG or commercial laundry waste system within 40-feet of any drain/receptor.
6. The use of PVC piping and fittings in return air plenums is strictly PROHIBITED.

2.3 *CONDENSATE DRAIN ABOVE GRADE*

A. PVC Piping
1. Piping in visible areas: ASTM D 2665, DWV Schedule 80, solid-wall drain, waste and vent.
2. Piping in non-visible areas: ASTM D 2665, DWV Schedule 40, solid-wall drain, waste and vent.
3. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain and vent patterns.
4. The use of PVC piping and fittings in return air plenums is strictly PROHIBITED.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 02 for excavating, trenching and backfilling.

3.2 PIPING INSTALLATION

A. Provide piping materials as listed in Part 2 of this Specification section.

B. Install cleanouts at grade and extend to where Building Sanitary Drain(s) connect to Building Sanitary Sewer(s).

C. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight.

D. Install cast-iron Sanitary Waste and Vent Piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

E. Install all PVC piping according to the following standards:
1. Underground: ASTM D2321.
2. Aboveground: ASTM D2665.

F. Make changes in direction for Sanitary Waste and Vent Piping using appropriate branches, bends and long-sweep bends. Sanitary tees and short-sweep quarter-bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two (2) fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

G. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment, indicate with unbroken continuity of invert. Place hub ends of piping

upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements and other installation requirements. Maintain swab in piping and pull past each joint as completed.

H. Install Sanitary Waste and Vent Piping at the following minimum slopes, unless otherwise indicated:
   1. Building and Horizontal Sanitary Drain: 2-percent downward in direction of flow for piping NPS 3 and smaller; 1% downward in direction of flow for piping NPS 4 and larger.
   2. Vent Piping: 1-percent down toward vertical fixture vent or toward vent stack.

I. Minimum size for below grade Sanitary Waste and Vent Piping is 2-inches.

J. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

K. Do not enclose, cover or put piping into operation until it is inspected and approved by the Authority Having Jurisdiction.

3.3 JOINT CONSTRUCTION

A. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
   1. Compression Gasket Joints: Compression gaskets for hub and spigot pipe and fittings shall conform to ASTM C 564 and shall be tested to ASTM C 1563. Gaskets shall be compressed when the pipe is fully inserted.
   2. Mechanical joint coupling: Mechanical joint couplings for hubless pipe and fittings shall comply with CISPI 310, ASTM C 1277 or ASTM C 1540. The elastomeric sealing sleeve shall conform to ASTM C 564 or CAN/CSA B602 and shall be provided with a center stop. Mechanical joint couplings shall be installed in accordance with the manufacturer's installation instructions.

B. Brazed Joints: All joint surfaces shall be cleaned. An approved flux shall be applied where required. The joint shall be brazed with a filler metal conforming to AWS A 5.8.

C. Solvent Cement and Adhesive Primer:
   1. PVC Pipe and Fittings: Joint surfaces shall be clean and free from moisture. A primer that conforms to ASTM F 656 shall be applied. Solvent cement conforming to ASTM D 2564, CSA B 137.3, CSA B 181.2 or CSA B 182.1 shall be applied to all joint surfaces. The joint shall be made while the cement is wet and shall be in accordance with ASTM D 2855. Solvent-cement joints shall be permitted above or below ground.
   2. CPVC Pipe and Fittings: Joining method for pipe and fittings shall be solvent cement welding. Solvent cement shall be a “one-step” primerless type CPVC cement designated by the system manufacturer, specially formulated for resistance to high temperatures and manufactured in accordance with ASTM F493. Mechanical connections for special equipment connection or transition to other system materials shall be as specified by the CPVC system manufacturer.

3.4 HANGER AND SUPPORT INSTALLATION

A. Refer to Division 22 05 29 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs: According to the following:

a. 100-feet and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer Than 100-feet: MSS Type 43, adjustable roller hangers.

3. Multiple, Straight, Horizontal Piping Runs 100-feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping at base and at each floor.

C. Rod diameter may be reduced one (1) size for double-rod hangers, with 3/8-inch minimum rods.

D. Install hangers for cast-iron piping with the following maximum horizontal spacing and minimum rod diameters:

CAST IRON PIPING HANGER SCHEDULE			
NPS Pipe Size	Maximum Hanger Spacing (feet)	Minimum Hanger Rod Size (inches)	Maximum Vertical Spacing (feet)
1½ and 2	5	3/8	15
3	5	1/2	15
4	5	5/8	15
6	5	3/4	15
8	5	7/8	15

E. Install hangers for copper piping/tubing with the following maximum horizontal spacing and minimum rod diameters:

COPPER PIPING/TUBING HANGER SCHEDULE			
NPS Pipe Size	Maximum Hanger Spacing (feet)	Minimum Hanger Rod Size (inches)	Maximum Vertical Spacing (feet)
Piping (All Sizes)	12	1/2	10
Tubing 1¼ and Less	6	3/8	10
Tubing 1½ and Larger	10	1/2	10

F. Install hangers for PVC piping with a maximum horizontal spacing of 4-feet and a minimum hanger rod diameter of 1/2-inch. Install supports for vertical PVC piping every 10 feet.

G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings and specialties.

B. Connect Building Drain piping to Building Sewer piping. Use transition fitting to join dissimilar piping materials.

C. Connect Sanitary Waste and Vent piping to the following:
1. Plumbing Fixtures: Connect Sanitary Waste piping in sizes indicated, but not smaller than required by the Plumbing Code in-force.
2. Plumbing Fixtures and Equipment: Connect Sanitary Vent piping in sizes indicated, but not smaller than required by the Plumbing Code in-force.
3. Plumbing Specialties: Connect Sanitary Waste and Vent piping in sizes indicated, but not smaller than required by the Plumbing Code in-force.

3.6 SANITARY VENT PIPING

A. Install Sanitary Vent Piping through roof as follows:
   1. 3-inch minimum size and extended a minimum of 12-inches above the roof.
   2. Locate at least 8-feet away from outside wall of building, 15-feet away from outside air intakes or operable windows, and 2-feet away from roof flashing work.
   3. Offset vent piping to allow for thermal expansion and contraction.
   4. Vent flashing to extend at least 12-inches from vent pipe, clamp between roofing and extend up, over and turn down inside vent pipe.

3.7 FIELD QUALITY CONTROL

A. During installation, notify the Authority Having Jurisdiction at least 24-hours before inspection must be made. Perform tests specified below in presence of the Authority Having Jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   2. Final Inspection: Arrange for final inspection by the Authority Having Jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If the Authority Having Jurisdiction finds that piping will not pass test or inspection, the Contractor shall make the required corrections and arrange for reinspection at his expense.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test Sanitary Waste and Vent piping according to procedures of the Authority Having Jurisdiction or, in the absence of such requirements, the Ohio Plumbing Code (as follows):
   1. Sanitary waste and vent rough-in test: Drainage and vent piping and fittings shall be tested prior to the installation of the plumbing fixtures and prior to the installation of wall and ceiling coverings to verify the integrity of the system in accordance with one of the following methods:
      a. Sanitary waste and vent rough-in water test: A water test shall be applied to the drainage system either in its entirety or in sections. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening, and the system shall be filled with water to the point of overflow. If the system is tested in sections, each opening shall be tightly plugged except the highest openings of the section under test, and each section shall be filled with water, but no section shall be tested with less than a 10-foot head of water. In testing successive sections, at least the upper 10-feet of the next preceding section shall be tested so that no joint or pipe in the building, except the uppermost 10-feet of the system, shall have been submitted to a test of less than a 10-foot head of water. This pressure shall be held for at least fifteen (15) minutes. The system shall then be tight at all points.
      b. Sanitary waste and vent rough-in air test: When permitted by the manufacturer of the piping, fittings, and solvent cement (if part of the plumbing system), an air test shall be made by forcing air into the system until there is a uniform gauge pressure of 5-psig or sufficient to balance a 10-inch column of mercury. This pressure shall be held for a test period of at least fifteen (15) minutes. Any adjustments to the test pressure required because of changes in ambient temperature or the seating of gaskets shall be made prior to the beginning of the test period. Testing shall be done with dual pressure relief valves rated for 7.5-psig.
      c. Alternative sanitary waste and vent rough-in test: When permitted by the manufacturer of the piping, fittings, and solvent cement (if part of the plumbing system), an alternative method of testing the drainage and vent system, such as compressed gas or vacuum, may be permitted to meet the drainage and vent

rough-in test requirements of the OPC as long as the test is conducted strictly in accordance with the requirements published in the manufacturer's installation instructions

2. Sanitary waste and vent final test: After the plumbing fixtures have been set and their traps filled with water, the entire drainage system shall be subjected to one of the following final tests:
   a. Visual and operational final test: All plumbing fixtures shall be operated and a visual inspection of accessible piping and joints shall be performed to determine that there are no visible leaks.
   b. Sanitary waste and vent final test: The final test of the completed drainage and vent systems shall be made, after the fixtures are connected, as follows:
      1) Close all stack openings;
      2) A manometer tube shall be placed through a trap seal to the system side and water shall be added to a fixture until an equivalent of at least 1-inch water column is read on the manometer gauge or water-can. Water may be added to a water closet bowl or trap tailpiece extension until the water level is at least one inch higher than the original trap seal;
      3) Maintain the initial water column for fifteen (15) minutes;
      4) The system shall then be separated at a trap seal, AAV, or other means as directed by the plumbing inspector for verification that the entire system is interconnected.
   c. Alternative sanitary waste and vent final test: Any other testing method equal to the 1-inch water column. Except as provided for in the OPC, compressed or stored air may not be used unless otherwise permitted by the manufacturer of piping, fittings, and solvent cement (if part of the plumbing system).

B. When required by the Authority Having Jurisdiction, a smoke test shall be made by filling all traps with water and then reintroducing into the entire system a pungent, thick smoke produced by one or more smoke machines. When the smoke appears at stack openings on the roof, they shall be closed and a pressure equivalent to a one-inch water column shall be developed and maintained for the period of the inspection. The use of chemical smoke shall be prohibited.

C. Where the Authority Having Jurisdiction, due to practical difficulties or hardships, finds that a smoke test cannot be performed, a peppermint test shall be substituted in lieu thereof. Such peppermint test shall be conducted by the introduction of two ounces of oil of peppermint into the roof terminal of every line or stack to be tested. The oil of peppermint shall be followed at once by ten quarts of hot (140 degrees F) water whereupon all roof vent terminals shall be sealed. A positive test, which reveals leakage, shall be the detection or the odor of peppermint at any trap or other point on the system. Oil of peppermint or individuals whose person or clothes have come in contact with oil of peppermint shall be excluded from the test area.

D. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

E. Prepare reports for tests and required corrective action.

3.8 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION

SECTION 221423 - STORM DRAIN PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 as set forth in these Specifications are hereby incorporated into and shall become a part of this Section.

1.2 SUMMARY

A. Scope of Work
   1. Provide all Storm Drain Piping systems as indicated on the Contract Documents.
   2. As used in this Section, the term “Storm Drain” shall refer to Primary and Secondary (Emergency) Storm Drains inclusively unless noted otherwise.

1.3 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing Storm Drain piping systems with a minimum working pressure rating of 10-foot head of water unless noted otherwise.

1.4 SUBMITTALS

A. Product Data: For piping, tubing, fittings and couplings.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp or other markings of specified testing agency. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

B. Codes and Standards: Comply with all applicable codes, rules, regulations and/or standards (edition-in-force; complete with all interim agreements and local amendments in effect) pertaining to products, materials and/or installation of Storm Drain Systems as follows:
   1. American Association of State Highway and Transportation Officials (AASHTO)
   2. Authority Having Jurisdiction (AHJ)
   3. ANSI International (ANSI)
   4. American Society of Mechanical Engineers (ASME)
   5. American Society of Plumbing Engineers (ASPE)
   6. American Society of Sanitary Engineers (ASSE)
   7. ASTM International (ASTM)
   8. American Welding Society (AWS)
   9. Cast Iron Soil Pipe Institute (CISPI)
   10. Environmental Protection Agency (EPA)

11. International Association of Plumbing and Mechanical Officials (IAPMO)
12. NSF International (NSF)
13. Plumbing and Drainage Institute (PDI)
14. State of Ohio
    a. Ohio Building Code (OBC)
    b. Ohio Plumbing Code (OPC)
15. Owner's construction and/or material standards
16. Other applicable codes, requirements, rules or regulations of bodies lawfully empowered and having jurisdiction over this project.

PART 2 - PRODUCTS

2.1 STORM DRAIN BELOW GRADE

A. Cast Iron Piping
   1. Piping: ASTM A74, ASTM A888 or CISPI 301 service weight, hub and spigot.
   2. Fittings: ASME B16.4, ASME B16.12, ASTM A74, ASTM A888 or CISPI 301, hub-and-spigot.

B. PVC Piping
   1. Socket type connections
      a. Piping: ASTM D2665, DWV Schedule 40, solid-wall drain, waste and vent.
      b. Fittings: ASTM D2665, socket type, made to ASTM D3311, drain patterns
   2. Bell-and-spigot connections
      a. Piping: ASTM D3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
      b. Fittings: ASTM D3034, PVC with bell ends.

C. HDPE Piping
   1. Butt-fusion connections
      a. Piping: ASTM D3350, PE4710 resin, butt-fusion joints.
      b. Fittings: ASTM D2513, D2683 and D3261, PE4710 resin, butt-fusion joints, drain patterns

2.2 FOUNDATION DRAIN

A. HDPE Piping
   1. Butt-fusion connections
      a. Piping: ASTM D3350, PE4710 resin, perforated with slots or drilled holes, butt-fusion joints.
      b. Fittings: ASTM D2513, D2683 and D3261, PE4710 resin, butt-fusion joints, drain patterns

B. Filter Fabric: Encase pipe in polyester or polypropylene geotextile fabric, density weight of 3 to 5 ounces/square yard and meeting AASHTO M-288 Class 3 for Subsurface Drainage, Stabilization and Separation. Encase filter fabric in minimum 6-inches of pea gravel.

2.2 STORM DRAIN ABOVE GRADE

A. Cast Iron Piping

1. Piping: ASTM A74, ASTM A888 or CISPI 301 hubless, service weight.
2. Fittings: Cast iron, ASME B16.4, ASME B16.12, ASTM A74, ASTM A888, CISPI 301, hubless.

B. PVC Piping (Provide Deduct Pricing if Used in Lieu of Cast Iron)
1. Piping: ASTM D 2665, DWV Schedule 80, solid-wall drain, waste and vent (for visible piping). Schedule 40, solid-wall drain, waste and vent for all non-visible piping).
2. Fittings: ASTM D 2665 or ASTM F1866, socket type.
3. The use of PVC piping and fittings in return air plenums is strictly PROHIBITED.

2.3 EXCAVATION

A. Refer to Division 31 for excavating, trenching and backfilling.

2.4 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.

2.5 PIPING INSTALLATION

A. Provide piping materials as listed in Part 2 of this specification section.

B. Install cleanouts at grade and extend to where Building Storm Drain(s) connect to Building Storm Sewer(s).

C. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight.

D. Install cast-iron drain piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

E. Install all PVC Piping according to the following standards:
1. Underground: ASTM D2321.
2. Aboveground: ASTM D2665.

F. Install all HDPE piping per the manufacturer's requirements.

G. Make changes in direction for Storm Drain Piping using appropriate branches, bends and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

H. Lay buried Building Storm Drain Piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements and other installation requirements. Maintain swab in piping and pull past each joint as completed.

I. Install Storm Drain Piping at the following minimum slopes, unless otherwise indicated:

1. Building Storm Drain: 1-percent downward in direction of flow.
2. Horizontal Storm Drain: 2% downward in direction of flow for piping NPS 3 and smaller; 1-percent downward in direction of flow for piping NPS 4 and larger.

J. Sleeves are not required for cast-iron drain piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

K. Do not enclose, cover or put piping into operation until it is inspected and approved by the Authority Having Jurisdiction.

2.6 JOINT CONSTRUCTION

A. Cast-Iron Piping: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
1. Compression Gasket Joints: Compression gaskets for hub and spigot pipe and fittings shall conform to ASTM C564 and shall be tested to ASTM C1563. Gaskets shall be compressed when the pipe is fully inserted.
2. Mechanical joint coupling: Mechanical joint couplings for hubless pipe and fittings shall comply with CISPI 310, ASTM C1277 or ASTM C1540. The elastomeric sealing sleeve shall conform to ASTM C564 and shall be provided with a center stop. Mechanical joint couplings shall be installed in accordance with the manufacturer's installation instructions.

B. PVC Piping: Joint surfaces shall be clean and free from moisture. A primer that conforms to ASTM F656 shall be applied. Solvent cement conforming to ASTM D2564 shall be applied to all joint surfaces. The joint shall be made while the cement is wet and shall be in accordance with ASTM D2855. Solvent-cement joints shall be permitted above or below ground.

C. HDPE Piping: Make joints per manufacturer's installation requirements.

2.7 HANGER AND SUPPORT INSTALLATION

A. Refer to Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. Install the following:
1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
3. Multiple, Straight, Horizontal Piping Runs 10-feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping at base and at each floor.

C. Rod diameter may be reduced one (1) size for double-rod hangers, with 3/8-inch minimum rods.

D. Install hangers for cast-iron piping with the following maximum horizontal spacing and minimum rod diameters:

CAST IRON PIPING HANGER SCHEDULE			
NPS Pipe Size	Maximum Hanger	Minimum Hanger	Maximum Vertical

	Spacing (feet)	Rod Size (inches)	Spacing (feet)
3	5	1/2	15
4	5	5/8	15
6	5	3/4	15
8	5	7/8	15

E. Install hangers for copper piping/tubing with the following maximum horizontal spacing and minimum rod diameters:

F. Install hangers for PVC piping with a maximum horizontal spacing of 4-feet and a minimum hanger rod diameter of 1/2-inch. Install supports for vertical PVC piping every 10-feet.

G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

2.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings and specialties.

B. Connect interior Storm Drain Piping to exterior Storm Drain Piping. Use transition fitting to join dissimilar piping materials.

C. Connect Storm Drain Piping to roof drains and storm drainage specialties.

D. Provide Downspout Shoes and connect to downspout by General Trades Contractor. Extend Storm Drain Piping from Downspout Shoe as indicated on the Drawings and connect to Building Storm Drain by Site Utility Contractor.

2.7 FIELD QUALITY CONTROL

A. During installation, notify the Authority Having Jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of the Authority Having Jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
   2. Final Inspection: Arrange for final inspection by the Authority Having Jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If the Authority Having Jurisdiction finds that piping will not pass test or inspection, the Contractor shall make required corrections and arrange for reinspection at his expense.

C. Reports: Prepare inspection reports and have them signed by the Authority Having Jurisdiction.

D. Test Storm Drain piping according to procedures of the Authority Having Jurisdiction or, in the absence of such requirements, the Ohio Plumbing Code (as follows):
   1. Storm Drain piping and fittings shall be tested prior to the installation of wall and ceiling coverings to verify the integrity of the system in accordance with one of the following methods:
      a. Storm Drain water test: A water test shall be applied to the drainage system either in its entirety or in sections. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening, and the system shall be

filled with water to the point of overflow. If the system is tested in sections, each opening shall be tightly plugged except the highest openings of the section under test, and each section shall be filled with water, but no section shall be tested with less than a 10-foot head of water. In testing successive sections, at least the upper 10-feet of the next preceding section shall be tested so that no joint or pipe in the building, except the uppermost 10-feet of the system, shall have been submitted to a test of less than a 10-foot head of water. This pressure shall be held for at least fifteen (15) minutes. The system shall then be tight at all points.

b. Storm Drain air test: When permitted by the manufacturer of the piping, fittings, and solvent cement (if part of the plumbing system), an air test shall be made by forcing air into the system until there is a uniform gauge pressure of 5-psig or sufficient to balance a 10-inch column of mercury. This pressure shall be held for a test period of at least fifteen (15) minutes. Any adjustments to the test pressure required because of changes in ambient temperature or the seating of gaskets shall be made prior to the beginning of the test period. Testing shall be done with a dual pressure relief valve rated for 7.5-psig.

c. Alternative Storm Drain test: When permitted by the manufacturer of the piping, fittings, and solvent cement (if part of the Plumbing system), an alternative method of testing the Storm Drain system, such as compressed gas or vacuum, may be permitted to meet the drainage and vent rough-in test requirements of the OPC as long as the test is conducted strictly in accordance with the requirements published in the manufacturer's installation instructions.

E. In lieu of a water test, an air pressure test may be used by attaching an air compressor or test apparatus to any suitable opening. All other inlets and outlets to the system shall be closed, forcing air into the system until there is a uniform pressure of five (5) pounds per square inch. The pressure shall be maintained for fifteen (15) minutes.

F. The final air test shall test the entire Storm Drain system by connecting an air machine to any suitable opening or outlet and applying air pressure equivalent to a one (1) inch water column. It shall be maintained for at least a fifteen (15) minute period. If there are no leaks or forcing of trap seals as may be indicated by the functioning of a drum, float, or water column, the system shall be deemed airtight.

2.8 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses. Flush lines as required to remove collected debris.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION

SECTION 221429 - SUMP PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Submersible sump pumps.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:
   1. Include plans, elevations, sections, and installation details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

C. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with manufacturer's written instructions for handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

2.2 SUBMERSIBLE SUMP PUMPS

A. Submersible, Fixed-Position, Single-Seal Sump Pumps:
   1. Manufacturers: Subject to complying with the requirements of this Section, provide products from one of the following:
      a. Zoeller Company
      b. Armstrong
      c. Aurora
      d. ITT
      e. Liberty Pumps
      f. Myers
   2. Description: Factory-assembled and -tested sump-pump unit.
   3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump.
   4. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
   5. Impeller: Statically and dynamically balanced, ASTM A48/A48M, Class No. 25 A bronze for clear wastewater handling, and keyed and secured to shaft.
   6. Pump and Motor Shaft: Stainless steel or steel, with factory-sealed, grease-lubricated ball bearings.
   7. Seal: Mechanical.
   8. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
      a. Motor housing fluid: Oil.
   9. Controls:
      a. Enclosure: NEMA 250, Type 1; wall mounted.
      b. Switch Type: Mercury-float type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
      c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
      d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mercury-float switch matching control and electric bell; 120 V ac, with transformer and contacts for remote alarm bell.
   10. Control-Interface Features:
      a. Remote Alarm Contacts: For remote alarm interface.
      b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
         1) On-off status of pump.
         2) Alarm status.

2.3 SUMP-PUMP BASINS AND BASIN COVERS

A. Basins: Factory-fabricated, watertight, cylindrical, basin sump with top flange and sidewall openings for pipe connections.
   1. Material: Polyethylene.
   2. Reinforcement: Mounting plates for pumps, fittings, and accessories.
   3. Anchor Flange: Same material as or compatible with basin sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.

B. Basin Covers: Fabricate metal cover with openings having gaskets, seals, and bushings; for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.
   1. Reinforcement: Steel, perforated, capable of supporting foot traffic for basins installed in foot-traffic areas.

C. Capacities and Characteristics: See Sump Pump Schedule on the Drawings.

2.4 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."
   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation and filling are specified in Division 31 sections

3.2 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

3.3 INSTALLATION

A. Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test, inspect, and adjust components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections:
   1. Perform each visual and mechanical inspection.
   2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Pumps and controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Perform startup service: Complete installation and startup checks according to manufacturer's written instructions.

3.6 ADJUSTING

A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust control set points.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION

SECTION 221430 – PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. The General Conditions, Special Conditions and Division 1 through Division 32 as set forth in these specifications are hereby incorporated into and shall become a part of the specifications for work under this title, insofar as they apply hereto.

B Provide plumbing piping specialties or accessories as required by either the Equipment Manufacturer or the Authority Having Jurisdiction.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Comply with all applicable codes, rules, regulations and/or standards (edition-in-force; complete with all interim agreements and local amendments in effect) pertaining to products, materials and/or installation of sanitary waste and vent piping systems as follows:
1. Authority Having Jurisdiction (AHJ)
2. ANSI International (ANSI)
3. American Society of Mechanical Engineers (ASME)
4. American Society of Plumbing Engineers (ASPE)
5. American Society of Sanitary Engineers (ASSE)
6. ASTM International (ASTM)
7. Cast Iron Soil Pipe Institute (CISPI)
8. NSF International (NSF)
9. Ohio Plumbing Code (OPC)
10. Plumbing and Drainage Institute (PDI)
11. Owner’s building and/or material standards
12. Other applicable codes, requirements, rules or regulations of bodies lawfully empowered and having jurisdiction over this project.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for piping materials and installation.

D. NSF Compliance: Comply with NSF 61, "Drinking Water System Components--Health Effects, Sections 1 through 9," for potable domestic water plumbing specialties.

1.3 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:
1. Domestic Water Piping: 125 psig.
2. Sanitary Waste and Vent Piping: 10-foot head of water.

1.4 SUBMITTALS

A. Submit per the provisions of Section 22 05 00.

B. Product Data: Include rated capacities and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections.

C. Maintenance Data: For plumbing specialties to include in maintenance manuals.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents per the requirements of Section 22 05 00 "Common Work Results for Plumbing".

B. Operating Key Handles: Equal to 100 percent of amount installed for each key-operated hose bibb, hydrant and access panel installed.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. All similar valves used on the project shall be by the same manufacturer.

B. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements provide products by one (1) of the manufacturers specified.
   2. Unless noted otherwise, none of the manufacturers listed for products under this Section shall be considered Basis-of-Design.

2.2 BACKFLOW PREVENTERS

A. See Schedule(s) on the Drawings for specific manufacturers, model numbers and features.

B. Containment Backflow Preventers: Backflow Preventer for domestic water service 4” or larger: Provide and install a reduced pressure backflow preventers on the water service main in a heated enclosure. The reduced pressure backflow preventer assembly shall consist of a pressure differential relief valve located in a zone between two positive seating check valves and captured springs. Backsiphonage protection shall include provision to admit air directly into the reduced pressure zone via a separate channel from the water discharge channel. The assembly shall include two tightly closing shutoff valves before and after the valve and test cocks. The assembly shall meet the requirements of ASSE 1013; AWWA C511-92; CSA B64.5; and UL Classified File EX3185. Listed by IAPMO. Approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California.
   1. Install water pressure regulators where necessary to limit the incoming water pressure to 80 psig inside the building.

C. Isolation Backflow Preventers

1. Backflow Preventer for HVAC Equipment: Provide a reduced pressure backflow preventer assembly for HVAC make-up water. The assembly shall consist of a pressure differential relief valve located in a zone between two positive seating check valves. Seats and seat discs shall be replaceable in both check valves and the relief valve without the use of special tools. Service of all internal check valve components shall be through top mounted access covers threaded to the main valve body. The check valve poppet assembly shall be guided via the use of a corrosion resistant plastic guide. The check valve and relief valve seats shall be push-in type. The relief valve cover shall be secured with stainless steel bolts and shall utilize a quarter-turn locking joint to capture the spring load of the relief valve. The relief valve shall have an internal sensing line to sense the inlet water supply. All rubber elastomers shall be of chloramine resistant material. The assembly shall also include two resilient seated isolation valves, four top-mounted resilient seated test cocks and an air gap drain fitting. The assembly shall meet the requirements of: USC Manual 8th Edition; ASSE 1013; AWWA C511; CSA B64.4.
2. Backflow Preventer for Playing Field and Landscape Irrigation Systems: Provide a reduced pressure backflow preventer assembly for Playing Field and Landscape irrigation water. The assembly shall consist of an internal pressure differential relief valve located in a zone between two positive seating check modules with captured springs and silicone seat discs. Seats and seat discs shall be replaceable in both check modules and the relief valve. There shall be no threads or screws in the waterway exposed to line fluids. Service of all internal components shall be through a single access cover secured with stainless steel bolts. The assembly shall also include two resilient seated isolation valves, four resilient seated test cocks and an air gap drain fitting. The assembly shall meet the requirements of: USC Manual 8th Edition; ASSE 1013; AWWA C511; CSA B64.4.

D. Dual Check Valve for Ice Makers and Carbonated Beverage Dispensers: Backflow preventer body and adapters are of 316 stainless steel construction and all rubber components comply with FDA food additive regulations. All materials in contact with the potable water are in compliance with the requirements of the Safe Drinking Water Act, Public Law 93-523 and National Interim Primary Drinking Water Regulations. Strainer manufactured from NSF approved acetal plastic. The assembly shall meet the requirements of ASSE 1022. The assembly shall be equal to Watts SD-3.

EXCEPTION: The backflow preventer is not required on ice makers and/or carbonated beverage dispensers equipped with an ASSE 1022 backflow prevention device by the manufacturer.

2.3 HEATED ENCLOSURES

A. Freeze-Protection Enclosures:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
   a. AquaSHIELD
   b. BF Products, Inc.
   c. G&C Enclosures
   d. Hubbell Power Systems, Inc. (Hot Box)
   e. HydroCowl, Inc. (Safe-T-Cover)
   f. WATTS
2. Description: Insulated enclosure designed to protect aboveground water piping, equipment, or specialties from freezing and damage, with heat source to maintain minimum internal temperature of 40 degrees F when external temperatures reach as low as minus 30 degrees F.

a. Standard: ASSE 1060.
b. Class I: For equipment or devices other than pressure or atmospheric vacuum breakers.
   1) Housing: Reinforced-aluminum
      a) Size: Of dimensions indicated, but not less than those required for access and service of protected unit.
      b) Drain opening.
      c) Access doors with locking devices.
      d) Insulation inside housing.
      e) Anchoring devices for attaching housing to concrete base.
   2) Heating: slab mounted heating system, electric heating cable or heater with self-limiting temperature control.
c. Monitoring System: Low-temperature or power failure that connects to the BAS or stand-alone cellular notification with battery back-up.

2.4 VACUUM BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
   1. Watts 288A (Basis-of-Design)
   2. Chicago Faucet
   3. Clayton
   4. Lawler
   5. Speakman
   6. T&S Brass

B. 125# SWP (ANSI 112.1.1, ASSE 1001) bronze body construction, full line size with body trim, disc float, full size orifice.

2.5 WATER PRESSURE-REDUCING VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
   1. Cash Acme.
   2. Conbraco Industries, Inc.
   3. Honeywell Water Controls.
   4. Watts Industries, Inc.
   5. Zurn Plumbing Products.

B. A water pressure reducing valve and strainer assembly shall be installed on the domestic water piping as indicated on the Drawings where supply main pressure exceeds 80 psig to reduce it to 70 psig or lower. Provision shall be made to permit the bypass flow of water back through the valve into the supply piping when pressures, due to thermal expansion on the outlet side of the valve, exceed the pressure in the main supply. Pressure reducing valves with built-in bypass check valves and integral strainer will be acceptable. Approved valves shall comply with ASSE 1003.

2.6 PROTECTIVE COVERING FOR ACCESSIBLE FIXTURES

A. Manufacturers: Subject to compliance with the specifications, provide from one of the following.

1. Truebro
2. Integral by trap/supplies manufacturer
3. ProFlo
4. Plumberex

B. Provide protective covering per ADA (Section 4.19.4), ADAAG (Section 606.5) and ICC/ANSI A117.1 (Section 606.6) for all domestic water supplies, traps and fixture drains under lavatories. PVC covers shall meet Testing Standard ASTM E 84-07 with a 25 flame spread/450 smoke index. With a one-piece design, fusion molded fabrication and pliable for high flexibility requirements. PVC covering material to be 1/8 inch thick. Surfaces to be soft, smooth, nonabsorbent, easy to clean U/V inhibited, antimicrobial, antifungal properties. Surfaces to be soft, smooth, non-absorbent, easy to clean U/V inhibited, antimicrobial, antifungal properties.

C. For traps, the covering shall have a cleanout nut cap to allow service to the trap without disassembly. For supplies, the covering shall have a lock lid that prevents tampering but allows access without removal of the insulation. Fasteners shall remain substantially out of sight.

2.7 MIXING VALVES

A. Lavatory/Sink Tempering Valves
1. Lavatory/sink tempering valve shall be listed to ASSE 1070. All internal components shall be from corrosion resistant material. The valve must control each performance standard down to 0.25 gpm or 0.50 gpm.
2. Capacity of the valve must be 3 gpm @ 45 psi differential or 4 gpm @ 45 psi differential. Thermostatic tempering valve shall be constructed using Lead Free brass material which shall comply with state codes and standards, where applicable requiring reduced lead content. Control temperature must be adjustable between 80 - 120° F with a locking nut to prevent unauthorized or accidental adjustment. The valve shall contain integral checks to prevent cross flow and inlet screens to filter debris.

B. Shower Mixing Valves
1. Pressure-Balancing Mixing Valve: Provide pressure-compensating mixing valves to deliver a predetermined water temperature, compensating for pressure fluctuations in the domestic hot or cold water supplies.
2. Heavy, cast-brass construction, a poppet-type equalizing valve as part of a replaceable cartridge. Adjustable metal-to-metal temperature limit stop prevents accidental scalding caused by over adjustment of the handle. Includes integral checkstops, back-to-back and shallow wall installation. The mixing valve shall be listed to ASSE 1016 and ASSE Lead Free certified.

C. Master Mixing Valves
1. Master mixing valve shall be of the thermostatic type with liquid-filled thermal motor. It shall have bronze body construction with replaceable corrosion-resistant components. Valve construction shall employ a sliding piston control mechanism. Sliding piston and liner shall be of stainless steel material. Valve shall come equipped with union end stop and check inlets with removable stainless steel strainers. Valve shall control temperature from a low flow of 1 gpm up to a maximum flow rate for a given pressure differential. Valve shall provide protection against hot or cold supply failure and thermostat failure. Valve shall be listed to ASSE 1017 and ASSE Lead Free Certified.

2.8 FLOOR DRAINS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
   1. Jay R Smith Manufacturing Company
   2. Josam Manufacturing Company
   3. Mifab
   4. Watts Drainage
   5. Zurn Industries, Inc (Hydromechanics Division)

B. General: Provide floor drains of size, type, material and features as indicated on the Drawings.

C. All floor drains located in rooms with tile floors shall be provided with manufacturer's standard 6-inch square grate.

D. Provide barrier-type trap seal device as specified under this Section.

   EXCEPTION: Trap primer valves/trap seal devices are not required for floor drains as indicated on the Drawings or shower drains.

2.9 TRAP SEAL DEVICES

A. Barrier-Type Trap Seal Device
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
      a. Eco-Guard
      b. Sure Seal (RectorSeal)
      c. TrapGuard (ProVent Systems)
   2. Waterless Inline Drain Trap Seal. HDPE (High Density Poly Ethylene) housing with heavy duty proprietary silicone diaphragm and soft EPDM rubber sealing gasket. Barrier-type trap seals shall comply with ASSE 1072.

2.10 ROOF DRAINS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
   1. Josam Manufacturing Company
   2. Mifab
   3. Jay R Smith Manufacturing Company
   4. Wade Division, Tyler Pipe
   5. Watts Drainage
   6. Zurn Industries, Inc (Hydromechanics Division)

B. General: Provide roof drains of size, type, material and features as indicated on the Drawings.

2.11 AREA DRAINS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
   1. Josam Manufacturing Company
   2. Mifab
   3. Jay R Smith Manufacturing Company
   4. Wade Division, Tyler Pipe

5. Watts Drainage
6. Zurn Industries, Inc (Hydromechanics Division)

B. General: Provide area drains of size, type, material and features as indicated on the Drawings.

2.12 DOWNSPOUT NOZZLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
1. Josam Manufacturing Company
2. Mifab
3. Jay R Smith Manufacturing Company
4. Wade Division, Tyler Pipe
5. Watts Drainage
6. Zurn Industries, Inc (Hydromechanics Division)

B. General: Provide downspout nozzle with nickel bronze body, inlet type to match downspout material, wall flange.

2.13 CLEANOUTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
1. Josam Manufacturing Company
2. Mifab
3. Jay R Smith Manufacturing Company
4. Wade Division, Tyler Pipe
5. Watts Drainage
6. Zurn Industries, Inc (Hydromechanics Division)

B. General: Provide factory-fabricated drainage piping products of size and type indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements and governing regulations.

C. Provide cleanouts where shown, at bends and angles and as required by the Plumbing Code-in-force. Extend to make flush installation with floor, wall or finish grade

D. Provide cleanouts for specific applications as follows:
1. Above-grade, horizontal piping: Zurn Z1440 cleanout with Dura-Coated cast iron body with gas and watertight ABS tapered thread plug.
2. Floor: Zurn ZN-1400 adjustable floor cleanout, Dura-Coated cat iron body with gas and watertight ABS tapered thread plug and round scoriated secured top adjustable to finish floor.
3. Carpeted floor: Zurn ZN-1400-CM adjustable floor cleanout, Dura-Coated cat iron body with gas and watertight ABS tapered thread plug and round scoriated secured top adjustable to finish floor and carpet marker.
4. Tile floor: Zurn ZN-1400-T adjustable floor cleanout, Dura-Coated cat iron body with gas and watertight ABS tapered thread plug and square scoriated secured top adjustable to finish floor.
5. Wall: Provide cleanout plug complete with Zurn Z1460-9 square wall access panel and frame. Smooth, nickel bronze panel secured to frame, set flush to finish wall plane, complete with securing lugs.

2.14 INTERCEPTORS

A. FOG (Fats/Oils/Grease) Interceptor
   1. Manufacturer: Subject to compliance with requirements, provide products by one of the following.
      a. EC Babbert
      b. Park Environmental
      c. Hamilton Tank
      d. Canplas
      e. Proceptor
      f. Schier
      g. Xerxes
   2. FOG Interceptor shall be of size and capacity as indicated on the Drawings.
   3. The FOG Interceptor shall be constructed of precast concrete having a 28 day minimum compressive strength of 4500 PSI using a Type I Portland Cement.
   4. Steel Reinforcement: The FOG interceptor shall be designed for H-20-44 traffic loading as defined by AASHTO 14th ED. 1989 using a 30% impact factor. Structural reinforcement placement shall be in accordance to ACI. All reinforcement steel shall comply with ASTM A615 grade 60 or ASTM A706 Grade 60. Bar bending shall comply with latest ACI standards. Lifting inserts to be installed for handling per manufacturer's requirements.
   5. Manhole Access: FOG interceptor shall have adequate manhole access covers and frames to permit access for cleaning all areas of the interceptor. Each manhole access shall be minimum 20” diameter clear opening and be water-tight. Cast iron frame/covers shall conform to ASTM A48-83 Class 30 and be traffic duty. Manhole covers shall be placed at grade elevation by using concrete extension rings or 24” RCP.
   6. Interior Liner: The grease interceptor shall be lined with a corrosive-resistant liner, Carboline - Plasite 4500-S 100% Solids Flake Filled, Premium Epoxy Coating with25 mil dry film thickness.
   7. OPTION: The FOG Interceptor shall be of size and capacity as indicated on the Drawings and constructed using an isophthalic polyester resin specifically designed for the manufacture of reinforced fiberglass products. The interceptor is comprised of two cells or chambers, providing integral baffling. Provide adequate treatment time limiting effluent discharge levels of non-emulsified solvent extractable matter of animal or vegetable origin to a maximum of 100 ppm and total suspended solids (TSS) to a maximum of 350 ppm. Provide with inlet/outlet cleanout, sample, and ventilation ports together with an extension collar and frame and cover to allow access for removal of FOG. Include a 30-year warranty against leakage, corrosion and structural failure. The interceptor shall be installed per the manufacturer’s recommendations.
   8. Sample well: Class II concrete with design strength of 4500 psi at 28 days. Unit is of monolithic construction at floor and first stage of wall with sectional riser to required depth. Cast iron frame and grates are manufactured of grey cast iron conforming to ASTM A48, Class 30, Heavy-Duty AASHTO H20.

B. Lint Interceptor
   1. Manufacturer: Subject to compliance with requirements, provide products by one of the following.
      a. Zurn Industries Inc (Hydromechanics Division; Basis-of-Design)
      b. Josam Manufacturing Company
      c. MIFAB
      d. Jay R Smith Manufacturing Company
      e. Wade Division, Tyler Pipe
      f. Watts Drainage

2. Lint Interceptor shall be of size and capacity as indicated on the Drawings, cast iron body with epoxy coated interior and exterior for on-floor installation. Furnished with a removable stainless steel primary (6 x 6 mesh screen) and secondary lint screens and complete with a top access gasketed secured cover.

2.15 EXPANSION JOINTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
   1. Metraflex (Basis-of-Design)
   2. Flexicraft
   3. U.S. Bellows

B. Bellows expansion coupling
   1. The bellows shall be designed in accordance with the design equations for unreinforced and reinforced bellows as specified in *Section C of The Standards of the Expansion Joint Manufacturers, Fifth Edition, 1980* including all current addenda.
   2. If reinforcement of the bellows is necessary for pressure, the reinforcing rings shall be formed integrally with the bellows. No bolted-on control devices such as equalizing rings shall be used.
   3. Pipe expansion joints weighing more than 500 pounds shall be provided with lifting lugs.
   4. Materials: Pipe expansion joint materials shall be as specified on the expansion joint data sheet. Material certifications shall be available for inspection.
   5. Fabrication
      a. Bellows shall be formed from seamless or longitudinally butt-welded cylinders. If welded, the butt weld must be planished to within 10% of the original sheet thickness.
      b. Bellows convolutions shall be "U" shaped and formed with an even pitch and height. Circumferential welds joining one convolution to another are not permitted.
      c. Bellows shall be provided in the as formed unannealed condition.
      d. End connections are to match the adjacent piping as specified on the data sheet.
      e. All welding shall be in accordance with ASME Section IX or AWS DI.I.
   6. Additional requirements
      a. Each pipe expansion joint shall be provided with a stainless steel nameplate indicating the date of manufacture, design rating of the pipe expansion joint and any other information required by the purchase order.
      b. When the pipe expansion joint is supplied with an internal sleeve, the flow direction must be indicated and be plainly visible on the outside of the joint.
      c. All surfaces of the pipe expansion joint shall be thoroughly cleaned of dirt, grease, oil and all foreign matter.
      d. Shipping bars shall be installed on the pipe expansion joint to maintain the proper shipping length. Shipping bars are to be painted yellow.
      e. Each pipe expansion joint shall be tagged with recommended installation instructions.

C. Braided U-shaped expansion connector
   1. Braided flexible expansion loops shall consist of two parallel sections of braided metal hose, a 180-degree return bend, with inlet and outlet 90 degree elbow connections. The loops shall be engineered to move in all three planes, and shall impart no thrust loads to system anchors (2).
   2. Materials of construction of the braided metal hoses are to be a type 321 stainless steel with a type 304 stainless steel braid. End fittings (3) shall be consistent with pipe material and connection fittings.

3. Loops shall be designed to meet the design pressure, temperature, and movement requirements for the system (4). Loops shall be capable of accommodating piping system and equipment movements and vibration as needed (5).
4. Loops shall be furnished with factory supplied hanger / support lug located at the bottom of the 180-degree return. Also provided at the bottom return will be a plugged FPT to be used for a drain or air release vent (6).

2.16 EXPANSION TANKS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
   1. Amtrol (Basis-of-Design)
   2. Pro-Flo
   3. Watts

B. High strength deep drawn steel dome with welded construction, separate rigid corrosion-resistant polypropylene liner, heavy-duty butyl diaphragm barrier, adjustable factory-charged sealed air cushion, stainless steel domestic cold water connector and welded air charge fitting with protective plastic cap.

C. Expansion tanks to be provided complete with shut-off valves and unions.

2.16 WATER HAMMER ARRESTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
   1. Zurn
   2. Josam
   3. MIFAB
   4. Jay R Smith
   5. Wade
   6. Watts

B. All stainless steel construction with nesting-type bellows contained within a casing having sufficient displacement volume to dissipate the calculated kinetic energy generated in piping system. Both casing and bellows constructed of Type 304 stainless steel.

2.17 ACCESS PANELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
   1. Milnor (Basis-of-Design)
   2. Josam
   3. MIFAB
   4. Jay R Smith
   5. Wade
   6. Watts
   7. Zurn

B. Provide access panels where required for access to concealed equipment, valves and piping. Location of all access panels shall be approved by the Architect.

C. Panel size shall be adequate for service intended. Use fire rated UL listed access panels in fire rated ceilings or walls.

D. Access panels shall be Milcor Type M, for masonry walls, Type "K" for plaster ceilings or Type "AT" for non-accessible acoustical tile ceiling and fire rated type for fire rated ceiling and walls.

E. Access panels shall have locks of a manufacturer with cores keyed to master key as selected by the Owner.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with requirements in the following Sections for specific specialty installation requirements and applications:
   1. Section 22 11 16 "Domestic Water Piping" for application of specialties in domestic water systems
   2. Section 22 13 16 "Sanitary Waste and Vent System" for application of specialties in horizontal and building drain and vent systems.
   3. Section 22 14 23 "Storm Drain System" for application of specialties in primary and secondary (relief) storm drain systems.

B. Reduced pressure backflow preventer installation:
   1. Install reduced pressure backflow preventer in each water supply connection.
   2. Install reduced pressure backflow preventer level and true.
   3. Install for proper direction of flow.
   4. Install shutoff valve and strainer assembly on inlet side of double detector check valve.
   5. Support reduced pressure backflow preventer assembly and piping with channel support systems, MFMA-2, factory-fabricated components for field assembly.
      a. Manufacturers:
         1) Cooper Industries; B-Line Products
         2) Grinnell Corp.; Power-Strut Unit.
         3) Michigan Hanger Co., Inc.; O-Strut Div.
         4) National Pipe Hanger Corp.
         5) Unistrut Corp.
      a. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
      b. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
      c. Supports: Provide type as suitable for piping and components.
      d. Fasteners: Provide per manufacturer's requirements.
      e. Provide post bases for channel support system and securely bolt to floor.

C. Install heated enclosure for backflow preventers on concrete pad per manufacturer’s instructions. Protect enclosure with bollards per detail on plumbing drawings.

D. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate at each change in direction of piping greater than 45-degrees.
   3. Locate at minimum intervals of 50-feet.
   4. Locate at base of each vertical soil and waste stack.

5. Install wall mounted cleanouts 18-inches above finished floor.

E. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.

F. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.

G. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   1. Position floor drains for easy access and maintenance.
   2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
      a. Radius 30-inches or Less: Equivalent to 1-percent slope, but not less than 1/4-inch total depression.
      b. Radius 30- to 60-inches: Equivalent to 1-percent slope.
      c. Radius 60-inches or Larger: Equivalent to 1-percent slope, but not greater than 1-inch total depression.
   3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
   4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

H. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.

I. Fasten recessed-type plumbing specialties to reinforcement built into walls.

J. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties.

K. Install individual shutoff valve in each water supply to plumbing specialties. Install shutoff valves in accessible locations.

L. Install escutcheons at wall, floor and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings and specialties.

3.3 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 221523 - NATURAL GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.

B. Unless noted otherwise, none of the manufacturers listed for products under this Section shall be considered as Basis-of-Design.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:
1. Piping and Valves: 100-psig minimum unless otherwise indicated.
2. Service Regulators: 65-psig minimum unless otherwise indicated.
3. Minimum Operating Pressure of Service Meter: Per requirements of the service purveyor.

B. Natural Gas System Pressure within Buildings: More than 0.5-psig but not more than 5-psig.

1.5 SUBMITTALS

A. Product Data: For each type of the following:

1. Piping and fittings materials.
2. Piping specialties.
3. Corrugated, stainless-steel tubing with associated components.
4. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
5. Pressure regulators. Indicate pressure ratings and capacities.
6. Dielectric fittings.

1.6 SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural gas piping according to requirements of Authority Having Jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating and protect from direct sunlight.

D. Protect stored polyethylene piping and valves from direct sunlight.

1.9 COORDINATION

A. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Section 221430 "Plumbing Specialties."

1.10 NATURAL GAS METER SET

A. Duke Energy will provide a natural gas meter set including, but not necessarily limited to, gas meter, main pressure regulator and shutoff valve. Plumbing contractor to provide riser bar,

connecting piping and protective bollards per the requirements of Duke Energy and this Specification.

B. The requirements of the Utility Purveyor will supersede those of this Specification.

PART 2 - PRODUCTS

2.1 UNDERGROUND EXTERIOR PIPING AND FITTINGS

A. Polyethylene (PE) Plastic Pipe: ASTM D 2513, SDR 11.
   1. PE piping below grade shall be of a continuous length; joints in the underground piping are PROHIBITED.
   2. The use of PE pipe manufactured two or more years prior to installation is PROHIBITED.
   3. PE Transition Fittings: Factory-fabricated fittings with Polyethylene pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
   4. Service-Line Risers: Comply with the requirements of the utility purveyor.
   5. PE Mechanical Couplings, NPS 2 and Larger:
      a. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.
         1) Lyall, R.W. and Company, Inc.
         2) Mueller Co.
         3) Perfection Corporation
      b. Fiber-reinforced plastic body.
      c. PE body tube.
      d. Buna-nitrile seals.
      e. Acetal collets.
      f. Stainless-steel bolts, nuts, and washers.
      g. Coupling shall be capable of joining steel pipe to PE pipe.
   6. Steel Mechanical Couplings: Capable of joining steel pipe to PE pipe.
      a. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.
         1) GE Oil and Gas
         2) Smith-Blair, Inc.
      b. Stainless-steel or Steel flanges and tube with epoxy finish.
      c. Buna-nitrile seals.
      d. Stainless-steel or Steel bolts, washers, and nuts.
      e. Coupling shall be capable of joining steel pipe to PE pipe.
      f. Factory-installed anode for steel-body couplings installed underground.
   7. Tracer Wire: Provide a Number 12 AWG or heavier insulated, solid copper wire on the top of the PE piping. Secure the tracer wire to the pipe with duct tape wrapped twice around the circumference of the piping and applied every 36-inches. Extend the tracer wire to the top of the meter riser.
   8. Warning Tape: Provide buried gas line caution tape 6-inches above the piping. The tape shall be heavy-duty vinyl, bright yellow in color, a minimum 2-inches in width with black 1-inch lettering and be installed the length of the piping.

2.2 ABOVEGROUND INTERIOR PIPING, TUBING AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
   a. Material Group: 1.1.
   b. End Connections: Threaded or butt welding to match pipe.
   c. Lapped Face: Not permitted underground.
   d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
   e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
5. Mechanical Couplings:
   a. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.
      1) GE Oil and Gas
      2) Smith-Blair, Inc.
   b. Stainless-steel or Steel flanges and tube with epoxy finish.
   c. Buna-nitrile seals.
   d. Stainless-steel or Steel bolts, washers, and nuts.
   e. Coupling shall be capable of joining steel pipe to polyethylene pipe, or steel pipe to steel pipe.
   f. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.

B. Annealed-Temper Copper Tube: Comply with ASTM B 88, Type K (ASTM B 88M, Type A) or ASTM B 88, Type L (ASTM B 88M, Type B).
1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
2. Bronze Brazed Fittings: ASME B16.24, Class 150.
3. Protective Coating for Underground Tubing: Factory-applied, extruded polyethylene a minimum of 0.022 inch thick.

2.3 PIPING SPECIALTIES

A. Appliance Flexible Connectors:
1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5-psig.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72-inches.

B. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125-psig.

C. Basket Strainers:
   1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
   2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
   3. Strainer Screen: 40-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
   4. CWP Rating: 125-psig.
   5. CWP Rating: 750-psig.

D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.4 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 degrees F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05-percent phosphorus are prohibited.

2.5 MANUAL GAS SHUTOFF VALVES

A. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
   1. CWP Rating: 125-psig.
   2. Threaded Ends: Comply with ASME B1.20.1.
   3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
   4. Tamperproof Feature: Locking feature for valves as required by utility purveyor or Owner.
   5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1-inch and smaller.
   6. Service Mark: Valves 1-1/4-inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

B. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
   1. CWP Rating: 125-psig.
   2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
   3. Tamperproof Feature: Locking feature for valves as required by utility purveyor or Owner.
   4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
   1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.
      a. A.Y. McDonald Mfg. Co.
      b. Apollo Flow Controls, Conbraco Industries, Inc.
      c. BrassCraft Manufacturing Co., a Masco Company.
      d. Lyall, R.W. and Company, Inc.

e. Perfection Corporation
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as required.
8. CWP Rating: 600-psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

D. Bronze Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.
a. A.Y. McDonald Mfg. Co.
b. Lee Brass Company
2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged as required
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125-psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Cast-Iron, Lubricated Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.
a. A.Y. McDonald Mfg. Co.
b. Flowserve Corporation
c. Homestead Valve
d. Milliken Valve Company
e. Mueller Co.
f. R & M Energy Systems; Robbins & Myers
2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as required.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125-psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.6 MOTORIZED GAS VALVES

A. Automatic Gas Valves: Comply with ANSI Z21.21.
1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.
a. Dungs, Karl, Inc.
b. Eaton

c. Eclipse Innovative Thermal Technologies
d. Honeywell Building Solutions; Honeywell International, Inc.
e. Johnson Controls
2. Body: Brass or aluminum.
3. Seats and Disc: Nitrile rubber.
4. Springs and Valve Trim: Stainless steel.
5. Normally closed.
6. Visual position indicator.
7. Electrical operator for actuation by appliance automatic shutoff device.

B. Electrically Operated Valves: Comply with UL 429.
1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.
a. Dungs, Karl, Inc.
b. Eclipse Innovative Thermal Technologies
c. Goyen Valve Corp.
d. Magnatrol Valve Corp.
e. Parker Hannifan Corp.
f. Watts
2. Pilot operated.
3. Body: Brass or aluminum.
4. Seats and Disc: Nitrile rubber.
5. Springs and Valve Trim: Stainless steel.
6. 120VAC, 60Hz, Class B, continuous-duty molded coil, and replaceable.
7. NEMA ICS 6, Type 4, coil enclosure.
8. Normally closed.
9. Visual position indicator.

2.7 PRESSURE REGULATORS

A. General Requirements:
1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.
1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.
a. Actaris
b. American Meter Co.
c. Eclipse Innovative Thermal Technologies
d. Fisher Control Valves and Instruments, a brand of Emerson Process Management
e. Invensys
f. Itron Gas
g. Maxitrol Company
h. Richards Industries
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.

6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150-percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 2-psig.

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.
1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.
   a. Canadian Meter Company Inc.
   b. Eaton
   c. Harper Wyman Co.
   d. Maxitrol Company
   e. SCP, Inc.
2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 2-psig.

2.8 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.
   a. A.Y. McDonald Mfg. Co.
   b. Capitol Manufacturing Co.
   c. Central Plastics Company
   d. HART Industrial Unions, LLC
   e. Jomar Valves
   f. Matco-Norca
   g. Watts
   h. Wilkins
   i. Zurn Industries, LLC
2. Description:
   a. Standard: ASSE 1079.
   b. Pressure Rating: 125-psig minimum at 180 degrees F.
   c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.
   a. Capitol Manufacturing Co.
   b. Central Plastics Company
   c. Matco-Norca
   d. Watts
   e. Wilkins
2. Description:
   a. Standard: ASSE 1079.
   b. Factory-fabricated, bolted, companion-flange assembly.
   c. Pressure Rating: 125-psig minimum at 180 degrees F.
   d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.
   a. Advance Products and Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company
   d. Pipeline Seal and Insulator, Inc.
2. Description:
   a. Nonconducting materials for field assembly of companion flanges.
   b. Pressure Rating: 150-psig.
   c. Gasket: Neoprene or phenolic.
   d. Bolt Sleeves: Phenolic or polyethylene.
   e. Washers: Phenolic with steel backing washers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural gas piping according to NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 requirements for prevention of accidental ignition.

3.3 EXTERIOR PIPING INSTALLATION

A. Comply with NFPA 54 for installation and purging of natural gas piping.

B. Install underground, natural gas piping buried at least 36-inches below finished grade. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

1. If natural gas piping is installed less than 36-inches below finished grade, install it in containment conduit.

2. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

C. Install underground, PE, natural-gas piping according to ASTM D 2774.

3.4 INTERIOR PIPING INSTALLATION

A. Comply with NFPA 54 for installation and purging of natural gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural gas piping at uniform grade of 2-percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Verify final equipment locations for roughing-in.

L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of three (3) pipe diameters, but not less than 3-inches long

and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

N. Extend relief vent connections for line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
   1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
   2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2-inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
   3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
   4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
      a. EXCEPTION: Tubing passing through partitions or walls does not require striker barriers.
   5. Prohibited Locations:
      a. Do not install natural gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
      b. Do not install natural gas piping in solid walls or partitions.

Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

R. Connect branch piping from top or side of horizontal piping.

S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

T. Do not use natural-gas piping as grounding electrode.

U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

V. Install pressure gage downstream from each line regulator. Pressure gages are specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."

W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.5 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install anode for metallic valves in underground PE piping.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

B. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

STEEL PIPING HANGER SPACING			
NPS Pipe Size	Maximum Horizontal Spacing (feet)	Hanger Rod Diameter (inches)	Maximum Vertical Spacing (feet)
1/2	6	3/8	N/A
3/4 or 1	8	3/8	N/A
1-1/4	10	3/8	Every floor level
1-1/2 to 3	10	1/2	Every floor level
4 or larger	10	5/8	Every floor level

C. Install hangers for drawn-temper copper tubing with the following maximum spacing and minimum rod sizes:

COPPER/COPPER-ALLOY TUBING HANGER SPACING			
NPS Pipe Size	Maximum Horizontal Spacing (feet)	Hanger Rod Diameter (inches)	Maximum Vertical Spacing (feet)
1/2	4	3/8	N/A
3/4	6	3/8	N/A
1	8	3/8	Every floor level

3.7 CONNECTIONS

A. Connect to utility's gas main according to utility purveyor's procedures and requirements.

B. Install natural gas piping electrically continuous and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72-inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.8 LABELING AND IDENTIFYING

A. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for piping and valve identification.

3.9 PAINTING

A. Comply with requirements in Division 09 Section "Exterior Painting" and Division 09 Section "Interior Painting" for painting interior and exterior natural-gas piping.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars and piping specialties, except components, with factory-applied paint or protective coating.
   1. Alkyd System: MPI EXT 5.1D.
      a. Prime Coat: Alkyd anticorrosive metal primer.
      b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
      c. Topcoat: Exterior alkyd enamel (flat).
      d. Color: Per the utility purveyor's requirements.

C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections: Test, inspect, and purge natural gas according to NFPA 54 and the Authority Having Jurisdiction.

B. Natural gas piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION

SECTION 223300 - ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Commercial, electric, storage, domestic-water heaters.
   2. Domestic-water heater accessories.

B. Unless otherwise indicated, the manufacturers listed for products provided under this Section shall not be considered as Basis-of-Design.

1.3 SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:
   1. Wiring Diagrams: For power, signal, and control wiring.

C. Product Certificates: For each type of commercial, electric, domestic-water heater, from manufacturer.

D. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

E. Warranty: Sample of warranty.

F. Operation and Maintenance Data: For electric domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects."

1.5 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.6 WARRANTY

A. Manufacturer's standard in which manufacturer agrees to repair or replace components of electric domestic-water heaters that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including storage tank and supports.
      b. Faulty operation of controls.
      c. Deterioration of metals, metal finishes, and other materials beyond normal use.
   2. Warranty Period: Manufacturer's standard warranty, minimum of five (5) years, from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 COMMERCIAL, ELECTRIC, DOMESTIC WATER HEATERS

A. Commercial, Electric, Storage, Domestic Water Heaters:
   1. See Schedule(s) on the Drawings for specific manufacturers, model numbers and features.
   2. Standard: UL 1453.
   3. Storage-Tank Construction: Non-ASME-code, steel vertical arrangement.
      a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
         1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
         2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
      b. Pressure Rating: 150-psig.
      c. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending lining material into tappings.
   4. Factory-Installed Storage-Tank Appurtenances:
      a. Anode Rod: Replaceable magnesium.
      b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
      c. Insulation: Comply with ASHRAE/IESNA 90.1.
      d. Jacket: Steel with enameled finish.

e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
f. Temperature Control: Adjustable thermostat.
g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

5. Special Requirements: NSF 5 construction.

B. Capacity and Characteristics: Refer to Schedules on the Drawings.

2.2 DOMESTIC-WATER HEATER ACCESSORIES

A. Expansion Tanks:
1. Manufacturers: Subject to compliance with requirements provide products by one (1) of the manufacturers specified.
   a. A.O. Smith Corporation
   b. AMTROL, Inc.
   c. State Industries
   d. Watts Water Technologies, Inc.
   e. Wilkins, a Zurn Industries Company
2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air pre-charge to minimum system-operating pressure at tank.
3. Construction:
   a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
   b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
   c. Air-Charging Valve: Factory installed.
4. Capacity and Characteristics: See Schedules on the Drawings.

B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.

D. Heat-Trap Fittings: ASHRAE 90.2.

E. Manifold Kits: Domestic-water heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple domestic-water heater installation. Include ball-, butterfly-, or gate-type shutoff valves to isolate each domestic-water heater and calibrated balancing valves to provide balanced flow through each domestic-water heater.
1. Comply with requirements for shutoff valves specified in Section 22 05 23. "General Duty Valves for Plumbing."
2. Comply with requirements for balancing valves specified in Section 22 14 30 "Plumbing Specialties."

F. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Electric domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 for retesting and re-inspecting requirements for correcting the Work.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 22 05 00 "Common Work Results for Plumbing" and Division 03 Section "Cast-in-Place Concrete."
   1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
   2. Maintain manufacturer's recommended clearances.
   3. Arrange units so controls and devices that require servicing are accessible.

B. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
   1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 22 05 23 "General Duty Valves for Plumbing Piping."

C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

D. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 22 14 30 "Plumbing Specialties."

F. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."

G. Assemble and install inlet and outlet piping manifold kits for multiple electric, domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each electric, domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each electric, domestic-water heater outlet. Comply with requirements for valves specified in Section 22 05 23 "General Duty Valves for Plumbing Piping" and comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."

H. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

I. Fill electric domestic-water heaters with water.

J. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 22 11 16 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
   2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Sections for retesting and re-inspection requirements and for correcting the Work.

C. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain electric domestic water heaters.

END OF SECTION

SECTION 223400 - FUEL-FIRED DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Commercial, gas-fired, high-efficiency, storage, domestic-water heaters.
   2. Domestic-water heater accessories.

B. Unless otherwise indicated, the manufacturers listed for products provided under this Section shall not be considered as Basis-of-Design.

1.3 SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:
   1. Wiring Diagrams: For power, signal, and control wiring.

C. Product Certificates: For each type of commercial, gas-fired domestic-water heater, from manufacturer.

D. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

E. Warranty: Sample of special warranty.

F. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE/IESNA Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IESNA 90.1.

C. ASME Compliance:
   1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
   2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects."

1.5 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.6 WARRANTY

A. Warranty: Manufacturer's standard in which manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within five (5) years of activation.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including storage tank and supports.
      b. Faulty operation of controls.
      c. Deterioration of metals, metal finishes, and other materials beyond normal use.
   2. Warranty Period: Manufacturer's standard warranty, minimum of five (5) years, from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC WATER HEATERS

A. See Schedule(s) on the Drawings for specific manufacturers, model numbers and features.

A. Commercial, Gas-Fired, High-Efficiency, Storage, Domestic-Water Heaters:
   1. Standard: ANSI Z21.10.3/CSA 4.3.
   2. Description: Manufacturer's proprietary design to provide at least 95- percent combustion efficiency at optimum operating conditions.
   3. Storage-Tank Construction: ASME-code steel with 150-psig minimum working-pressure rating.
      a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
         1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
         2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
      b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.

c. Lining: Manufacturer's standard complying with NSF 61 Annex G barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.

4. Factory-Installed Storage-Tank Appurtenances:
   a. Anode Rod: Replaceable magnesium.
   b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
   c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
   d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
   e. Jacket: Steel with enameled finish.
   f. Burner or Heat Exchanger: Comply with UL 795 or approved testing agency requirements for gas-fired, high-efficiency, domestic-water heaters and natural gas fuel.
   g. Temperature Control: Adjustable thermostat.
   h. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
   i. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4-M. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

B. Capacity and Characteristics: Refer to Schedules on Drawings.

2.2 DOMESTIC WATER HEATER ACCESSORIES

A. Expansion Tanks:
   1. Manufacturers: Subject to compliance with requirements provide products by one (1) of the manufacturers specified.
      a. A.O. Smith Corporation
      b. AMTROL, Inc.
      c. State Industries
      d. Watts Water Technologies, Inc.
      e. Wilkins, a Zurn Industries Company
   2. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air pre-charge to minimum system-operating pressure at tank.
   3. Construction:
      a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
      b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
      c. Air-Charging Valve: Factory installed.
   4. Capacity and Characteristics: See Schedules on the Drawings.

B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.

D. Heat-Trap Fittings: ASHRAE 90.2.

E. Manifold Kits: Domestic-water heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple domestic-water heater installation. Include shutoff valves to isolate each domestic-water heater and calibrated balancing valves to provide balanced flow through each domestic-water heater.

F. Comply with requirements for shutoff valves specified in Section 22 05 23 "General Duty Valves for Plumbing Piping."
   1. Comply with requirements for balancing valves specified in Section 22 11 16 "Domestic Water Piping."

G. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1-M, manually operated. Furnish for installation in piping.

H. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include 1/2-psig (14”W.C.) pressure rating as required to match gas supply.

I. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
   1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect assembled domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Domestic water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 40 00 Sections" for retesting and re-inspection requirements and for correcting the Work.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC WATER HEATER INSTALLATION

A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 22 05 00 "Common Work Results for Plumbing" and Division 03 Section "Cast-in-Place Concrete."
   1. Exception: Omit concrete bases for commercial domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
   2. Maintain manufacturer's recommended clearances.
   3. Arrange units so controls and devices that require servicing are accessible.

B. Install domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
   1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 22 0 523 "General Duty Valves for Plumbing Piping."

C. Install gas-fired, domestic-water heaters according to NFPA 54.
   1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
   2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
   3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.
   4. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in Section 23 11 23 "Facility Natural-Gas Piping."

D. Install combination temperature-and-pressure relief valves in top portion of domestic water heaters. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest approved waste receptor.

E. Install water-heater drain piping as indirect waste to spill by positive air gap into approved waste receptor. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 22 14 30 "Plumbing Specialties."

F. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."

G. Assemble and install inlet and outlet piping manifold kits for multiple domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each domestic-water heater outlet. Comply with requirements for valves specified in Section 22 05 23 "General Duty Valves for Plumbing Piping."

H. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.

I. Fill domestic-water heaters with water.

J. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

A. Comply with requirements for domestic-water piping specified in Section 22 11 16 "Domestic Water Piping."

B. Comply with requirements for gas piping specified in Section 23 11 23 "Natural Gas Piping."

C. Drawings indicate general arrangement of piping, fittings, and specialties.

D. Where installing piping adjacent to fuel-fired, domestic water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
   2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Sections for retesting and re-inspection requirements and for requirements for correcting the Work.

C. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage, domestic-water heaters.

END OF SECTION

SECTION 2240 00 – PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED STANDARDS

A. The Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 as set forth in these Specifications are hereby incorporated into and shall become a part of this Section.

1.2 SUMMARY

A. Provide plumbing piping specialties or accessories as required by either the plumbing fixture/equipment manufacturer, the Owner or the Authority Having Jurisdiction.

B. Provide plumbing fixtures/equipment as indicated on the Contract Documents.

C. Provide fittings, trim, carriers, stops and all accessories required for a complete installation.

1.2 DEFINITIONS

A. ADA Accessible Fixture: Plumbing fixture that can be approached, entered and used by people with disabilities.

B. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

C. Tempered Water: Water having a temperature range between 85- and 110-degrees F.

D. Tepid Water: Water having a temperature range between 60- and 100-degrees F.

1.3 SUBMITTALS

A. Submit per the provisions of Section 22 05 00 "Common Work Results for Plumbing".

B. Product Data: Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture indicated.

C. Shop Drawings: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.

D. Maintenance Data: For plumbing fixtures to include in maintenance manuals specified in Section 22 05 00 "Common Work Results for Plumbing".

1.4 QUALITY ASSURANCE

A. Source Limitations: Unless noted otherwise on the Drawings, obtain plumbing fixtures, faucets and other components of each category through one (1) source from a single manufacturer.
   1. EXCEPTION: If fixtures, faucets or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Select combinations of fixtures and trim, faucets, fittings and other components that are compatible.

D. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
   1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
   2. Hand Sinks: NSF 2 construction.
   3. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
   4. Stainless-Steel Fixtures Other Than Service Sinks: ASME A112.19.3M.
   5. Vitreous-China Fixtures: ASME A112.19.2M.
   6. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.

E. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
   1. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
   2. Faucets: ASME A112.18.1M.
   3. Hose-Connection Vacuum Breakers: ASSE 1011.
   4. Hose-Coupling Threads: ASME B1.20.7.
   5. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
   6. NSF Materials: NSF 61.
   7. Pipe Threads: ASME B1.20.1.
   8. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
   9. Supply and Drain Fittings: ASME A112.18.1M.

F. Comply with the following applicable standards and other requirements specified for shower faucets:
   1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
   2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
   3. Faucets: ASME A112.18.1M.
   4. Hand-Held Showers: ASSE 1014.
   5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
   6. Hose-Coupling Threads: ASME B1.20.7.
   7. Manual-Control Antiscald Faucets: ASTM F 444.
   8. Pipe Threads: ASME B1.20.1.
   9. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
   10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
   11. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.

G. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1M.
3. Plastic Tubular Fittings and Piping: ASTM F 409.
4. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
5. Tubular Brass Drainage Fittings and Piping: ASME A112.18.1M.

H. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Floor Drains: ASME A112.21.1M.
2. Hose-Coupling Threads: ASME B1.20.7.4.
3. Off-Floor Fixture Supports: ASME A112.6.1M.
4. Pipe Threads: ASME B1.20.1.
5. Plastic Toilet Seats: ANSI Z124.5.
6. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES AND ACCESSORIES

A. See Schedule(s) on the Drawings for specific manufacturers, model numbers and features.
1. Plumbing Contractor shall install provide all Domestic Water, Sanitary Waste and Vent piping complete with, but not necessarily limited to, all shutoff valves, accessories, fittings and trim required for fully operational fixtures/equipment.

B. Plumbing Contractor-furnished fixtures/equipment
1. Emergency Eye/Face Wash
   a. Unit to be mounted on countertop with swivel to swing away from sink. Unit with two rubber bound soft stream heads with covers, individual flow controls and filters. 1/2-inch IPS chrome plated brass stay-open ball valve with chrome plated brass ball, Teflon™ seals and flag handle. Thermostatic mixing valve to precisely blend hot and cold water to deliver warm (tepid) water. ANSI-compliant identification sign. Unit shall conform to ANSI/ISEA Z358.1.
   b. Unit to be wall-mounted with heavy-duty cast aluminum wall bracket with corrosion resistant powder coated finish. Unit with two rubber bound soft stream heads with covers, individual flow controls and filters. 1/2-inch IPS chrome plated brass stay-open ball valve with Teflon™ seals and flag handle. Approx. 11-inch diameter stainless steel bowl. Thermostatic mixing valve to precisely blend hot and cold water to deliver warm (tepid) water. ANSI-compliant identification sign. Unit shall conform to ANSI/ISEA Z358.1.
   c. Unit to be wall-mounted, ADA-compliant, with welded stainless steel wall bracket. Unit with four rubber bound soft stream heads with covers, individual flow controls and filters. 1/2-inch IPS chrome plated brass stay-open ball valve with Teflon™ seals and flag handle. Approx. 11-inch diameter stainless steel bowl. Thermostatic mixing valve to precisely blend hot and cold water to deliver warm (tepid) water. ANSI-compliant identification sign. Unit shall conform to ANSI/ISEA Z358.1.
2. Emergency Shower: Shower complete with 10-inch diameter stainless steel head with 20 gpm flow control, 1-inch IPS stay-open stainless steel ball valve with PTFE seals. Furnished with stainless steel actuating arm and 29-inch stainless steel pull rod. Pipe support to be Schedule 40 stainless steel with orange polyethylene covers on vertical piping for high visibility and corrosion resistance. Thermostatic mixing valve to precisely

blend hot and cold water to deliver warm (tepid) water. Provide ANSI/ISEA-approved identification sign. Unit shall conform to ANSI/ISEA Z358.1.

3. Safety Station (Combination Emergency Eye/Face Wash and Shower)
   a. ADA-compliant combination eye/face wash and shower safety station. Unit complete with 10-inch diameter stainless steel head with 20-gpm flow control, 1-inch Type 316 stainless steel stay-open ball valve with Teflon™ seals. Furnished with stainless steel actuating arm and 47-1/2-inch stainless steel pull rod. Four rubber bound soft stream heads with covers, individual flow controls and filters. 1/2inch IPS chrome plated brass stay-open ball valve with chrome plated brass ball, Teflon™ seals and flag handle. Pipe support to be Schedule 40 stainless steel with orange polyethylene covers on vertical piping for high visibility and corrosion resistance. Thermostatic mixing valve to precisely blend hot and cold water to deliver warm (tepid) water. Provide ANSI/ISEA-approved identification sign. Unit shall conform to ANSI/ISEA Z358.1.
4. Drinking Fountain
   a. Frame: Heavy-duty galvanized steel chassis to support fountain top and all working mechanisms. No operating parts connected to cabinet panels. Cabinet to be mounted flush to wall. Front and side panels shall be removable. Basin shall be stainless steel. Cabinet color to be standard color as selected by Architect. Cabinet to be installed on wall bracket.
   b. Fountain Top: One-piece stainless steel polished to a bright luster finish. Basin shall have integral drain grid and embossed bubbler pad and shall be contoured to eliminate splashing or standing water.
   c. Bubbler: Built in flow regulator to provide a constant stream between 20-psig to 105 psig water pressure. Flexible and one-piece water saver bubbler guard, anti-sweat, non-squirt and protected to meet all sanitary codes.
   d. Push Bars: Light touch activation with front push bar/button with textured finish.
   e. System: Waterway shall have copper components and completely lead-free materials. All joints to be brazed with silver solder. A strainer with easily cleanable screen capable of filtering 100-micron or larger particles shall be provided.
   f. Capacity: See schedule on drawings.
5. Lavatory
   a. Wall mounted, white vitreous china, front overflow, D-shaped bowl, self-draining deck area with contoured back and side splash shields, faucet ledge, faucet holes on 4-inch centers. Lavatory to be mounted on cast-iron carrier, concealed arm support, with feet bolted to floor.
   b. Countertop mounted, white vitreous china, front overflow, oval-shaped bowl, self-draining deck area, faucet ledge, faucet holes on 4-inch centers.
   c. Faucet shall be lead-free brass, polished chrome exterior, cover plate, push-button, vandal-resistant non-aerating. Provide chrome plated grid drain and tailpiece.
   d. Faucet shall be lead-free brass, polished chrome exterior, cover plate, 4-inch wrist blade handles, vandal-resistant non-aerating. Provide chrome plated grid drain and tailpiece.
   e. Provide lead free-brass, chrome-plated, ball-type supply stops with loose-key handles.
   f. Provide chrome-plated brass p-traps with built-in PO plug.
   g. ADA compliant lavatories: Provide white vinyl trap and supplies protection on those lavatories designated for ADA compliance. Fasteners shall remain out of sight and be easily removable.
   h. Public hand-washing facilities: Provide ASSE 1070 thermostatic mixing valve beneath lavatory to provide tempered water at the point-of-delivery.
6. Mop Sink
   a. White molded stone sink, floor mounted with 2-inch wide shoulders, stainless steel shoulder caps, stainless steel drain body with 3-inch cast iron, no hub and stainless

steel combination flat strainer.

b. Flush-with-floor (recessed into floor), rear & left side splashes (above floor), with removable fiberglass subway grating, allows mop buckets to roll over sink at floor level, removable stainless steel strainer basket, 4-inch waste pipe.

c. Provide the following accessories:

1) Chrome plated faucet with wall brace, hose thread outlet, integral vacuum breaker and integral stops.

2) In-line check valves on domestic hot and cold water supply piping.

d. Seal around edges of all mating surfaces between basin and wall guard with adjoining surfaces.

7. Sink

a. Countertop, self-rimming with 8-inch centers. Seamless die-drawn construction of 18-gauge Type 304 stainless steel. Interior and top surfaces polished to a non-porous finish. Fully coated underside insulation for sound and reduces condensation. Straight-sided compartment with 1-3/4-inch radius corners. Certified to ASME A112.19.3.

b. ADA-compliant, countertop, self-rimming with 8-inch centers. Seamless die-drawn construction of 18-gauge Type 304 stainless steel. Interior and top surfaces polished to a non-porous finish. Fully coated underside insulation for sound and reduces condensation. Straight-sided compartment with 1-3/4-inch radius corners. 3-1/2-inch drain opening located at back of unit. Certified to ASME A112.19.3.

c. Faucet shall be lead-free brass, polished chrome exterior, gooseneck spout, 4-inch wrist blade handles, cover plate, vandal-resistant non-aerating.

d. Provide lead-free brass, chrome-plated, ball-type supply stops with loose-key handles.

e. Provide chrome-plated brass flat grid strainer with tailpiece.

f. Provide chrome-plated brass p-trap with built-in PO plug.

g. ADA compliant sinks: Provide white vinyl trap and supplies protection on those sinks designated for ADA compliance. Fasteners shall remain out of sight and be easily removable.

h. Public hand-washing facilities: Provide ASSE 1070 thermostatic mixing valve beneath sink to provide tempered water at the point-of-delivery.

8. Urinal

a. Wall-mounted, white vitreous china, high-efficiency 0.5-gpf, flushing rim, siphon jet flushing action, extended sides, top spud. Urinal to be mounted on cast-iron carrier with feet bolted to floor.

b. ADA-compliant wall-mounted, white vitreous china, high-efficiency 0.5-gpf, flushing rim, siphon jet flushing action, extended sides, top spud. Urinal to be mounted on cast-iron carrier with feet bolted to floor.

c. Flush valve shall be quiet exposed diaphragm-type, chrome plated, ADA-compliant metal oscillating non-hold-open handle, screw driver angle stop with protective cap, adjustable tailpiece, vacuum breaker flush connection, top spud coupling and wall and spud flanges

9. Utility Sink

a. White molded stone sink, floor mounted with faucet ledge, baked enamel angle legs, and stainless steel combination flat strainer.

b. Provide the following accessories:

1) Chrome plated faucet with wall brace, hose thread outlet, integral vacuum breaker and integral stops.

2) In-line check valves on domestic hot and cold water supply piping.

c. Seal around edges of all mating surfaces between basin and wall guard with adjoining surfaces.

10. Water Closet

a. Wall-mounted, white vitreous china, elongated bowl, top spud, high-efficiency 1.28-

gpf/1.6-gpf siphon jet. Water closet to be mounted on cast-iron carrier with feet bolted to floor.

b. ADA-compliant, wall-mounted, white vitreous china, elongated bowl, top spud, high-efficiency 1.28-gpf/1.6-gpf siphon jet. Water closet to be mounted on cast-iron carrier with feet bolted to floor.

c. Flush valve shall be quiet exposed diaphragm-type, chrome plated, ADA-compliant metal oscillating non-hold-open handle, screw driver angle stop with protective cap, adjustable tailpiece, vacuum breaker flush connection, top spud coupling and wall and spud flanges.

d. Open front less cover, elongated, extra heavy-duty, injection molded solid plastic toilet seat. Features two molded-in bumpers, self-sustaining check hinges with non-corrosive stainless steel posts and pintles. Certified to IAPMO/ANSI Z124.5-2013 Plastic Toilet Seats as a class Commercial Heavy Duty.

C. Owner-furnished fixtures/equipment

1. See Schedules on the Plumbing Drawings for fixtures/equipment and accessories provided by the Owner and installed under this Contract. This Contractor to include all components and accessories as indicated on the schedules.
2. Plumbing Contractor shall install all required Owner-furnished fixtures/equipment and provide all Domestic Water, Sanitary Waste and Vent, and Natural Gas piping complete with, but not necessarily limited to, all shutoff valves, accessories, fittings, trim, et al associated with connections similar to those specified and scheduled for Plumbing Fixtures.

D. Food Service-furnished fixtures/equipment

2. See Schedules on the Plumbing Drawings and the Food Service Consultant Documents for kitchen equipment furnished and/or installed by the Food Service Contractor.
3. Plumbing Contractor shall install provide all Domestic Water, Sanitary/FOG Drain and Vent (direct and indirect), and Natural Gas piping complete with, but not necessarily limited to, all shutoff valves, accessories, fittings, trim, et al associated with connections to food service equipment similar to those specified and scheduled for plumbing fixtures.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for Domestic Water and Sanitary Waste and Vent piping systems and supports to verify actual locations and sizes of piping connections and that locations and types of supports match those indicated, before plumbing fixture installation. Use manufacturer's roughing-in data if roughing-in data is not indicated.

B. Review approved casework shop drawing submittals from the General Trades Contractor. Coordinate location and size of countertop fixtures, casework and openings before proceeding with rough-in work. Verify that installation of countertop fixture will not interfere with operation of the casework.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FIXTURE INSTALLATION

A. Assemble fixtures, trim, fittings and other components according to manufacturers' written instructions.

B. For wall-hanging fixtures, install off-floor supports affixed to building substrate.
   1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
   2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
   3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-hanging fixtures onto waste fitting seals and attach to supports.

D. Install wall-hanging fixtures with tubular waste piping attached to supports.

E. Install counter-mounting fixtures in and attached to casework.

F. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.

G. Install domestic water supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
   1. EXCEPTION: Omit shutoff valve to emergency equipment.

H. Install traps and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

J. Install flush valves for ADA-compliant water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

K. Install toilet seats on water closets.

L. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

M. Install water-supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.

N. Install shower, flow-control fittings with specified maximum flow rates in shower arms.

O. Install traps on fixture outlets.
   1. EXCEPTION: Omit trap on fixtures with integral traps.
   2. EXCEPTION: Omit trap on indirect wastes, unless otherwise indicated.

P. Install chrome plated brass escutcheons at piping wall or ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings.

Q. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Refer to Division 07 Section "Joint Sealants" for sealant and installation requirements.

3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings and specialties.

B. Connect water supplies from water distribution piping to fixtures.

C. Connect drain piping from fixtures to drainage piping.

D. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.

E. Ground equipment.
   1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Verify that installed fixtures are categories and types specified for locations where installed.

B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.5 MOUNTING HEIGHTS

A. Fixtures to be mounted at the following heights or according to manufacturer's recommendations, unless noted or directed otherwise.
   1. Regular Mounting Heights: See Architectural drawings and sections for fixture mounting heights.
   2. Handicapped Mounting Heights: See Architectural drawings and sections for fixture mounting heights.

3.6 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets, shower valves, and flushometer valves to produce proper flow and stream.

C. Replace washers and seals of leaking and dripping faucets and stops.

D. Adjust equipment temperature settings.

3.7 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
   1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
   2. Remove sediment and debris from drains.

3.8 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Unless otherwise indicated on the Drawings or Specifications, the Contractor's use of the installed Plumbing Fixtures shall be as permitted in writing by the Owner. The Contractor shall maintain fixtures to the satisfaction of the Owner. The Owner shall have the right to terminate the Contractor's use of such fixtures at his discretion. Any of the installed fixtures (including fittings and trim) not authorized for use found damaged at the time of final inspection shall be removed and replaced by the Contractor at no additional cost to the Owner.

END OF SECTION

SECTION 230000 - GENERAL - HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. The General Conditions, Special Conditions and Division 1 through Division 32, as set forth in these specifications, are hereby incorporated into and shall become a part of the specifications for work under this title, insofar as they apply hereto.

B. Furnish material, labor, tools, accessories and equipment to complete and leave ready for operation all HVAC systems for this project as described in these specifications and as shown on the drawings, or as required.

1.2 SCOPE OF WORK

A. Work includes, but is not limited to:

1. Provide demolition of equipment and systems in the existing portions of the building that remain as indicated on the project drawings.
2. Provide variable refrigerant flow systems as indicated on the project design drawings complete with outdoor packaged air-cooled heat pump and indoor ducted or ceiling mounted terminal units.
3. Provide new packaged, indoor, 100% outside air ventilation unit with roof mounted air cooled condenser as indicated on the drawings for the new Middle School Addition and Music addition. DOAS-1 and DOAS-2.
4. Provide new packaged, indoor, 100% outside air ventilation unit with roof mounted air cooled condensing unit as indicated on the drawings to replace the existing equipment.
5. Provide two new condensing boilers complete with new primary loop piping and circulation pumps to replace the existing single boiler and pumps.
6. Provide new closed circuit evaporative cooling tower to replace the existing cooling tower.
7. Provide new condenser water pumps to replace the existing condenser water pumps.
8. Provide refrigerant piping, controls and accessories.
9. Provide all required condensate drain and equipment drain piping.
10. Provide hydronic piping and accessories as indicated on the project drawings.
11. Provide pipe, equipment and duct insulation.
12. Provide exhaust fans as indicated on the drawings.
13. Provide new ductwork and all associated grilles, diffusers, registers, etc.
14. Provide new direct digital control system and building automation system as specified in Sections 230900 and 230993. The HVAC Contractor is to provide all necessary coordination for the installation of the control system. The HVAC Contractor is to install the direct digital control system devices that are furnished by the Automatic Temperature Control Contractor for installation in the ductwork and piping systems. The Automatic Temperature Control Contractor shall be a sub-contractor to the HVAC Contractor.
15. Provide new electric cabinet unit heaters and electric unit heaters where indicated on the project drawings.
16. Provide new hydronic cabinet unit heaters where indicated on the project drawings.
17. Provide air balancing as specified in Section 230593.
18. Coordinate all work with Owner’s Commissioning Contractor.

1.3 ALTERNATES

A. Refer to the bid form for applicable project alternates.

1.4 QUALIFICATIONS

A. Installer: Company specializing in performing the work of this Section with minimum three years documented experience.

1.5 LICENSES

A. The installation of this HVAC work shall be made by Contractors and craftsmen licensed by the Governing Authorities.

B. Obtain all permits and licenses required by code authorities having jurisdiction.

1.6 FEES

A. The Owner will obtain and pay for the building permit. The Contractor shall obtain all inspections or additional permits required by all laws, ordinances, rules, regulations or public authority having jurisdiction and obtain certificates of such inspections and permits and submit same to the Architect. The Contractor shall pay all fees, charges and other expenses in connection therein for HVAC work including inspection fees, etc. associated with the building permit.

1.7 CODES, REGULATIONS AND STANDARDS

A. Unless otherwise noted, the following latest enforced Edition shall apply to this work:

Ohio Building Code
Life Safety Code
National Fire Protection Association
Ohio Fire Code
OSHA Requirements
EPA Requirements

1.8 QUALITY ASSURANCE

A. The HVAC Contractor shall be responsible for all costs associated with changes to wire size, conduit size, fuse size, starter size, pipe size, duct size, monitoring, supports, etc. caused by the change of equipment from the basis of design specified to other named manufacturers. The Contractor is responsible to insure that the other manufacturer named supplied equipment will fit within space allocated, with appropriate clearances for maintenance, operation, service, code requirements, etc. Any contractor utilizing a manufacturer other than basis of design shall be responsible for any additional requirements for electrical service, concrete pad size, physical space limitations, and capacities at no additional cost to the building Owner. If manufacturers are listed, no other manufactures except those listed within the Sections of this Division, that are in turn able to comply with the contract document requirements and minimum standards of these specifications, will be acceptable.

B. Work provided or performed by the Contractor shall be guaranteed to be replaced and

made good at his own expense any defects which may develop, within one (1) year after final payment and acceptance by the building Owner, due to faulty workmanship or material, upon receipt of written notification of the defect from the building Owner.

1.9 COORDINATION DRAWINGS

A. General:

1. The HVAC Contractor shall be in charge of the coordination drawing process and shall be responsible to resolve all conflicts and settle any disputes resulting from the coordination drawing process.
2. Contract drawings are diagrammatic. Included in the base bid shall be all offsets, fittings, etc. for a completed project. Only if major rerouting of ductwork is required, with significant cost increases, as approved by the Owner's Representative, Architect and Engineer, will additional money be warranted.
3. Field discrepancies shall be resolved by the field foreman. When discrepancies cannot be resolved, the signed-off coordination drawings shall be re-examined for rights.
4. Documented, coordinated, dimensioned work will have precedence. Owner will not pay for rework of a particular trade. Uncoordinated work will not be tolerated.
5. Coordination drawings shall be a phased process with the General Contractor, Sheet Metal Contractor, Architect and Engineer determining the sequence of work.
6. Each Contractor shall coordinate the exact location of their work with the work of other trades prior to fabrication or installation of same. Verify all dimensions and elevations. Provide additional offsets and sections of material as may be required to meet the applicable job condition requirements. Coordinate with and review all related Construction Drawings and Shop Drawings of all equipment suppliers prior to start of work.
7. It is the responsibility of the HVAC Contractor to coordinate between his equipment suppliers and his temperature control subcontractor and other subcontractors as to which control devices are supplied with equipment, required wiring and voltages, and other related coordination times, so as to ensure a complete, proper, and operable installation.

B. Process

1. The Sheet Metal Contractor shall have precedence for the allotment of available space. Ductwork rerouting for gravity drain lines may be required and shall be approved by the Engineer.
2. The Sheet Metal Contractor shall be responsible for all trades, pre-coordinating their layouts and shop drawings with each other, including the Sheet Metal Contractor.
3. The Sheet Metal Contractor shall prepare drawings in ACAD Release 2013 or newer edition. All ACAD files shall be saved suitable for release 2013. He shall be responsible for the base drawings to be used by all other Contractors. Base drawings shall include architectural, structural and reflected ceiling plan information.
4. The Sheet Metal Contractor shall prepare ductwork drawings, at a minimum scale of 1/4" = 1'-0", in REVIT or ACAD Release 2013 or newer edition. After the Sheet Metal Contractor has finished CD with base drawing and ductwork, it shall be circulated in the following order:

    a. Plumbing Contractor
    b. Piping Contractor
    c. Fire Protection Contractor

d. Electrical Contractor
e. General Contractor

5. Each Contractor shall use the CD for preparation of their installation drawings.
6. After all trades have completed the coordination process, the General Contractor shall hold a coordination meeting to resolve conflicts. Each Contractor shall have available a drawing of his layout to be used with a light table for overlaying purposes. A representative of each Contractor, the Architect and the Engineer shall attend. All conflicts shall be resolved at the coordination meeting. The Architect and Engineer shall resolve all major conflicts as to the degree each Contractor shall alter their layout in order to allow for sufficient space for installation of the work.
7. After all work is coordinated and all conflicts resolved, each contractor shall update coordination documents in order to reflect all required minor and major modifications.
8. When all coordination is complete, the Sheet Metal Contractor shall distribute two (2) sets of prints of the revised coordination drawings to each of the trades involved in the project, one (1) set for the Owner's Representative and one (1) set for as-built drawings.

C. Sheet Metal Contractor:

1. All horizontal ducts shall be located and dimensioned from column center lines. Each duct shall be drawn to scale with width, depth and bottom of duct elevation clearly noted.
2. All vertical ducts shall be located from column center lines in two (2) directions. When concealed in a shaft, each vertical duct shall be shown in its total length.
3. Terminal units, heating coils, fire dampers, grilles and diffusers shall be located and dimensioned. Terminal units shall be located so as to be readily accessible from removable ceiling panel or access panel.

D. HVAC Piping Contractor:

1. Piping and conduits shall be located and dimensioned from column center lines. Size, center line elevation and required pitch shall be clearly noted.
2. Long drain lines shall have center line elevations indicated at 20 foot intervals.
3. Conduits less than 1 inch in size are not required to be indicated on coordination drawings; however, the Electrical Contractor is responsible for routing these conduits in a manner to not cause a conflict with other trades. Conduits not indicated on coordination drawings shall be field offset to avoid all conflicts.

E. General Contractor:

1. All furrings and holes shall be clearly noted.
2. All ceiling heights shall be clearly noted.

F. Service Areas:

1. Contractors shall indicate service areas for all equipment, terminal units, etc. by shaded areas on drawings

PART 2 - NOT APPLICABLE

PART 3 – EXECUTION

3.1 EXISTING WORK

A. Each Contractor shall locate existing site utilities, installed in previous phase, prior to beginning work. Provide adequate means of protection during work operations. Repair existing utilities damaged during work operations to the satisfaction of the utility owner and at Contractors expense.

B. Should uncharted or incorrectly charted piping or other utilities be encountered during work operations, notify the Engineer immediately for procedure directions. Cooperate with utility companies in maintaining active services and facilities in operation.

3.2 OPENING LOCATIONS AND CUTTING

A. Each Contractor shall give the General Contractor locations and sizes of all openings required for the installation of new mechanical work before new walls, etc. are started.

B. All cutting through poured concrete slabs and walls shall be done with core drills. No jack hammers will be allowed. All cutting and patching by General Contractor that is coordinated by the HVAC Contractor. All cutting and patching not coordinated by the HVAC Contractor with the General Contractor shall be by the HVAC Contractor.

3.3 CLEANING AND PAINTING

A. All equipment shall be kept dry and clean during the construction period.

B. Prime and paint by General Contractor, unless otherwise noted.

C. When all work is completed and all work has been satisfactorily tested and accepted by the Architect, mechanical equipment and other exposed surfaces shall be thoroughly cleaned.

D. Repair marred and damaged factory painted finish with materials and procedures to match original factory finish.

3.4 EXCAVATION AND BACKFILL

A. Provide all excavation and backfill necessary to get the work in place. Compaction and backfill materials are to be provided by this Contractor. Work to follow Division 31, Earthwork.

3.5 CONCRETE WORK

A. Each Contractor shall provide concrete pads required for equipment they have supplied in this Division. See Division 3 - Cast-in-Place Concrete.

3.6 PROTECTION AND DAMAGE

A. In addition to the provisions and stipulation of the General Conditions, each contractor and subcontractor shall provide various types of protection as follows:

1. Protect finished floors from chips and cutting oil by the use of metal drip receiving pan and oil proof floor cover.

2. Protect equipment and finished surfaces from welding and cutting splatters with baffles and splatter blankets.
3. Protect equipment and finished surfaces from paint droppings, insulation adhesive and sizing droppings, etc. by use of drop cloths.

B. All equipment shall be stored at the site with openings, bearings, etc., covered to exclude dust and moisture. All stock piled pipe shall be placed on dunnage and protected from weather and from entry of foreign material.

C. Piping and construction openings and excavations required for Mechanical work shall be covered when work is not in progress as follows:

1. Cap pipe openings with fittings or plugs.
2. Cover wall and ceiling openings with plywood, or canvas covered framing.
3. Cover floor openings and excavations with structural material of adequate strength to support traffic.

D. The Owners property and the property of other Contractors shall be scrupulously respected at all times (including damage from leaks). Provide drop cloths and visqueen or similar barriers where dust and debris is generated, to protect adjacent area.

E. Contractor shall be held responsible for damage caused by his work or through neglect of his workmen. Repairing of damaged work shall be done by Contractor as directed by the Architect. Cost of repairs shall be paid by Contractor.

F. The Owner reserves the right to make emergency repairs as required to keep equipment in operation without voiding the Contractor's guarantee bond not relieving the contractor of his responsibilities during the bonding period.

3.7 SPECIAL ATTENTION

A. After all dust making procedures are performed and finishes cured, Sheet Metal Contractor shall start all air handling units in order to purge the building. Sheet Metal Contractor shall adequately protect each intake of air handling unit with disposable filter media to prevent damage to unit. Sheet Metal Contractor shall perform service maintenance; thoroughly clean all units including coils, and replace filters on all air handling units before the Owner occupies the space and at no additional cost.

END OF SECTION 230000

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Grout.
5. Equipment installation requirements common to equipment sections.
6. Painting and finishing.
7. Concrete bases.
8. Supports and anchorages.
9. Fire stopping.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.
5. Roof Curbs

B. Welding certificates.

1.4 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified, at the expense of the Contractor installing the mechanical equipment. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.6 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

D. Provide coordination drawings as specified in section 230000.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.

a. Custom Curb
b. Pate Co. (Basis of Design)
c. ThyCurb

2.2 ROOF CURBS, PIPE CURBS AND ROOF PIPE SUPPORTS

A. Prefabricated Roof Curbs:

1. Roof Curbs and Equipment Supports: Minimum 18 gauge galvanized steel, continuous welded seams, mitered corners, wood nailer, strip, 12 inches minimum height and vertical counterflashing with lag screws. Where curb is used for equipment support, provide internal reinforcing as required to support equipment load and integral base plates. Where curb is around a roof penetration, provide 1-1/2 inch thick, 3 lb. density rigid fiberglass insulation. Where curb is installed on a pitched roof, curb shall be sloped to match roof pitch. Provide raised cant to accommodate the roof insulation thickness. Pate Company ES-2.
2. Pipe Curb: For vents or other piping passing through the roof, use a Pate Company PCA-2 curb with PCC pipe curb cover. Provide 1-1/2 inch thick, 3 lb. density rigid fiberglass insulation. Cover to be complete with graduated neoprene boots with stainless steel clamps.

B. Roof Pipe Supports

1. Roof pipe supports shall be free standing, black, lexan, pillow block pipe stands. Pipe stands shall have a “V” shape cradle, curved base edges and corners, stacking pins for secure stacking for height adjustment, vent tunnels to prevent condensate buildup and guide holes at top of cradle for installation of pipe strap.
2. Treated wood blocking for pipe support is <u>not</u> acceptable.

2.3 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.4 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.5 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

B. Manufacturers:

1. Cascade Waterworks Mfg. Co.
2. Dresser Industries, Inc.; DMD Div.
3. JCM Industries.
4. Smith-Blair, Inc.
5. Viking Johnson.
6. Victaulic Co. of America

C. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one (1) end with threaded brass insert, and one solvent-cement-joint end.

D. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one (1) end with threaded brass insert, and one (1) solvent-cement-joint end.

E. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four (4) part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

F. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.6 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250 psig minimum working pressure at 200 deg F.

1. Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Hart Industries, International, Inc.
e. Watts Industries, Inc.; Water Products Div.
f. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150 psig minimum working pressure as required to suit system pressures.

1. Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

a. Perfection Corp.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Co., Inc.
d. Victaulic Co. of America.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

2.7 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.8 FIRE STOPPING

A. Description: UL-classified Systems; C-AJ or W-L-7001-7999. Type of fill materials; one or both of the following: Latex sealant or mortar.

PART 3 - EXECUTION

3.1 ROOF WORK

A. The General Contractor shall provide roof openings where indicated on the architectural drawings and where specifically coordinated with the HVAC contractor. All additional steel support framing that is required for roof penetrations shall be provided by HVAC Contractor except where indicated on the structural design drawings.

B. The HVAC Contractor shall coordinate the size and location of all roof curbs.

C. The HVAC Contractor shall install all roof curbs and pipe supports. Secure curbs and supports to roof deck by means of screws bolts and inserts.

3.2. PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

New Piping:

1. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
2. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome- plated finish.
3. Insulated Piping: One-piece, stamped-steel type with spring clips.
4. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
5. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
6. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast- brass type with polished chrome-plated finish.
7. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and spring clips.
8. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
9. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

3. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.

Q. Verify final equipment locations for roughing-in.

R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32, wiped smooth.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate Teflon tape or Permatex pipe thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges or mechanically grooved couplings in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.

1. Contractor installing equipment on the inside of the building shall provide the associated concrete base. The Contractor installing equipment on the exterior of the building is responsible to coordinate size and location of the associated concrete pad with the Site Concrete Contractor.
2. Construct 4 inches high, unless otherwise noted, chamfered, concrete bases of dimensions indicated, but not less than 4 inches larger in all directions than supported unit and so expansion anchors will be a minimum of ten (10) bolt diameters from edge of the bases.
3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
4. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

5. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
6. Install anchor bolts to elevations required for proper attachment to supported equipment.
7. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
8. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 5 Sections for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.9 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.10 FIRE STOPPING

A. Provide fire stopping for all mechanical penetrations of all fire rated construction such as walls and floors.

END OF SECTION 230500

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes basic requirements for factory-installed and field-installed motors.

B. Related Sections:

1. Section 017419 – “Construction Waste Management”.
2. Section 018113.14 – “Sustainable Design Requirements - LEED v4 / 4.1 BD+C: New Construction”.
3. Section 019113 – “General Commissioning Requirements”.

1.2 DEFINITIONS

A. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.

B. Field-Installed Motor: A motor installed at Project site and not factory installed as an integral component of motorized equipment.

1.3 SUBMITTALS

A. Product Data for Field-Installed Motors: For each type and size of motor, provide nameplate data and ratings; shipping, installed, and operating weights; mounting arrangements; size, type, and location of winding terminations; conduit entry and ground lug locations; and information on coatings or finishes.

B. Shop Drawings for Field-Installed Motors: Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Include the following:

1. Each installed unit's type and details.
2. Nameplate legends.
3. Diagrams of power and control wiring. Provide schematic wiring diagram for each type of motor and for each control scheme.

C. Qualification Data: For testing agency.

D. Test Reports: Written reports specified in Parts 2 and 3.

E. Operation and Maintenance Data: For field-installed motors to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

B. Source Limitations: Obtain field-installed motors of a single type through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70,
Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:

1. Compatible with the following:

a. Magnetic controllers.
b. Multi-speed controllers.

2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
3. Matched to torque and horsepower requirements of the load.
4. Matched to ratings and characteristics of supply circuit and required control sequence.

B. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.

PART 2 - PRODUCTS

2.1 MOTOR REQUIREMENTS

A. Motor requirements apply to factory-installed and field-installed motors except as follows:

1. Different ratings, performance, or characteristics for a motor are specified in another Section.
2. Manufacturer for a factory-installed motor requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.

B. Comply with Energy Independence and Security Act of 2007.

C. Comply with NEMA MG 1 table 12-11 unless otherwise noted.

D. Comply with IEEE 847 for Severe-Duty motors.

2.2 MOTOR CHARACTERISTICS

A. Motor Phase: As indicated on drawings.

B. Frequency Rating: 60 Hz.

C. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

D. Service Factor: 1.15.

E. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.

F. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

G. Enclosure: Open drip proof for interior mounted motors. Totally enclosed fan cooled for exterior mounted motors.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium efficiency.

C. Stator: Copper windings, unless otherwise indicated.

1. Multi-speed motors shall have separate winding for each speed.

D. Rotor: Squirrel cage, unless otherwise indicated.

E. Bearings: Double-shielded, pre-lubricated ball bearings suitable for radial and thrust loading.

F. Temperature Rise: Match insulation rating, unless otherwise indicated.

G. Insulation: Class F, unless otherwise indicated.

H. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Designed with critical vibration frequencies outside operating range of controller output.
2. Temperature Rise: Matched to rating for Class B insulation.
3. Insulation: Class H.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
5. Motor shall be design for vector or inverter-duty service with design resistant to transient spikes, high frequencies and short time rise pulse produced by

inverters.
6. Motor manufacture shall ensure specified motor operational and performance characteristics are suitable for inverter drive operation.
7. Motor shall be provided with minimum of one shaft mounted grounding protection ring to discharge pulse width modulation induced shaft voltages and bearing currents in reducing the effects of bearing pitting and scoring.
8. Motor shall include factory wired internal automatic reset high temperature thermal protector switch wired to over sized motor terminal box.

I. Rugged-Duty Motors: Totally enclosed, with 1.15 minimum service factor, greased bearings, integral condensate drains, and capped relief vents. Windings insulated with non-hygroscopic material.

1. Finish: Chemical-resistant paint over corrosion-resistant primer.

2.4 SINGLE-PHASE MOTORS

A. Type: One of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split-phase start, capacitor run.
3. Capacitor start, capacitor run.
4. ECM motors.

B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.

C. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, pre-lubricated-sleeve type for other single-phase motors.

E. Source Quality Control: Perform the following tests on each motor according to NEMA MG 1:

1. Measure winding resistance.
2. Read no-load current and speed at rated voltage and frequency.
3. Measure locked rotor current at rated frequency.
4. Perform high-potential test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive field-installed motors for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in of conduit systems to verify actual locations of conduit connections before motor installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 MOTOR INSTALLATION

A. Anchor each motor assembly to base, adjustable rails, or other support, arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and align with load transfer link.

B. Wiring of motor to controller and auxiliary controls and/or safeties shall be in accordance with motor controller manufacture instructions, NFPA 70 and local code requirements.

C. Properly ground all equipment according to controller manufacturer’s requirements regarding noise attenuation and electromagnetic interference. Where not specifically specified by motor controller manufacture, ground equipment according to NFPA 70.

D. Requirements of motor T-lead conductors shall comply with Division 26 Specification 260519 “Wires and Cable”.

3.3 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
2. Test interlocks and control features for proper operation.
3. Verify that current in each phase is within nameplate rating.

B. Testing: Perform the following field quality-control testing:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.15.1. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.4 ADJUSTING

A. Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.

3.5 CLEANING

A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean motors, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 230513

SECTION 230515 - GENERAL PIPING REQUIREMENTS

PART 1 - GENERAL

1.1 PIPING SYSTEMS - GENERAL

A. The following instructions apply to all piping systems, except where otherwise noted.

1. Provide unions or flanges at each final connection and at each piece of equipment.
2. Make connections to equipment as detailed on the Drawings or per manufacturer's installation instructions.
3. Where connection size is smaller than piping, make reduction at final connection only (Do not reduce size of pipe drop).
4. Provide valves and specialties as required, to complete installation of each piece of equipment, for proper operation.

B. Clean out and flush water piping systems.

C. If other means of draining are not provided, install drain valves at all low points to permit complete draining of each water system.

D. Certified Pipe Welding Bureau. Welds to be stamped at each joint or fitting.

E. Install dielectric unions at all connections of dissimilar metals.

F. Related Requirements:

1. Section 017419 – “Construction Waste Management”.
2. Section 018113.14 – “Sustainable Design Requirements - LEED v4 / 4.1 BD+C: New Construction”.
3. Section 019113 – “General Commissioning Requirements”.

PART 2 - PRODUCTS

2.1 COPPER PIPE

A. Copper pipe to be of type and thickness as specified in section 232113. Fittings shall be wrought copper fittings with soldered ends designed for 150 psi (steam) and 300 psi (water) pressure. All joints and fittings shall comply with the latest edition of ASME code for pressure piping. 2-1/2 inches and larger equipment and valved connections shall be flanged.

B. In domestic water piping, all soldered joints shall be made with lead-free nickel silver solder for 150 psi, 250 deg F.

2.2 BLACK STEEL PIPE

A. Steel pipe to be of type specified in section 232113. For welded piping1-1/2 inches and smaller, pipe shall be butt welded steel. Larger pipe shall be seamless steel or electric

resistance welded. Pipe thickness shall be as scheduled in the specifications. All joints and fittings shall comply with the latest edition of ASME code for pressure piping.

B. Threaded pipe shall be accurately cut NPT tapered right hand threads. Screwed fittings shall be of the same make and thickness for weight as the pipe used.

C. Butt weld pipe joints shall be butt type, single vee made by fusion welding oxy-acetylene, electric welding using high test welding rod or semi-automatic metal arc welding machines using micro-wire. Branches in straight pipe are to be made with welding tees of same make and thickness of weight as the pipe used. Branches 1/4 the size of the main or less may be made with weld neck flanges, weld-o-let's or thread-o-let fittings. Elbows shall be long radius.

D. Socket weld pipe joints shall be made using 2000 lb. socket weld steel fittings. All other items shall be per part 2.2, paragraph C this section of specifications.

E. Flanged pipe: Connections to valves, equipment, etc. shall be made with 125 - 150 lb. standard flanges, except for 250 - 300 lb. extra heavy flanges or fitting on valves, equipment, etc. furnished with extra heavy flanges. Flanged joints are to be faced square and true.

F. Mechanical grooved pipe joints shall be made with self centering, mechanical pipe couplings, that shall engage and lock in place the rolled grooved pipe and fittings in a watertight connection. Couplings shall be malleable iron, bolted sectional housing clamps to hold an EPDM sealing gasket in position. Bolts and nuts are to be heat- treated carbon steel. Pipe shall have rolled grooved ends, cut grooves are not acceptable. Fittings shall be malleable iron castings, extra strong wall with grooved ends. Mechanical grooved piping may be used for hot and chilled water piping that is of size 2-1/2 inch and larger.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Each union or flange is to be installed to permit east removal of parts and equipment, and in a position permitting the device or equipment to be removed without disconnecting piping. Connections to equipment shall be arranged to facilitate ease of removal and service without dismantling of the run-outs of main piping, and shall be installed by the use of multiple elbows or other similar methods to minimize strain on the equipment connections.

B. Use of grooved mechanical couplings and fasteners on condenser water systems to be as follows:

1. Grooved joint piping systems shall be installed in accordance with the manufacturer's guidelines and recommendations.
2. To assure uniformity and compatibility of piping products in grooved end piping systems, grooved joint couplings, fittings, valves and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
3. Grooved ends shall be clean and free from indentations, projections and roll marks in the area from the pipe end to the groove.
4. The gasket style and elastomeric material shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by the grooved coupling manufacturer.
5. Grooved coupling manufacturer's factory trained field representative shall provide on-site training for the Contractor's field personnel in the proper use of grooving tools' application of groove and installation of grooved piping products. The

factory trained representative shall periodically inspect the product installation. The Contractor shall remove and replace any improperly installed products.

C. Make reductions in piping lines with reducing coupling or weld fitting reducer.

D. Install piping to provide clearance for personnel passage, headroom, operation of doors or windows, equipment, lighting outlets, or with Owner's apparatus and equipment.

E. In pipe spaces to be entered for servicing, piping shall be offset so that all lateral runs are located either near floor or 6'-0" above floor and all vertical piping is held close to the wall through that height. Keep all piping to side of chase wherever possible.

F. Piping containing liquids shall not be installed over electrical equipment.

G. Install pipes, valves, fittings, etc. to be insulated with a minimum of l/2-inch clearance between the finished covering and other work and between the finished covering of parallel, adjacent pipes.

H. Make changes in pipe line direction with fittings only.

I. Offset lines around columns, beams and other obstructions as required. Where special conditions are encountered in field, arrangement and alignment of piping shall be decided by the Owner's Representative.

J. At time of erection, piping components shall be cleaned of loose material. After erection, and prior to putting in service, lines shall be blown or flushed free of loose materials. Clean strainer screens and sediment pockets prior to putting lines in service.

K. Install valves at service connections to equipment and branch lines from main lines. All valves and unions to be installed so as to be accessible through ceiling or wall access panel.

L. Contractor is responsible for conformance with all applicable requirements for welding and burning. Contractor shall obtain all necessary permits.

M. SECURELY SUPPORT all piping from structure with approved hangers, rods, brackets and accessories.

N. Where piping is installed in new masonry block walls, coordinate with General Contractor so piping extends out through a masonry joint where possible.

O. Bullhead fittings are not allowed.

P. Where exposed pipes pass through walls, floors or ceilings of finished rooms, provide chrome-plated escutcheons. Prime-coated black iron escutcheons may be used in unfinished rooms. Protect escutcheons from tool marks.

Q. Keep pipe level except where a slope is required. Use eccentric reducers to keep top of pipe level.

R. Avoid trapping of piping.

S. Use transition fittings as recommended by manufacturers to change from one pipe material or type to another.

T. All new piping during the installation period shall have openings protected with temporary caps or protective covers as required to keep the inside of the piping system clean from all dirt, debris and foreign material.

U. At completion of project, thoroughly flush each of the various HVAC hydronic circulating systems with a cleaning solution as recommended by the chemical supplier and the various material manufacturers, so as to remove any oil, rust, dirt, scale or grease that may be present.

V. Do not obstruct passageways, headroom, door and window operation, and similar areas with the installation of piping.

3.2 PIPING PROHIBITIONS

A. Contractor shall not run piping over electrical panels, across windows, door openings, access panels, lighting fixture or within 36 inches in front of electrical panels. Obtain instructions from the Architect if a conflict occurs.

B. On any given system, the Contractor will not be permitted to mix and joint different types of pipe material. For example, if a hot water heating system uses copper and steel, the Contractor may change from one to the other only once the line may not be changed back to the first material further downstream.

C. Drain lines shall be continuously sloped; trapping is expressly prohibited.

END OF SECTION 230515

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following meters and gages for mechanical systems:

1. Thermometers.
2. Gages.
3. Test plugs.

B. Related Requirements:

1. Section 017419 – “Construction Waste Management”.
2. Section 018113.14 – “Sustainable Design Requirements - LEED v4 / 4.1 BD+C: New Construction”.
3. Section 019113 – “General Commissioning Requirements”.

1.2 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated; include performance curves.

B. Shop Drawings: Schedule for thermometers and gages indicating manufacturer's number, scale range, and location for each.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.

2.2 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

A. Manufacturers:

1. Palmer - Wahl Instruments Inc.
2. Trerice, H. O. Co.
3. Weiss Instruments, Inc.
4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Type: Liquid-in-glass type, 9 inch long of chrome plated brass construction or self-

powered digital type with glass passivated thermistor and internal potentiometer.

C. Tube: Red reading, liquid filled, with magnifying lens. The use of mercury shall be prohibited.

D. Tube Background: Satin-faced, non-reflective aluminum with permanently etched scale markings.

E. Window: Clear acrylic held in place with removable stainless steel cap.

F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

G. Stem: Brass for thermowell installation and of length to suit installation.

H. Accuracy: Plus or minus 1 scale division to maximum of 1.5 percent of range.

2.3 THERMOWELLS

A. Manufacturers: Same as manufacturer of thermometer being used.

B. Description: Pressure-tight, socket-type brass or stainless steel fitting made for insertion into piping and of type, diameter, and length required to hold thermometer. Thermowell to have a two inch extension with threaded cap nut and cap for all insulated piping.

2.4 PRESSURE GAGES

A. Manufacturers:

1. Palmer - Wahl Instruments Inc.
2. Trerice, H. O. Co.
3. Weiss Instruments, Inc.
4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.

1. Case: Dry or Glycerine filled type,4-1/2 inch diameter.
2. Pressure-Element Assembly: Stainless Steel, Bourdon tube.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, non-reflective aluminum with permanently etched scale markings.
6. Pointer: Black metal.
7. Window: Glass.
8. Ring: Stainless Steel.
9. Accuracy: Grade 2A, plus or minus 0.5 percent of scale range.
10. Range for Fluids under Pressure: Two (2) times operating pressure.
11. Provide gauges without back mounting plate.
12. Vacuum Range: 30 inches HG of vacuum to 15 PSIG of pressure.

2.5 TEST PLUGS

A. Manufacturers:

1. Peterson Equipment Co., Inc.
2. Sisco Manufacturing Co.
3. Trerice, H. O. Co.
4. Watts Industries, Inc.; Water Products Div.

B. Description: 1/2 inch NPT, Corrosion-resistant brass body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 1000 psi at 350 deg F.

D. Core Inserts: Two (2) self-sealing rubber valves.

1. Insert material for air, water, oil, or gas service at 20 to 350 deg F shall be Nordel.

E. Test Kit: Furnish one (1) test kit containing one (1) pressure gage and adaptor, two (2) thermometers, and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.

1. Pressure Gage: Small bourdon-tube insertion type with 2- to 3- inch diameter dial and probe. Dial range shall be 0 to 200 psig.
2. Low Range Thermometer: Small bimetallic insertion type with 2 inch diameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F.
3. Carrying case shall have formed instrument padding.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install liquid-in-glass thermometers in the following locations:

1. Where indicated on the design drawing piping diagrams.
2 Inlet and outlet of each hydronic boiler and cooling tower.

B. Provide the following temperature ranges for thermometers:

1. Heating Hot Water: 30 to 200 deg F, with 2-degree scale divisions.
2. Condenser Water: 0 to 100 deg F, with 2-degree scale divisions.

3.2 GAGE APPLICATIONS

A. Install dry-case-type pressure gages for discharge of each pressure-reducing valve.

B. Install liquid-filled-case-type pressure gages at inlet and outlet of cooling tower and boiler.

C. Install liquid-filled-case-type pressure gages at suction and discharge of each pump.

3.3 TEST PLUG APPLICATIONS

A. Inlet and outlet of each water source heat pump.

B. Inlet and outlet of each strainer on coils.

C. Inlet and outlet of each temperature regulating valve.

D. Inlet and outlet of each pressure reducing valve.

E. Both inlets to differential pressure transmitters.

3.4 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.

C. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

D. Install needle-valve and snubber fitting in piping for each pressure gage for fluids.

E. Install test plugs in tees in piping. Install test plugs with sufficient clearance to permit installation of test gauges and thermometers.

3.5 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines and equipment.

3.6 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 230519

SECTION 230523 – GENERAL DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide valves to facilitate maintenance and isolation of piping systems.

B. Related Requirements:

1. Section 017419 – “Construction Waste Management”.
2. Section 018113.14 – “Sustainable Design Requirements - LEED v4 / 4.1 BD+C: New Construction”.
3. Section 019113 – “General Commissioning Requirements”.

1.2 QUALITY ASSURANCE

A. STANDARDS

1. American National Standards Institute (ANSI), American Society of Mechanical Engineers (ASME), American Society for Testing and Materials (ASTM) and the Manufacturers' Standardization Society of the Valve and Fittings Industry (MSS).
2. ANSI B16.10, MSS SP0-67-90 Butterfly Valves..
3. MSS SP-78-92 Cast Iron Plug Valves Flanged and Threaded.
4. MSS SP-80-87 Bronze Gate, Globe, and Check Valves.
5. MSS SP-85-85 Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.
6. MSS SP-110-92 Ball Valves Threaded, Socket-Welded, Solder Joint, Grooved and Flared Ends.

B. To assure uniformity and compatibility of piping components in grooved end piping systems, all grooved products utilized shall be supplied by the same manufacturer.

1.3 DEFINITIONS

A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. NBR: Acrylonitrile-butadiene rubber.
4. PTFE: Polytetrafluoroethylene plastic.
5. SWP: Steam working pressure.
6. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. All similar valves used on the project shall be by the same manufacturer.

B. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.

2.2 VALVES, GENERAL

A. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

B. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

C. Valve Actuators:

1. Lever Handle: For quarter-turn valves NPS 5 and smaller, except plug valves.
2. Wrench: For plug valves with square heads. Furnish Owner with one (1) wrench for every ten (10) plug valves, for each size square plug head.

D. Extended Valve Stems: On insulated valves.

E. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves and ASME B16.24 for bronze valves.

F. Valve Grooved Ends: AWWA C606.

G. Solder Joint: With sockets according to ASME B16.18. Caution: Use solder with melting point below 840 deg F for angle, check, gate, and globe valves; below 421

deg F for ball valves.

H. Threaded Joint: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.3 BALL VALVES (2-1/2 INCHES AND SMALLER)

A. 400 psi WOG, 150 psi steam, bubble-tight against 100 psi, cast bronze body, self-aligning free floating stainless steel ball and stem with full flow port, non-rising stem, Teflon seat and body seal, quarter turn operation, solder joint or screwed ends. Valves to include memory stop and stem extensions for insulated piping.

1. Drain valves with hose fitting, dust cover and chain attachment: Apollo No. 78-144 (or equivalent manufacturer)
2. All other valves: Apollo No. 77-140/240 (or equivalent manufacturer)
3. Manufacturers:

a. Apollo (Basis of Design)
b. Hammond
c. Milwaukee
d. Nibco
e. Watts
f. Victaulic Co. of America

B. Two-Piece Standard Port Ductile Iron Ball Valve, (Sizes 2 inch to 2-1/2 inch):

1. Manufacturer:

a. Victaulic Company Series 726
b. Hammond
c. Milwaukee
d. Watts

2. Description:

a. Standard: MSS SP-72.
b. CWP Rating: 800 psig
c. Body Material: ASTM A 536 Ductile Iron
d. Ends: Grooved.
e. Seats: TFE.
f. Stem: Stainless steel.
g. Ball: Stainless Steel.
h. Port: Full port to match pipe size.

2.4 BUTTERFLY VALVES (3 INCHES AND LARGER)

A. 225 psi line pressure, bubble-tight bi-directionally against 225 psi differential pressure, 250 psi dead end pressure, cast iron lugged type body, double-seated, stainless steel disc, with EPDM seat, stainless steel shaft, bronze bushings, 200° F maximum water temperature.

1. 12 inches and smaller: Keystone Fig. 22 (or equivalent manufacturer)

2. 14 inches and larger : Keystone Fig. AR2 (or equivalent manufacturer)

B. Manufacturers:

1. DeZurik
2. Keystone
3. Milwaukee
4. Nibco
5. Norris
6. Watts

2.5 DUCTILE IRON GROOVED END BUTTERFLY VALVES (3 INCHES AND LARGER)

A. 300 CWP Ductile Iron Grooved End Butterfly Valve:

B. Manufacturer:

1. Victaulic Company Vic-300 MasterSeal and Series W706
2. Keystone
3. Milwaukee

C. Description:

1. Standard: MSS SP-67, Type I.
2. CWP Rating: 300 psig
3. Body Material: Coated, ductile iron.
4. Stem: Two piece stainless steel.
5. Disc: Stainless Steel, Offset.
6. Seal: EPDM.

2.6 CHECK VALVES

A. Pump discharge and vertical piping

1. Semi-steel body, bronze mounted, anti-water hammer type

a. 2-1/2 inches and smaller: Williams No. 329
b. 3 inches and larger: Williams No. 636
c. Manufacturers:

1) McAlear
2) Mission
3) Mueller
4) Williams (Basis of Design)
5) Victaulic Co. of America

B. 2 inches and smaller: 200 psi WOG, bronze swing check, solder joint tubing ends or threaded ends with replaceable composition disc and integral seat.

1. 2 inches and smaller in copper pipe: Powell Fig. 1825 (or equivalent manufacturer).
2. 2 inches and smaller in steel pipe: Powell Fig. 560 (or equivalent manufacturer).

C. 2-1/2 inches and larger: 200 psi WOG, iron body bronze trim, renewable disc; Powell Fig. 559 (or equivalent manufacturer).

D. Manufacturers:

1. Hammond
2. Lunkenheimer
3. Powell (Basis of Design)
4. Victaulic Co. of America

2.7 DUCTILE IRON GROOVED END SPRING-LOADED CHECK VALVES

A. 300 and 230 CWP Ductile Iron Grooved Spring Loaded Check Valves:

B. Manufacturer:

1. Victaulic Company Series W716 and Series W715
2. Mueller
3. Powell

C. Description:

1. CWP Rating: 300 psig.
2. CWP Rating 14 inch and larger: 230 psig
3. Body Material: ASTM-A536 Ductile Iron.
4. Disc: Spring operated, bronze, ductile iron or stainless steel.
5. Seal: EPDM.

2.8 MANUAL CALIBRATED BALANCING VALVES

A. Bell & Gossett Circuit Setter Plus or equal by Armstrong, Taco, Tour & Andersson, Flowset with positive shut-off, memory stop screw or 4-turn digital readout handwheel, drain connection, read-out valves with EPT insert and check valve, insulated cover, bronze or Ametal brass body, brass ball or globe type, carbon filled TFE or Ametal seats, calibrated name plate. Balancing valves to be 30 PSIT/250 Deg, F rated for 1/2” to 3” NPT connections, 200 PSIG/250 Deg, F rated for 1/2” to 3/4” sweat or grooved connections and 125 PSIG/250 Deg, F rated for 4” flanged or grooved connections.

B. Furnish a portable flow measuring instrument for verifying and determining flow. Furnish carrying case, gage, valve block and color coded hoses for low and high pressure connections, and connectors for connection to read-out valves.

2.9 AUTOMATIC FLOW CONTROL BALANCING VALVES

B. Griswald automatic flow control valves or equal by Armstrong, Taco or Nexus Valve with cartridges that automatically control flow rates with plus or minimum 5% accuracy over an operating pressure differential range of at least 14 times the minimum required for control. Valve internal control mechanism shall consist of a stainless steel one-piece cartridge with segmented port design and full travel linear coil spring or equivalent. Body design shall allow inspection or removal of cartridge or strainer without disturbing piping connections. Provide isolation valves on both inlet and outlet side of the balancing valves that permit removal of balancing valve without drain down

of piping. Valves 2-1/2 inch and smaller shall be solder or screwed ends, valves 3 inch and larger shall be flanged.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

F. Examine grooved ends for conditions that might cause leakage. Ends should be free from indentations or projections in the area from the valve end to the groove.

G. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE APPLICATIONS

A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball valves for size 2-1/2” and less; butterfly valves for sizes 3” and larger.
2. Throttling Service: Ball valves for size 2-1/2” and less; butterfly valves for sizes 3” and larger.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

3.3 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions, grooved couplings or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system

shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full stem movement.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Dual-Plate Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

G. Provide sufficient space to allow adjustment of balancing values.

H. Install drain valves in piping at low points and trapped areas to provide complete drainage of all systems.

3.4 JOINT CONSTRUCTION

A. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated. Open valves before soldering.

3.5 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes hangers and supports for mechanical system piping and equipment.

B. Related Requirements:

1. Section 017419 – “Construction Waste Management”.
2. Section 018113.14 – “Sustainable Design Requirements - LEED v4 / 4.1 BD+C: New Construction”.
3. Section 019113 – “General Commissioning Requirements”.

1.2 DEFINITIONS

A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

A. Design channel support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

B. Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

1.4 SUBMITTALS

A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer for multiple piping supports and trapeze hangers. Include design calculations and indicate size and characteristics of components and fabrication details.

C. Welding Certificates: Copies of certificates for welding procedures and operators.

1.5 QUALITY ASSURANCE

A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified:

1. Pipe Hangers:

   a. Grinnell Corp.
   b. Michigan Hanger Co., Inc.
   c. National Pipe Hanger Corp.
   d. PHD Manufacturing, Inc.

2. Channel Support Systems:

   a. Grinnell Corp.; Power-Strut Unit.
   b. Michigan Hanger Co., Inc.; O-Strut Div.
   c. National Pipe Hanger Corp.
   d. Thomas & Betts Corp.
   e. Unistrut Corp.

3. Thermal-Hanger Shield Inserts:

   a. Michigan Hanger Co., Inc
   b. Pipe Shields, Inc.
   c. Rilco Manufacturing Co., Inc.
   d. Value Engineered Products, Inc.

4. Powder-Actuated Fastener Systems:

   a. Gunnebo Fastening Corp.
   b. Hilti, Inc.
   c. ITW Ramset/Red Head.
   d. Masterset Fastening Systems, Inc.

2.2 MANUFACTURED UNITS

A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.

1. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.
2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.

1. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

C. Thermal-Hanger Shield Inserts: 100 psi minimum compressive-strength insulation, encased in sheet metal shield.

1. Material for Cold Piping: ASTM C 552, Type I cellular glass with vapor barrier.
2. Material for Hot Piping: ASTM C 552, Type I cellular glass.
3. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
4. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
5. Insert Length: Extend 2" beyond sheet metal shield for piping operating below ambient air temperature.

2.3 MISCELLANEOUS MATERIALS

A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

C. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.

D. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.

1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
2. Properties: Nonstaining, noncorrosive, and nongaseous.
3. Design Mix: 5000-psi 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger requirements are specified in Sections specifying equipment and systems.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.

C. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated stationary pipes, NPS ½ to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
3. Carbon-or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of

insulation.

4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
5. Adjustable Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated stationary pipes, NPS 3/4 to NPS 2.
6. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 2.
7. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 2.
8. U-Bolts (MSS Type 24): For support of heavy pipe, NPS 1/2 to NPS 30.
9. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
10. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36 , with steel pipe base stanchion support and cast-iron floor flange.
11. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from two (2) rods if longitudinal movement caused by expansion and contraction might occur.
12. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
13. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.

D. Hanger Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

E. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.

7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32):1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where head room is limited.

F. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360-degree insert of high-density, 100-psi minimum compressive-strength, cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.

G. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.

3.2 HANGER AND SUPPORT INSTALLATION

A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.

1. Field assemble and install according to manufacturer's written instructions.

C. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.

D. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

E. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

F. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

H. Install hangers and supports to allow controlled thermal of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.

K. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.

a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert. Include steel weight distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
c. Do not exceed pipe stress limits according to ASME B31.9.

2. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick..
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.

3. Pipes NPS 8 and Larger: Include wood inserts.
4. Insert Material: Length at least as long as protective shield.
5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

L. Supports from roof decking systems are not permitted.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

3.4 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.

B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

A. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 230529

SECTION 230548 - VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Elastomeric isolation pads.
2. Freestanding and restrained spring isolators.
3. Housed spring mounts.
4. Elastomeric hangers.
5. Spring hangers.

B. Related Sections:

1. Section 017419 – “Construction Waste Management”.
2. Section 018113.14 – “Sustainable Design Requirements - LEED v4 / 4.1 BD+C: New Construction”.
3. Section 019113 – “General Commissioning Requirements”.

1.2 SUBMITTALS

A. Product Data: Include load deflection curves for each vibration isolation device.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.

1. Amber/Booth Company, Inc.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.
4. Vibration Eliminator Co., Inc.
5. Vibration Mountings & Controls/Korfund.

B. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Material: Standard neoprene.

C. Elastomeric Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-Code or otherwise identify to indicate capacity range.

D. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 100 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

E. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4 inch thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

F. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.

1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
2. Base: Factory drilled for bolting to structure.
3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel before contacting a resilient collar.
4. Static deflection: 2 inches.

G. Elastomeric Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range. Static deflection: 0.5 inches.

H. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

2.2 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be electro-galvanized. Hot-dip galvanized metal components for exterior use.
3. Baked enamel for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Provide vibration isolators for equipment and piping as indicated on the design drawings and as required by other sections of Division 23.

B. Install steel angles or channel, sized to prevent buckling, clamped with ductile-iron clamps to hanger rods for trapeze and individual pipe hangers. At trapeze anchor locations, shackle piping to trapeze. Requirements apply equally to hanging equipment. Do not weld angles to rods.

C. Install resilient bolt isolation washers on equipment anchor bolts.

3.3 QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. Isolator deflection.
2. Snubber minimum clearances.

3.4 ADJUSTING

A. Adjust isolators after piping systems have been filled and equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal

operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust snubbers according to manufacturer's written recommendations.

E. Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces.

3.5 CLEANING

A. After completing equipment installation, inspect vibration isolation devices. Remove paint splatters and other spots, dirt, and debris.

END OF SECTION 230548

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. IDENTIFY BY LABELS AND TAGS THE FOLLOWING ITEMS

1. Equipment such as exhaust fans, water source heat pumps, cooling towers, boilers, control cabinets, etc.
2. Piping, valves and ductwork exposed in equipment rooms and accessible service areas.
3. Piping, valves and ductwork running above accessible ceiling construction and near access panels in non-accessible construction areas.
4. All temperature control valves and automatic control dampers.

B. Install laminated plastic markers and metal stamped nameplates for equipment. Provide color banding, flow arrows and contents identification for piping and ductwork.

1.2 SUMMARY

A. This Section includes the following mechanical identification materials and their installation:

1. Equipment nameplates.
2. Equipment markers.
3. Pipe markers.
4. Stencils.
5. Valve tags.
6. Valve schedules.
7. Warning tags.

B. Related Requirements:

1. Section 017419 – “Construction Waste Management”.
2. Section 018113.14 – “Sustainable Design Requirements - LEED v4 / 4.1 BD+C: New Construction”.
3. Section 019113 – “General Commissioning Requirements”.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Valve numbering scheme.

D. Valve Schedules: For each piping system. Furnish three extra copies (in addition to mounted copies) to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, “Scheme for the Identification of Piping Systems,” for letter size, length of color field, colors and viewing angles of identification devices for piping.

1.5 COORDINATION

A. Coordination installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. All trades shall use the same type, style and appearance of identification.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:

a. Manufacturer, product name, model number, and serial number.
b. Capacity, operating and power characteristics, and essential data.
c. Labels of tested compliances.

2. Location: Accessible and visible.
3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, laminated plastic, white lettering on black background. Markers shall be screw on, except where screws might damage equipment, use a contact-type permanent adhesive.

1. Terminology: Match schedules as closely as possible.
2. Size: Sized for 3/4-inch lettering.

2.2 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

1. Colors: As indicated in specification schedule.

2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
3. Pipes with OD, including insulation, less than 6 inches: Full-band pipe markers extending 360 degrees around pipe at each location.
4. Pipes with OD, including insulation, 6 inches and larger: Either full-band or strip-type pipe markers at least three (3) times letter height and of length required for label.
5. Arrows: A separate unit on each pipe marker to indicate direction of flow. 2.3

2.3 VALVE TAGS

A. Valve Tags: 2" diameter tag stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme, approved by Engineer. Provide 5/32-inch hole for fastener.

1. Material: 16 gauge brass.
2. Valve-Tag Fasteners: Brass beaded chain.

2.4 VALVE SCHEDULES

A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulation), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
2. Frame: Extruded aluminum.
3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.5 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 15 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

B. Installing Contractor is responsible for valve tagging, equipment markers and pipe identification of all valves.

3.2 EQUIPMENT IDENTIFICATION

A. Install equipment markers with screws, or, if screws might damage equipment, use permanent adhesive on or near each major item of mechanical equipment.

1. Locate markers where accessible and visible. Include markers for the following general categories of equipment:

a. Evaporative cooling tower.
b. Boilers.
c. Pumps.
d. Water source heat pumps units.

3.3 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service of each piping system. Install with flow indication arrows showing direction of flow.

B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior non-concealed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and non-accessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings.

C. Pipe Identification

TYPE OF SERVICE	1" BAND COLOR	1/2" BAND COLOR	DESIGNATION
Condensate Drain	Black	Black	DR
Heating Water Supply	Yellow	Red	HWS
Heating Water Return	Yellow	Orange	HWR
Condenser Water Supply	Green	Green	CWS
Condenser Water Return	Green	Yellow	CWR
Make-up Water	Blue	White	MUW

3.4 VALVE TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves with captions similar to those indicated in the following:

TYPE OF SERVICE	VALVE TAG DESIGNATION
Heating Water Supply	HWS
Heating Water Return	HWR
Condenser Water Supply	CWS
Condenser Water Return	CWR

3.5 VALVE SCHEDULE INSTALLATION

A. Mount valve schedule on wall in accessible location where directed by Owner. Provide aluminum frame with plexiglass cover for valve chart.

3.6 WARNING TAG INSTALLATION

A. Write required message on, and attach warning tags to equipment and other items where required.

3.7 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work. Stencils, name tags, etc. must be readable from a standing position.

B. When arrows and letters cannot be stenciled on pipe, stencil identification on 16 gauge aluminum metal panels in correct color and hang panel on piping with key chains.

3.8 CLEANING

A. Clean faces of mechanical identification devices and glass and frames of valve schedules.

END OF SECTION 230553

SECTION 230593 - TESTING ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. The testing, adjusting and balancing work as specified in this section is to be performed by a certified balancing contractor (TAB) engaged by the Architect. Contractor shall provide all necessary assistance and coordination with the testing, adjusting and balancing to the (TAB) contractor as required to complete the balancing work and generate the balancing report as specified in this section.

B. This Section includes testing, adjusting and balancing to produce design objectives for the following:

1. Variable refrigerant flow fan coils to obtain airflow on plans and scheduled
2. Variable refrigerant flow cassettes to obtain scheduled airflow.
3. Water Source Heat Pumps
4. Air Systems:

    a. Packaged Roof top Units
    b. DOAS units
    c. Make Up Air Units
    d. Heat Pumps

5. Hydronic Piping Systems

    a. Condenser Water Systems
    b. Hot water Heating Systems

6. HVAC equipment quantitative-performance settings.
7. Verifying that automatic control devices are functioning properly.
8. Reporting results of activities and procedures specified in this Section.

C. Related Sections:

1. Section 017419 – “Construction Waste Management”.
2. Section 018113.14 – “Sustainable Design Requirements - LEED v4 / 4.1 BD+C: New Construction”.
3. Section 019113 – “General Commissioning Requirements”.

1.2 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including sub-mains, branches, and terminals, according to indicated quantities.

C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors,

and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

E. NC: Noise criteria.

F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

G. RC: Room criteria.

H. Report Forms: Test data sheets for recording test data in logical order.

I. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

J. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

K. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

L. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

M. TAB: Testing, adjusting, and balancing.

N. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

O. Test: A procedure to determine quantitative performance of systems or equipment.

P. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.3 SUBMITTALS

A. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit two (2) copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit two (2) copies of the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 90 days from Contractor's Notice to Proceed, submit two (2) copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.

D. Certified TAB Reports: Submit two (2) copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

E. Sample Report Forms: Submit two (2) sets of sample TAB report forms.

F. Warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.

B. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven (7) days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:

a. Submittal distribution requirements.
b. The Contract Documents examination report.
c. TAB plan.
d. Work schedule and Project-site access requirements.
e. Coordination and cooperation of trades and subcontractors.
f. Coordination of documentation and communication flow.

C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems”, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems", SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing", or TAB firm's forms approved by Engineer.

E. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

F. Instrumentation Calibration: Calibrate instruments at least every six (6) months or more frequently if required by instrument manufacturer.

1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.5 PROJECT CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.6 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven (7) days' advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed

1.7 WARRANTY

A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents or provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB frim fails to comply with the Contract Documents. Guarantee shall include the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS - NOT APPLICABLE

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

1. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine Project Record Documents described in Division 1 Section "Project Record

Documents."

D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

G. Examine system and equipment test reports.

H. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

I. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.

K. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

L. Examine strainers for clean screens and proper perforations.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine equipment for installation and for properly operating safety interlocks and controls.

P. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices are operated by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in variable-air-volume terminals.

4. Automatic modulating and shutoff valves, including two-way valves, are properly connected.
5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes is according to the Contract Documents.
8. Controller set points are set at indicated values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to indicated values.

Q. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling unit components.

L. Check for proper sealing of air duct system.

3.5 PROCEDURES FOR CONSTANT VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure fan static pressures to determine actual static pressure as follows:

a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
b. Measure static pressure directly at the fan outlet or through the flexible connection.
c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

2. Measure static pressure across each component that makes up a rooftop unit.

a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.

3. Measure static pressures entering and leaving other devices such as sound traps and heat recovery equipment, under final balanced conditions.
4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
5. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, belt, sheaves, motor sizes, and electrical connections to accommodate fan-speed changes including changing of belts, pulleys and sheaves.
6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in; full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, sub-main ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

a. Where sufficient space in sub-main and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Re-measure each sub-main and branch duct after all have been adjusted. Continue to adjust sub-main and branch ducts to indicated airflows within specified tolerances.

C. Measure terminal outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in

addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check expansion tank liquid level.
3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.
9. Check ethylene glycol percent by volume in chilled water system.

3.7 PROCEDURES FOR HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 5% of design.

B. Verify flow rate through automatic flow control valves.

C. Measure flow at all stations and adjust, where necessary, to obtain first balance.

D. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

E. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.8 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.
2. Motor horsepower rating.
3. Motor rpm.

4. Efficiency rating.
5. Nameplate measured voltage and amperage for each phase.
6. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Record observations, including: controller manufacturer, model and serial numbers, and nameplate data.

3.9 PROCEDURES FOR TEMPERATURE MEASUREMENTS

A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet and dry bulb temperatures every other hour for a period of two (2) successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside air, wet and dry-bulb temperatures.

3.10 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Check the operation of limiting controllers (i.e., high and low temperature controllers).

E. Check free travel and proper operation of control devices such as damper and valve operators.

F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.

G. Check the interaction of electrically operated switch transducers.

H. Check the interaction of interlock and lockout systems.

I. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or non-grounded power supply.

3.11 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:

1. Supply and Exhaust Fans: Plus 5% to plus 10%.
2. Air Outlets and Inlets: 0 to minus 10%.
3. Heating-Water Flow Rate: 0 to minus 10%.
4. Cooling-Water Flow Rate: 0 to minus 5%.

3.12 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system.

3.13 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

   1. Include a list of instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to certified field report data, include the following:

   1. Pump curves.
   2. Fan curves.
   3. Manufacturers' test data.
   4. Field test reports prepared by system and equipment installers.
   5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:

   1. Title page.
   2. Name and address of TAB firm.
   3. Project name.
   4. Project location.
   5. Architect's name and address.
   6. Engineer's name and address.
   7. Contractor's name and address.
   8. Report date.
   9. Signature of TAB firm who certifies the report.
   10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
   11. Summary of contents including the following:

      a. Indicated versus final performance.
      b. Notable characteristics of systems.

c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer, type size, and fittings.
14. Notes to explain why certain final data in the body of reports varies from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outside, return, and exhaust air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet and dry bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Settings for supply air, static pressure controller.
    g. Other system operating conditions that affect performance.

E. Water Source Heat Pump Test Reports: For air-handling units with coils, include the following:

1. Unit Data: Include the following:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement

2. Motor Data:

    a. Make and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.

3. Test Data (Indicated and Actual Values):

    a. Total airflow rate in cfm.
    b. Total system static pressure in inches wg.
    c. Fan speed.
    d. Discharge static pressure in inches wg.
    e. Filter static pressure differential in inches wg.
    f. Outside airflow in cfm.
    g. Return airflow in cfm.
    h. Outside air damper position.

F. Fan Test Reports: For supply fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class

2. Motor Data:

a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full load amperage and service factor.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Discharge static pressure in inches wg.
d. Suction static pressure in inches wg.

G. Air-Terminal-Device Reports:

1. Unit Data:

a. System and heat pump unit identification.
b. Location and zone.
c. Test apparatus used.
d. Area served.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Air velocity in fpm.
c. Preliminary airflow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final airflow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

H. Pump Test Reports:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.

e. Model and serial numbers.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full open flow rate in gpm.
e. Full open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

I. Closed Circuit Cooling Towers:

1. Unit Data

a. Identification/number
b. Manufacturer
c. Capacity
d. Model number
e. Serial number
f. Entering water temperature, design and actual
g. Leaving water temperature, design and actual
h. Pressure drop, design and actual
i. Water flow rate, design and actual
j. Entering dry bulb air temperature, design and actual
k. Entering wet bulb air temperature, design and actual

J. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.14 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.

2. Randomly check the following for each system:

   a. Measure airflow of at least 10% of air outlets.
   b. Measure water flow of at least 5% of terminals.
   c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
   d. Verify that balancing devices are marked with final balance position.
   e. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of Architect.
3. Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10% of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8 hour business day.
4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10% of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.15 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230700 - PIPE INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes preformed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

B. Related Requirements:

1. Section 017419 – “Construction Waste Management”.
2. Section 018113.14 – “Sustainable Design Requirements - LEED v4 / 4.1 BD+C: New Construction”.
3. Section 019113 – “General Commissioning Requirements”.

1.2 SUBMITTALS

A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

B. Shop Drawings: Show fabrication and installation details for the following:

1. Application of protective shields, saddles, and inserts at pipe hangers for each type of insulation and hanger.
2. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
3. Removable insulation at piping specialties and equipment connections.
4. Application of field-applied jackets.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.

C. ASHRAE Standards: Comply with performance efficiencies prescribed for ASHRAE 90.1, "Energy Efficient Design for New Buildings, Except Low Rise Residential Buildings" for pipe insulation.

D. No damaged or water soaked insulation shall be used.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.5 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields.

B. Coordinate clearance requirements with piping installer for insulation application.

1.6 SCHEDULING

A. Schedule insulation application after testing piping systems. Insulation application may begin on segments of piping that have satisfactory test results.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.

1. Mineral-Fiber Insulation:

a. CertainTeed Manson.
b. Knauf FiberGlass GmbH.
c. Owens-Corning Fiberglas Corp.
d. Schuller International, Inc.
e. Armacell

2.2 INSULATION MATERIALS

A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:

1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
2. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:

a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.

3. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
4. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
5. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

B. Cellular-Glass Insulation: Foamed glass, annealed, rigid, hermetically sealed cells, incombustible. Preformed Pipe Insulation, with Jacket: Comply with ASTM C 552, Type II, Class 2.

C. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-ruber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Adhesive: As recommended by insulation material manufacturer.

D. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves.

2.3 FIELD-APPLIED JACKETS

A. General: ASTM C 921, Type 1, unless otherwise indicated.

B. Standard PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil thick, high-impact, ultraviolet-resistant PVC.

1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps and mechanical joints.
2. Adhesive: As recommended by insulation material manufacturer.

C. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to indicated sizes. Comply with ASTM B 209, 3003 alloy, H-14 temper.

1. Finish and Thickness: Stucco-embossed finish, 0.020-inch thick.
2. Moisture Barrier: 1-mil thick, heat-bonded polyethylene and kraft paper.
3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.

2.4 ACCESSORIES AND ATTACHMENTS

A. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:

1. Aluminum: 0.007 inch thick.

B. Wire: 0.080 inch, nickel-copper alloy; 0.062 inch, soft-annealed, stainless steel; or 0.062 inch soft-annealed, galvanized steel.

C. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave pre-sized a minimum of 14.3 oz./sq. yd.

1. Tape Width: 4 inches.

2.5 VAPOR RETARDERS

A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.

E. Apply multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

H. Keep insulation materials dry during application and finishing.

I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

J. Apply insulation with the least number of joints practical.

K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.

L. Hangers and Anchors:

1. Apply insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper

insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.

O. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.
2. Circumferential Joints: Cover with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.
3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.

    a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.

4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.

P. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.

Q. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.

R. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.

1. Firestopping and fire-resistive joint sealers are specified in Division 7 Section "Firestopping."

S. Floor Penetrations: Apply insulation continuously through floor assembly.

1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

3.4 MINERAL FIBER INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet to form a vapor retarder between pipe insulation segments.
3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches on center.
4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
5. All exposed ends for mineral fiber insulation shall be neatly trimmed and beveled. All exposed insulation material shall be covered with mastic.

B. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch, and seal joints with vapor-retarder mastic.

C. Apply insulation to fittings and elbows as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions and cover with insulating cement trowelled smooth.
2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with tape and cover with insulating cement trowelled smooth.
3. Cover fittings with standard PVC fitting covers.

D. Apply insulation to valves and specialties as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.

3.5 CELLULAR GLASS INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of insulation to pipe with wire, tape, or bands without deforming insulation materials.
2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic.
3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
5. All exposed ends for mineral fiber insulation shall be neatly trimmed and beveled. All exposed insulation material shall be covered with mastic.

3.6 FIELD APPLIED JACKET APPLICATION

A. Apply aluminum metal jacket for all exterior make-up water and condenser water piping, with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal joints with weatherproof sealant recommended by insulation cover manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

B. Provide PVC fitting covers for all exposed piping that is to be insulated. For Victaulic piping, provide PVC fitting covers for all fittings and couplings.

3.7 PIPING SYSTEM APPLICATIONS

A. Materials and thicknesses for systems listed below are specified in schedules within this section.

B. Insulate the following piping systems:

1. Insulate heating hot water supply and return piping with glass fiber insulation
2. Insulate all make-up water piping and outdoor condenser water supply and return piping with glass fiber insulation.
3. Insulate indoor VRF system refrigerant piping with closed cell elastomeric insulation
4. Insulate outdoor VRF system refrigerant piping with closed cell elastomeric insulation and cover with manufacturers protective painted finish.
5. Insulate condensate drain piping with closed cell elastomeric insulation.

C. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:

1. Flexible connectors.
2. Vibration-control devices.
3. Fire-suppression piping.
4. Below-grade piping, unless otherwise indicated.
5. Hot water air chambers, unions, strainers, check valves, plug valves, and flow regulators.

D. MINIMUM INSULATION THICKNESS FOR PIPE SIZES

PIPING SYSTEM TYPES	FLUID TEMPERATURE RANGES (DEG. F)	LESS THAN 1" (INCHES)	1" TO 1-1/4" (INCHES)	1-1/2" TO 3" (INCHES)	4" AND LARGER (INCHES)
Hot Water Heating	Any	1.5	1.5	1.5	1.5
Condenser Water	Any (Outdoors)	1.0	1.0	1.0	1.0
Make-up Water	Any (Outdoors)	1.0	1.0	1.0	1.0
Make-up Water	Any (Indoors)	1.0	1.0	1.0	1.0

NOTE: The minimum listed thickness is based on a minimum R valve of 4.6. Thickness to vary if the insulation R value is different than 4.6. In addition, the minimum thickness is to be increased as required to meet ASHRAE 90.1.

E. Insulation at fire walls: All insulated piping penetrating walls with a fire resistive rating shall be insulated with molded foam glass; “ASJ-SSL” covering with a dual purpose fireproof, kraft aluminum foil, laminated white jacket. Insulation to be of same thickness as adjoining insulation.

F. REFRIGERANT PIPING AND CONDENSATE DRAIN PIPING

1. Pipe Insulation: 3/4 inch thick (or per Ashrae 90.1-2010, whichever is greater), fire retardant, flexible elastomeric thermal insulation.
2. Exposed Exterior Insulation: Cover with two coats of the insulation manufacturer’s coating that is recommended for UV protection.

F. PIPE INSULATING SUPPORT

1. On insulated piping with pipe supports around outside of covering provide galvanized steel formed bearing plates. Plates to be lined with length of foam glass insulation.

   a. 8" and smaller pipe: 12" long, 12 gauge plate

3.8 FIELD QUALITY CONTROL

A. Insulation applications will be considered defective if sample inspection reveals noncompliance with requirements. Remove defective Work and replace with new materials according to these Specifications.

END OF SECTION 230700

SECTION 230702 - DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes blanket insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

B. This Section includes semirigid and flexible duct and plenum insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

C. Related Requirements:

1. Section 017419 – “Construction Waste Management”.
2. Section 018113.14 – “Sustainable Design Requirements - LEED v4 / 4.1 BD+C: New Construction”.
3. Section 019113 – “General Commissioning Requirements”.

1.2 SUBMITTALS

A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

B. Shop Drawings: Show fabrication and installation details for the following:

1. Removable insulation sections at access panels.
2. Application of field-applied jackets.
3. Applications at linkages for control devices.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.

C. ASHRAE Standards: Comply with performance efficiencies prescribed for ASHRAE 90.1, "Energy Efficient Design For New Buildings, Except Low Rise Residential Buildings" for duct insulation.

D. No damaged or water soaked insulation shall be used.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.5 COORDINATION

A. Coordinate clearance requirements with duct Installer for insulation application.

1.6 SCHEDULING

A. Schedule insulation application after testing duct systems. Insulation application may begin on segments of ducts that have satisfactory test results.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified:

1. Mineral-Fiber Insulation:

a. CertainTeed Manson.
b. Knauf FiberGlass GmbH.
c. Owens-Corning Fiberglas Corp.
d. Schuller International, Inc.
e. Aeroflex USA Inc.; Aerocel.
f. Armacell LLC; AP Armaflex.
g. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
h. Kflex USA
i. Therma-Duct
j. AQC Industries

2.2 INSULATION MATERIALS

A. Mineral Fiber Board Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, without facing and with all-service jacket manufactured from aluminum foil, skrim kraft, vapor seal.

B. Mineral Fiber Blanket Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, without facing and with all-service jacket manufactured from aluminum foil, skrim kraft, vapor seal.

C. Duct Liner: Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

2.3 FIELD APPLIED JACKETS

A. General: ASTM C 921, Type 1, unless otherwise indicated.

B. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.

C. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.

1. Sheet and roll stock ready for shop or field sizing.
2. Finish and thickness are indicated in field-applied jacket schedules.
3. Factory-Fabricated Fitting Covers:

a. Same material, finish, and thickness as jacket.
b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
c. Tee covers.
d. Flange and union covers.
e. End caps.
f. Beveled collars.
g. Field fabricate fitting covers only if factory-fabricated fitting covers are not available

2.4 ACCESSORIES AND ATTACHMENTS

A. Wire: 0.062-inch, soft-annealed, galvanized steel.

B. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts and plenums; and to achieve a holding capacity of 100 lb for direct pull perpendicular to the adhered surface.

C. Self-Adhesive Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

2.5 VAPOR RETARDERS

A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials

that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts and fittings.

B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each duct system.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Apply multiple layers of insulation with longitudinal and end seams staggered.

E. Keep insulation materials dry during application and finishing.

F. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

G. Apply insulation with the least number of joints practical.

H. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

I. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.
2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.

J. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.

K. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.

L. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations.

M. Provide weld pins located a maximum of 18 inches on center for all insulation serving ductwork that has a width or height dimension that exceeds 20 inches.

N. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.

1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.

3.4 MINERAL-FIBER INSULATION APPLICATION

A. Blanket or Board Applications for Ducts and Plenums: Secure blanket insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install anchor pins and speed washers on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

   a. On duct sides with dimensions 18 inches and smaller, along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches on center.
   b. On duct sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3 inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
   c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not over-compress insulation during installation.

4. Impale insulation over anchors and attach speed washers.
5. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
6. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1 inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
7. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Apply insulation on round duct elbows with individually mitered gores cut to fit the elbow.
8. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.

3.5 FIELD APPLIED JACKET APPLICATION

A. Apply aluminum jacket directly over flexible elastomeric insulation located exterior to the building or in unconditioned mechanical spaces.

1. Apply aluminum jacket as recommended by the manufacturer.
2. Completely encapsulate insulation with jacket leaving no exposed raw insulation.
3. Seal watertight.

B. Pre-fabricated exterior jacketed duct is acceptable. Duct shall meet all insulation requirements and field dimensions.

1. Therma-Duct

2. Q-Duct

3.6 DUCT SYSTEM APPLICATIONS

A. Materials and thicknesses for systems listed below are specified in schedules at the end of this Section.

B. Insulate the following plenums and duct systems:

1. Indoor concealed outside air and supply air ductwork.
2. Indoor exposed outside air and supply air ductwork.
3. Outdoor exposed outside air and exhaust air ductwork.
4. Indoor exhaust air ductwork extending within ten feet of an exterior wall or roof termination.

C. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:

1. Metal ducts with duct liner.
2. Manufactured double wall, insulated duct systems.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
5. Flexible connectors.
6. Vibration-control devices.
7. Testing agency labels and stamps.
8. Nameplates and data plates.
9. Access panels and doors in air-distribution systems.

3.7 DUCT AND PLENUM APPLICATION SCHEDULE

A. Service: Indoor round outside air, supply air and exhaust air ducts; concealed.

1. Material: Mineral-fiber blanket.
2. Thickness: 1-1/2 inches.
3. Minimum R value: 3.5.
4. Number of Layers: One.

B. Service: Indoor rectangular outside air, supply air and exhaust air ducts; concealed.

1. Material: Mineral-fiber blanket.
2. Thickness: 1-1/2 inches.
3. Minimum R value: 3.5.
4. Number of Layers: One.

C. Service: Indoor round outside air, supply air and exhaust air ducts; exposed.

1. Material: Mineral-fiber blanket.
2. Thickness: 1-1/2 inches.
3. Minimum R Value: 3.5.
4. Number of Layers: One.

D. Service: Indoor rectangular outside air, supply air and exhaust air ducts; exposed.

1. Material: Mineral-fiber blanket.
2. Thickness: 1-1/2 inches.
3. Minimum R Value: 3.5.
4. Number of Layers: One.

E. Service: Outdoor rectangular outside air and exhaust air ducts; exposed.

1. Material: Flexible Elastomeric/ Mineral Fiber Blanket
2. Thickness: 2 inches.
3. Minimum R Value: 6.0.
4. Number of Layers: Two
5. Covering: Aluminum Jacket.

6. Pre-manufactured exterior duct is also acceptable if meets insulation requirements.

a) Therma-Duct

b) Q-Duct

END OF SECTION 230702

SECTION 230800 - HVAC COMMISSIONING

PART 1 - GENERAL

1.1 OWNER FURNISHED

A. See Section 019113 – General Requirements - Commissioning

1.2 RELATED DOCUMENTS

A. All drawings and general provisions of the contract, including all other Division 01 and general and supplementary conditions.

B. Section 019113 – General Requirements – Commissioning

1.3 SUMMARY

A. The purpose of the commissioning process is to provide the owner/operator of the facility with a high level of assurance that the mechanical systems have been installed in the prescribed manner, and operate within the performance guidelines set in the Contract Documents. The Commissioning Authority shall provide the owner with an unbiased, objective view of the system's installation, operation, and performance. This process is not intended to take away or reduce the responsibility of the design team or installing contractors to provide a finished product. Commissioning is intended to enhance the quality of system start-up and aid in the orderly transfer of systems for beneficial use by the owner. The Commissioning Authority will be a member of the construction team, administrating and coordinating commissioning activities with the design team, construction manager, subcontractors, manufacturers and equipment suppliers.

1.4 REFERENCES

A. See Section 019113 – General Requirements - Commissioning

1.5 SCOPE

A. See Section 019113 – General Requirements - Commissioning

1.6 HVAC SYSTEMS / EQUIPMENT INCLUDED IN THE COMMISSIONING PROCESS:

A. Air Handling Units

B. DOAS Units

C. Energy Recovery Modules

D. Make-up Air Unit

E. Air Cooled Condensing Units

F. Variable Refrigerant Flow Systems

G. Heat Pumps

H. Ductless Split AC units

I. Terminal Heaters

J. Pumps

K. Exhaust Fans

L. VFDs

M. DDC Control Systems

PART 2 - COMMISSIONING PLAN

2.1 COMMISSIONING PLAN DOCUMENT

A. See Section 019113 – General Requirements - Commissioning

2.2 COMMISSIONING TEAM

A. See Section 019113 – General Requirements - Commissioning

2.3 CONTRACT DOCUMENT

A. See Section 019113 – General Requirements - Commissioning

2.4 COMMISSIONING MEETINGS

A. See Section 019113 – General Requirements - Commissioning

2.5 MASTER FINDINGS LIST

A. The installing contractor will complete and document Pre-Functional Testing. Commissioning Agent conducts Functional Testing with assistance of installing contractor.

B. All findings from these inspections are documented and are posted to the master findings list and website within two business days.

C. Construction Manager (CM) will regularly distribute findings list to contractors and will hold contractor accountable to: 1.) correct any items and/or 2.) provide electronic responses for each finding.

D. Responsible contractor will correct finding(s) and provide written confirmation that the finding(s) have/has been corrected. If finding was not corrected, contractor provides written explanation.

E. Commissioning findings' status may be considered during the pay application approval process. Approval may be withheld due to unresolved findings and/or findings where written responses have not been provided.

F. CM provides responses back to CxA. All responses are updated to the Master Findings List.

G. Once written responses are provided for each finding, the CxA will re-inspect. The contractor will be back-charged at a rate not to exceed the CxA contract hourly rate for any finding(s) that was/were reported to have been resolved and that are found to be unresolved upon re-inspection.

H. Status will be tracked for each finding and the Master Findings List will be updated accordingly.

I. Once all findings have been resolved and the job is completed, a Final Report will be generated and a final commissioning meeting will be held.

2.6 PRE-FUNCTIONAL TESTING / MANUFACTURER'S CHECKLISTS

A. The installing contractor will complete the Pre-Functional Testing forms for each piece of equipment prior to start-up.

B. The equipment manufacturers' checklists must be completed by the installing contractor and reviewed by the Commissioning Authority before start-up can commence.

2.7 START-UP

A. Start-up of major HVAC systems may be witnessed by the Commissioning Authority. The appropriate contractors and/or manufacturer's representative will be required on site to perform start-up. No system will be started until the appropriate Pre-Functional Testing forms have been completed. No system will be started until the Manufacturer's checklists have been completed. Start-up will be performed according to the Manufacturer's recommended procedures. The Commissioning Authority may visit the site to review completeness of installation in conjunction with progress meetings prior to starting HVAC equipment.

B. Construction team members involved in installation, fabrication, manufacture, control, or design of equipment are required to be present at the time of start-up. A factory-authorized technician will be on site to start equipment when required by the specifications. This will minimize delays in bringing equipment on line and expedite

acceptable functional performance in accordance with the Owner's Project Requirements (OPR) and the Basis of Design (BOD).

2.8 CONTROLS MONITORING

A. Close monitoring of the Control Contractor's progress will promote efficient coordination of the Test and Balance (TAB) work. The DDC Contractor will be expected to submit point-to-point checklists verifying that his work has been completed and all systems are ready for TAB work and Functional Performance Testing. Programming and graphics will be surveyed by the Commissioning Authority for completeness and conformance with the Owner's Project Requirements (OPR), the Basis of Design (BOD) and the owner's scheduling requirements.

2.9 TAB MONITORING

A. The preliminary TAB report set-up will be reviewed prior to HVAC equipment start-up, in order to assure that the final TAB report format and content is acceptable.

B. TAB work will be monitored so that any problems that prevent or hinder proper air and water balance can be addressed and corrected with minimal delays. By addressing these problems as quickly as possible, we can assure that functional performance testing and owner training will take place on schedule.

C. A pencil copy of the TAB report will be reviewed prior to submission of the final TAB report. A TAB report approved by the Design Engineer of Record will be required before Functional Performance Testing can be carried out. The Commissioning Authority will visit the site during the TAB process as necessary to verify proper means and methods.

2.10 FUNCTIONAL TESTING

A. The Commissioning Authority will perform or witness installing contractor or manufacturer's representative performing Functional Testing based on the Owner's Project Requirements (OPR) and the Basis of Design (BOD). These tests will be completed for HVAC systems and subsystems.

B. Each major system will be tested. A random sample of each subsystem will be tested. This may be coordinated and witnessed by the Commissioning Authority and the owner's maintenance staff. Witnessing the FPT's will serve as a compliment to the O&M Training. No Functional Testing will be performed until the TAB report and the control contractor Point Installation Verification Checklists have been submitted and reviewed by the Commissioning Authority.

C. Off-season mode testing will be implemented as necessary to assure conformance with the Owner's Project Requirements (OPR) and the Basis of Design (BOD). Installing contractors will be expected to participate as required by the project specifications.

2.11 BUILDING TURN-OVER / OWNER ORIENTATION / USER TRAINING

A. Owner training will be provided by the installing contractor, or manufacturer's representative, and may be witnessed by the Commissioning Authority. This training should include both classroom training and hands-on operational training. The owner may choose to videotape this training for future use. The Commissioning Authority may visit the site during the Turn-Over and Training period to assure that any on-going HVAC related problems are being addressed and corrected in a timely and efficient manner.

B. The Commissioning Authority will assist in the coordination of off-season testing, calibrating, and servicing as specified in the contract documents.

2.12 WARRANTY REVIEW

A. The Commissioning Authority will participate in a 10-month walk-through to observe the operation of the HVAC system. This will include a review meeting with the Facility Maintenance Department, a discussion of warranty issues, energy usage, maintenance practices, usage changes, and chronic problems, as well as other issues affecting the owner and the operation of the HVAC systems.

PART 3 - EXECUTION

3.1 RESPONSIBILITIES OF HVAC EQUIPMENT / SYSTEM INSTALLER

A. The installing contractor in this division shall include in their quote the cost of participating in the commissioning process.

B. Include requirements for submittal data (including partial load data), O&M data, and training in each purchase order or sub-contract.

C. Assure cooperation and participation of specialty sub-contractors such as sheet metal, piping, refrigeration, and water treatment in commissioning activities.

D. Assure participation of major equipment manufacturers in appropriate startup, training, and testing activities.

E. Attend commissioning specific meetings scheduled by the Commissioning Authority or Construction Manager.

F. Assist and participate with the Commissioning Authority in system verification and performance testing, both Pre-Functional and Functional, to achieve design intent.

G. Prepare preliminary schedule for HVAC system inspections, O & M manual submission, training sessions, pipe and duct system testing, flushing and cleaning, equipment start-up, system verification, performance testing, and system completion for use by the Commissioning Authority. Update schedule as appropriate throughout the construction period.

H. Complete System Verification Checklists and manufacturer's pre-start checklists prior to scheduling startup of HVAC systems.

I. Monitor and respond to the Master Findings List distributed by the Commissioning Authority in writing within five (5) business days in order to expedite corrective actions necessary to achieve design intent. Failure to respond in writing within five business days will result in contractor non-compliance and will warrant the provision of a seventy-two (72) hour notice to comply and/or back charge to the contractor for all necessary corrective work. Items that are reported to have been corrected but that are found not to have been corrected after a maximum of two re-inspections will result in a back charge to the responsible contractor for any subsequent re-inspection that must be performed by the Commissioning Authority in order to verify that the corrective work has been completed.

J. Notify the Commissioning Authority a minimum of two weeks in advance of scheduled system start-up.

K. Update drawings to as-built condition and review with the Commissioning Authority throughout the construction process.

L. Schedule vendor and subcontractor provided training sessions as required by project specifications.

M. Provide written notification to the CM and Commissioning Authority that the following work has been completed in accordance with the project specifications, and that the equipment, systems and sub-systems are operating in accordance with design intent.

1. HVAC equipment including air handlers, VRF systems, heat pumps, DOAS units, energy recovery, splits systems, pumps, fans, ductwork, air terminals, dampers etc.
2. Fire detection and smoke detection devices furnished under other divisions as they affect the operation of the HVAC systems.
3. That BAS is functioning in accordance with design intent.

N. Participate in the off-season mode testing as required to achieve design intent.

O. Participate in operation and maintenance training as required by project specifications.

P. Provide a complete set of as-built drawings and operation and maintenance manuals for review. The Commissioning Authority shall review the as-built drawings and Operation and Maintenance manuals concurrently with the design team.

Q. In the event that any portion of the work to be completed by the mechanical contractor is subcontracted, ensure compliance with the commissioning process on the part of any individual(s) performing that work. To that end, ensure that each sub-contractor is provided a copy of this specification.

3.2 RESPONSIBILITIES OF TEST AND BALANCE CONTRACTOR (TABC)

A. Include cost for commissioning requirements in the contract price.

B. Attend commissioning specific meetings scheduled by the Commissioning Authority or Construction Manager.

C. Submit the TAB procedures and preliminary TAB report to the Commissioning Authority for review at least two weeks prior to beginning TAB work.

D. Notify the Commissioning Authority a minimum of two weeks in advance of scheduled TAB work.

E. Provide partial, preliminary TAB Reports by phase, by building section, by system, or as required by the Commissioning Authority.

F. Assist the Commissioning Authority in system verification and performance testing, both Pre-Functional and Functional.

G. Monitor and respond to the Master Findings List distributed by the Commissioning Authority in writing within five (5) business days in order to expedite corrective actions necessary to achieve design intent. Failure to respond in writing within five business days will result in contractor non-compliance and will warrant the provision of a seventy-two (72) hour notice to comply and/or back charge to the contractor for all necessary corrective work. Items that are reported to have been corrected but that are found not to have been corrected after a maximum of two re-inspections will result in a back charge to the responsible contractor for any subsequent re-inspection that must be performed by the Commissioning Authority in order to verify that the corrective work has been completed.

H. Participate in verification of the TAB report, which will consist of repeating any selected measurement contained in the TAB report where required by the Commissioning Authority for verification or diagnostic purposes.

I. Participate in the Functional Performance Tests as required to achieve design intent.

J. Provide sound and vibration testing where required to assist in diagnosis of areas exhibiting unacceptable levels of noise or vibration.

K. Participate in the off-season mode testing as required to achieve design intent.

L. Participate in O&M Training as required by project specifications.

M. In the event that any portion of the work to be completed by the test and balance contractor is subcontracted, ensure compliance with the commissioning process on the part of any individual(s) performing that work. To that end, ensure that each sub-contractor is provided a copy of this specification.

3.3 RESPONSIBILITIES OF TEMPERATURE CONTROL CONTRACTOR (TCC)

A. Include cost for commissioning requirements in the contract price.

B. Attend commissioning meetings scheduled by the Commissioning Authority.

C. Assure cooperation and participation of specialty sub-contractors such as TAB and electrical wiring subcontractor in commissioning activities.

D. Review control sequence and component selection for conformance with design intent.

1. Verify that specified safeties and interlocks have been selected.
2. Verify proper selection of control valves and actuators based on design parameters.
3. Verify proper selection of control dampers and actuators based on design parameters.
4. Verify that sensor selection conforms to design intent.

E. Provide the following submittals to the Commissioning Authority:

1. Hardware and software submittals.
2. Control panel construction shop drawings.
3. Narrative description of control sequences for each HVAC system and subsystem.
4. Schematics showing all control points, sensor locations, point names, actuators, controllers and where necessary, points of access.
5. A list of all control points, including analog inputs, analog outputs, digital inputs and digital outputs, and all set points. Include a description of which points will be adjustable from graphic and/or text screen. Include the values of all parameters for each system point. Provide a separate list for each stand-alone control unit.
6. A complete listing of all software routines employed in operating the control system. Also provide a program narrative that describes the logic flow of the software and the functions of each routine and sub-routine. The narrative should also explain individual math or logic operations that are not clear from reading the software listing.
7. Hardware operation and maintenance manuals.
8. Application software and project applications code manuals.
9. Panel and equipment insert documents.

F. Verify that specified interfaces provided by others are compatible with BAS hardware and software.

G. Coordinate installation and programming of BAS with construction and commissioning schedules.

H. Complete System Verification Checklists and manufacturer’s pre-start checklists prior to scheduling startup of HVAC equipment.

I. Provide control system technician to assist during equipment startup.

J. Monitor and respond to the Master Findings List distributed by the Commissioning Authority in writing within five (5) business days in order to expedite corrective actions necessary to achieve design intent. Failure to respond in writing within five business days will result in contractor non-compliance and will warrant the provision of a seventy-two (72) hour notice to comply and/or back charge to the contractor for all necessary corrective work. Items that are reported to have been corrected but that are found not to have been corrected after a maximum of two re-inspections will result in a back charge to the responsible contractor for any subsequent re-inspection that must be performed by the Commissioning Authority in order to verify that the corrective work has been completed.

K. Participate in the Functional Testing as required by the project specifications as required to achieve design intent.

L. Provide a control system technician to assist during Pre-Functional Testing and Functional Testing.

M. Provide system modifications to achieve system operation as defined by the design intent.

N. Provide support and coordination for TAB contractor. Provide all devices, such as portable operator terminals and all software for the TAB to use in completing TAB procedures.

O. Participate in the off-season mode testing as required to achieve design intent.

P. Participate in O&M Training as required by project specifications. Include training on hardware operations and programming.

Q. In the event that any portion of the work to be completed by the temperature control contractor is subcontracted, ensure compliance with the commissioning process on the part of any individual(s) performing that work. To that end, ensure that each sub-contractor is provided a copy of this specification.

END OF SECTION - 230800

SECTION 230900 - INSTRUMENTATION AND CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Building Automation System (BAS) Controls shall include a complete Control system for the new Batavia Middle School and new Batavia High School. The BAS shall be fully integrated with the control system in the existing Elementary School building and shall a Tridium Niagara 4 and based on the new Niagara 4 Framework. The Elementary addition will be served by the new N4 front end.

B. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

C. Furnish all labor, materials, equipment, and service necessary for a complete and operating Building Automation System (BAS) to manage and control the facility utilizing Direct Digital Controls as shown on the drawings and described herein. Drawings are diagrammatic only.

D. The BAS shall be integrated and interoperable with the facility infrastructure and include user access to all system data locally over the Local Area Network (LAN) with in the building and remotely by a standard Web Browser over the Internet. Any computer connected to the network, utilizing a web browser and having the proper password, shall be able to communicate with the building's BAS system.

E. All labor, material, equipment and software not specifically referred to herein or on the plans, that is required to meet the functional intent of this specification, shall be provided without additional cost to the Owner.

F. The BAS shall be furnished, installed and wired by direct employees of the approved control system contractor. Sub contracted installation/wiring contractors are not acceptable.

G. This Section includes control equipment for HVAC systems and components, software requirements, and installation requirements for complete, fully integrated temperature control system incorporating direct digital control (DDC) electronic temperature control.

H. The contractor shall provide all necessary documentation, data, configuration information, configuration tools, programs, program tools, drivers, licenses and other software such that the owner or their agents are able to perform repair, replacement, upgrades, and expansions of the system without subsequent or future dependence on the contractor.

I. Related Sections include the following:

1. Division 23 Section 230993 "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.
2. Division 23, Section 238166 - Variable Refrigerant Flow (VRF) System controls. Field installation of all VRF controls, devices, and wiring shall be performed under this Section 230900.

1.3 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES

A. The intent of this specification is to provide a peer-to –peer networked, stand-alone, distributed control system with the capability to integrate ANSI/ASHRAE Standard 135-2001 BACNet, LONWorks technology, OBIX TCP/IP, MODBUS, OPC, and other open and proprietary communication protocols in one open, interoperable system.

B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI/ASHARE Standard 135-2020, BACnet and LonMark to assure interoperability between all system components is required. For each LonWorks device that does not have LonMark certification, the device supplier must provide an XIF file and a resource file for the device. For each BACnet device, the device supplier must provide a PICS document showing the installed device's compliance level. Minimum compliance shall support the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet (BACnet Ethernet/IP) and /or RS-485 (BACnet MSTP) as specified.

C. All components and controllers supplied under this Division shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by host to pass data shall not be acceptable.

D. The supplied system must incorporate the ability to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a supplier-installed server for all database access. Systems requiring proprietary database and user interface programs shall not be acceptable.

E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a 'flat' single tiered architecture shall not be acceptable.

1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

1.4 SYSTEM DESCRIPTION

A. The Building Automation System (BAS) shall be based on the new Niagara 4 Framework a HTML-based framework developed by Tridium. Niagara 4 provides an open automation infrastructure that integrates diverse systems and devices (regardless of manufacturer, communication standard or software) into a unified platform that can be easily managed in real time over the Internet using a standard Web browser. Systems not developed on the new Niagara 4 Framework platform are unacceptable.

B. The entire Building Automation System shall be comprised of System Network Controllers (SNC) and a network of open, interoperable, peer-to-peer stand-alone Programmable Equipment Controllers (PEC) communicating using Niagara^{AX} FOX protocol over Ethernet; and a network of open, interoperable, peer-to-peer stand-alone Application Specific Controllers (ASC) communicating via LonMark/LonTalk communication protocol to System Network Controllers (SNC) and /or Programmable Equipment controllers (PEC).

C. All PEC controllers to be Niagara 4 based Jace(s). BACNet based PEC's requiring manufacturer specific engineering programming software tools not provided to the Owner and available to other contractors are not allowed.

D. Each major HVAC system shall have its own stand-alone PEC DDC controller. Control of a major HVAC system shall not be split between multiple PEC controllers. If a large HVAC system exceeds the point capacity of one PEC then monitor only points shall be connected to a separate PEC or IO module.

E. The BAS contractor shall install a separate, self-sufficient CAT5e communication cable network between System Network Controllers (SNC) and Programmable Equipment Controllers (PEC) which is completely independent of the Building network.

F. Assume network nodes between the buildings will be fiber optic between the Middle School and High School and either fiber or Cat 5e between the Elementary and the High School.

G. The Niagara Supervisor software shall reside on one of the two computers provided as part of the Building Automation System defined herein.

1.5 DEFINITIONS

A. ATC: Automatic Temperature Control

B. DDC: Direct digital controls

C. BAS: Building Automation System

D. GUI: Graphical User Interface

E. IBC: Interoperable BACnet Controller

F. IDC: Interoperable Digital Controller

G. INC: Interoperable Niagara^{AX} Controller

H. I/O: Input/output

I. LAN: Local Area Network

J. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.

K. NICS: Niagara Interoperable Compatibility Statement

L. OOT: Object Oriented Technology

M. PC: Personal computer

N. PID: Proportional plus integral plus derivative

O. PIM: Power Measurement Interface

P. POT: Portable Operator's Terminal

Q. RTD: Resistance temperature detector

R. WAN: Wide Area Network

S. WBI: Web Browser Interface

1.6 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:

1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:

    a. Space Temperature: Plus or minus 1 deg F
    b. Ducted Air Temperature: Plus or minus 1 deg F
    c. Outside Air Temperature: Plus or minus 2 deg F
    d. Dew Point Temperature: Plus or minus 3 deg F
    e. Temperature Differential: Plus or minus 0.25 deg F

f. Relative Humidity: Plus or minus 5 percent
g. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
h. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
i. Airflow (Terminal): Plus or minus 10 percent of full scale.
j. Air Pressure (Space): Plus or minus 0.01-inch wg.
k. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
l. Carbon Dioxide: Plus or minus 50 ppm.
m. Electrical: Plus or minus 5 percent of reading

1.7 SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays, switches, control panels and operator interface equipment.
2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
3. Wiring Diagrams: Power, signal, and control wiring.
4. Details of control panel faces, including controls, instruments, and labeling.
5. Written description of sequence of operation.
6. Schedule of dampers including size, leakage, and flow characteristics.
7. Schedule of valves including flow characteristics.
8. DDC System Hardware:

   a. Wiring diagrams for control units with termination numbers.
   b. Schematic diagrams and floor plans for field sensors and control hardware.
   c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.

9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.

10. Controlled Systems:

    a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
    b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
    c. Written description of sequence of operation including schematic diagram.
    d. Points list.

C. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with the latest ASHRAE 135.

D. Samples for Verification: For each color required, of each type of thermostat or sensor cover.

E. Software and Firmware Operational Documentation: Include the following:

1. Software operating and upgrade manuals.
2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.
5. Software license required by and installed for DDC workstations and control systems.

F. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.

G. Qualification Data: For Installer and manufacturer.

H. Field quality-control test reports.

I. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components

required for this Project. The control contractor shall have a minimum of three years documented experience for the installation of the specified control system.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Electronic Components shall be UL Listed.

D. Comply with ASHRAE 135 for DDC system components.

E. Damper components shall comply with AMCA 500.

F. Enclosures shall comply with NEMA 250.

G. Installation as a part of the HVAC system shall comply with NFPA 90A.

1.9 SOFTWARE LICENSE AGREEMENT

A. The Owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software.

B. Software license shall not expire or utilize any sort of protection hardware device for its use.

C. A software license information form describing the manufacturer’s policies and implementation shall be provided to the owner before the job is complete.

D. Software licensing for System Network Controllers (SNC) and Programmable Equipment Controllers (PEC) utilizing OBIX TCP/IP shall:

E. Give the Owner the capability to control their system and determine which contractors can bid and engineer their system.

F. Insure the Owner can prevent unauthorized contractors from accessing the system for engineering changes.

G. Give the owner the freedom to individually manage authorized parties and independent parties.

H. The Niagara Compatibility Statement (NiCS) for all SNC’s and PEC’s shall allow open access and set as follows:

1. Accept Station In = All
2. Accept Station Out = All
3. Accept Tool In = All
4. Accept Tool Out = All

In any case owner shall be free to direct the modification of any software license, regardless of supplier, to allow open access to all controllers.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

B. System Software: Update to latest version of software at Project completion.

1.11 COORDINATION

A. Coordinate location of thermostats and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment with Division 28 Section "Fire Detection and Alarm" to achieve compatibility with equipment that interfaces with that system.

C. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

D. Coordinate equipment with Division 26 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.

E. Coordinate equipment with Division 26 Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

F. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

G. Coordinate equipment with Division 26 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.

H. Coordinate equipment with Division 26 Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

I. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

1.12

A.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified.

1. Siemens Talon Controls as installed by ASA Controls.
2. Tridium Controls as installed by Plug Smart
3. Schneider Electric as installed by IES/Comfort Systems.

4. Tridium Controls as installed by Siemens Industry, Inc.
5. Trane Tracer UC w Lynxspring JENEsys Open Controls as installed by Trane Technologies Branch Office.
6. ***Tridium Controls as installed by the K Company.***

B. The installing contractor shall have not less than 5 years experience in providing and installing the proposed system. The installing contractor shall provide a list of projects (not less than 3 projects) that the installing contractor has completed along with Owner's name, address and telephone number to the Batavia School District representative.

C. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan and control device depicted by point-and-click graphics.

2.2 MATERIALS

A. Operator Workstation: One PC-based microcomputer with minimum configuration for each new school (total of 2) as follows:

1. Motherboard: With 8 integrated USB 2.0 ports, integrated Intel Pro 10/100 (Ethernet), integrated audio, bios, and hardware monitoring.
2. Processor: Intel Core™ i3 or higher.
3. Random-Access Memory not less than 16 GB.
4. Graphics: Video card, minimum, PCI Express x 16 Gen discrete graphics. Intel HD Graphics.
5. Monitor: flat panel not less than 24 inches**,** LCD color.
6. Keyboard: QWERTY, 105 keys in ergonomic shape.
7. Hard Drive: not less than 1000 GB.
8. Removable Storage: minimum DVD-RW.
9. Mouse: Three button, optical.
10. Uninterruptible Power Supply: not less than 1500 va.
11. Operating System: not less than Microsoft Windows 7 Professional with XP Mode 64-bit high-speed Internet access.

    a. ASHRAE 135 Compliance: Workstation shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.

12. Printer: Black-and-white, laser-jet type as follows:

    a. Print Head: 1200 x 1200 dpi resolution.
    b. Paper Handling: Minimum of 250 sheet trays.
    c. Print Speed: Minimum of 120 characters per second.

13. Application Software:

    a. I/O capability from operator station.

b. System security for each operator via software password and access levels.
c. Automatic system diagnostics; monitor system and report failures.
d. Database creation and support.
e. Automatic and manual database save and restore.
f. Dynamic color graphic displays with up to 10 screen displays at once.
g. Custom graphics generation and graphics library of HVAC equipment and symbols.
h. Alarm processing, messages, and reactions.
i. Trend logs retrievable in spreadsheets and database programs.
j. Alarm and event processing.
k. Object and property status and control.
l. Automatic restart of field equipment on restoration of power.
m. Data collection, reports, and logs. Include standard reports for the following:

1) Current values of all objects.
2) Current alarm summary.
3) Disabled objects.
4) Alarm lockout objects.
5) Logs.

n. Custom report development.
o. Utility and weather reports.
p. Workstation application editors for controllers and schedules.
q. Maintenance management.

14. Custom Application Software:

a. English language oriented.
b. Full-screen character editor/programming environment.
c. Allow development of independently executing program modules with debugging/simulation capability.
d. Support conditional statements.
e. Support floating-point arithmetic with mathematic functions.
f. Contains predefined time variables.

B. Diagnostic Terminal Unit: Portable notebook-style, PC-based microcomputer terminal capable of accessing system data by connecting to system network with minimum configuration as follows:

1. System: With one integrated 4 USB 2.0 ports, integrated Intel Pro 10/100 (Ethernet), integrated audio, bios, and hardware monitoring.
2. Processor: Intel Intel Core^{TM} i5 Dual Core 2.5 GHz or higher.
3. Random-Access Memory: not less than 16 GB.
4. Graphics: Video adapter not less than HD 1600 x 900 display, 2GB video memory.
5. Screen: not less than 17 inches with anti-glare wide screen, WXGA+ display screen, LCD color.
6. Keyboard: QWERTY 105 keys in ergonomic shape.
7. Hard-Disk Drive: 750 GB**.**
8. 24X CD/DVD ROM, CD/RW for backup.

9. Wireless 802.11 g Network Card.
10. Battery with AC Adapter
11. Laptop Bag.
12. Pointing Device: Touch pad or other internal device.

C. Any proprietary engineering software, configuration and/or troubleshooting software required to fully support programming/changes/modifications of any and all ASC controllers furnished by contractor for this project shall be preloaded, configured and licensed for use by owner.

D. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.

1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

   a. Global communications.
   b. Discrete/digital, analog, and pulse I/O.
   c. Monitoring, controlling, or addressing data points.
   d. Software applications, scheduling, and alarm processing.
   e. Testing and developing control algorithms without disrupting field hardware and controlled environment.

3. Standard Application Programs:

   a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.
   b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
   c. Chiller Control Programs: Control function of condenser-water reset, chilled-water reset, and equipment sequencing.
   d. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
   e. Remote communications.
   f. Maintenance management.
   g. Units of Measure: Inch-pound and SI (metric).

4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
5. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) data link/physical layer protocol.

2.3 SYSTEM NETWORK CONTROLLER (SNC)

A. The BAS contractor shall supply one or more System Network Controllers (SNC) as part of this contract. Number of SNC's required is dependent on the type and quantity of PEC and ASC devices provided. It is the responsibility of the BAS contractor to coordinate with the Division 23 and 26 contractors to determine the quantity and type of devices furnished under those Divisions which may impact the number of System network Controllers.

B. The System Network Controller (SNC) shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the SNC. It shall be capable of executing application control programs to provide:

1. Calendar functions
2. Scheduling
3. Trending
4. Alarm monitoring and routing
5. Time synchronization
6. Integration of controller data through NiagaraAX drivers installed in the SNC.
7. Network Management functions for all controllers

C. The System Network Controller must provide the following hardware features as a minimum:

1. One Ethernet Port – 10/100 Mbps One RS-232 port
2. One RS-232 port
3. One LonWorks Interface Port – 78KB FTT-10A
4. One RS-485 ports
5. Battery Backup
6. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
7. The SNC must be capable of operation over a temperature range of 32 to 122°F
8. The SNC must be capable of withstanding storage temperatures of between 0 and 158°F
9. The SNC must be capable of operation over a humidity range of 5 to 95% RH, non-condensing

D. The SNC shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the SNC shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it.

E. The SNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 32 simultaneous users.

F. Event Alarm Notification and actions

1. The SNC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
2. The SNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up telephone connection, or wide-area network.
3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:

    a. To alarm
    b. Return to normal
    c. To fault

4. Provide for the creation of a minimum of eight of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.
5. Provide timed (schedule) routing of alarms by class, object, group, or node.
6. Provide alarm generation from binary object “runtime” and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.

G. Control equipment and network failures shall be treated as alarms and annunciated.

H. Alarms shall be annunciated in any of the following manners as defined by the user:

1. Screen message text
2. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:

    a. Day of week
    b. Time of day
    c. Recipient

3. Pagers via paging services that initiate a page on receipt of email message
4. Graphic with flashing alarm object(s)
5. Printed message, routed directly to a dedicated alarm printer

I. The following shall be recorded by the SNC for each alarm (at a minimum):

1. Time and date
2. Location (building, floor, zone, office number, etc.)
3. Equipment (air handler #, accessway, etc.)
4. Acknowledge time, date, and user who issued acknowledgement.
5. Number of occurrences since last acknowledgement.

J. Alarm actions may be initiated by user defined programmable objects created for that purpose.

K. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.

L. A log of all alarms shall be maintained by the SNC and/or a server (if configured in the system) and shall be available for review by the user.

M. Provide a “query” feature to allow review of specific alarms by user defined parameters.

N. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

O. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

P. Data Collection and Storage:

1. The SNC shall have the ability to collect data for any property of any object and store this data for future use.
2. The data collection shall be performed by log objects, resident in the SNC that shall have, at a minimum, the following configurable properties:

    a. Designating the log as interval or deviation.
    b. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
    c. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
    d. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
    e. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.

3. All log data shall be stored in a relational database in the SNC and the data shall be accessed from a server (if the system is so configured) or a standard Web browser.
4. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.
5. All log data shall be available to the user in the following data formats:

    a. HTML
    b. XML
    c. Plain Text
    d. Comma or tab separated values

6. Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.
7. The SNC shall have the ability to archive its log data either locally (to itself), or remotely to a server or other SNC on the network. Provide the ability to configure the following archiving properties, at a minimum:

    a. Archive on time of day
    b. Archive on user-defined number of data stores in the log (buffer size)
    c. Archive when log has reached it’s user-defined capacity of data stores
    d. Provide ability to clear logs once archived

Q. AUDIT LOG

1. Provide and maintain an Audit Log that tracks all activities performed on the SNC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the SNC), to another SNC on the network, or to a server. For each log entry, provide the following data:

    a. Time and date
    b. User ID
    c. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

R. DATABASE BACKUP AND STORAGE

1. The SNC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.
2. Copies of the current database and, at the most recently saved database shall be stored in the SNC. The age of the most recently saved database is dependent on the user-defined database save interval.
3. The SNC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

S. GRAPHICAL USER INTERFACE SOFTWARE

1. System graphics shall be located on the local SNC's and served up via the SNC's embedded web server.
2. All points shall have "Pushbuttons" adjacent to the displayed point data.

    a. Digital Output points shall have Hand-Off-Auto (HOA) pushbuttons.
    b. Analog Outputs Analog Output points to have Manual-Auto (M-A) pushbuttons.
    c. Digital Inputs shall have TestOn-TestOff-Auto (T-O-A) pushbuttons. TestOn and TestOff allows operator to override physical value and force Digital Input to On or Off state. Program shall use TestOn/TestOff value for normal program operation when commanded by operator.
    d. Analog Inputs shall have Test-Auto (T-A) pushbuttons. Test allows operator override physical value and force Analog Input to selected value. Program shall use Test value for normal program operation when commanded by operator.
    e. All setpoint values to have Manual-Auto (M-A) "Pushbuttons". Setpoints values which are automatically adjusted by the program shall revert to their current calculated program value when indexed from Manual back to Auto. Constant setpoint values to revert to initial programmed default value when indexed from Manual back to Auto.
    f. Digital software points (i.e. Economizer Enable/Disable, Occupied Time Period, etc.) shall have Hand-Off-Auto (HOA) pushbuttons. Values shall revert to their current calculated program value when indexed to Auto.
    g. Data point background color to change to Purple when manually commanded by operator.

3. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access

to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.

4. Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:

    a. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.

5. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.
6. Graphics shall support layering and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.
7. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.

    a. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
    b. Holidays shall be set by using a graphical calendar without requiring any keyboard entry from the operator.

8. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.

9. Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No entry of text shall be required. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:

    a. Create, delete or modify control strategies.
    b. Add/delete objects to the system.
    c. Tune control loops through the adjustment of control loop parameters.
    d. Enable or disable control strategies.
    e. Generate hard copy records or control strategies on a printer.
    f. Select points to be alarmable and define the alarm state.
    g. Select points to be trended over a period of time and initiate the recording of values automatically.

10. On-Line Help. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.
11. Security. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the

ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.

12. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
13. Alarm Console
14. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.
15. When the Alarm Console is enabled, a separate alarm notification window will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

T. WEB BROWSER CLIENTS

1. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™, Mozilla FireFox™ or Netscape Navigator™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.
2. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the BAS, shall not be acceptable.
3. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.

    a. The Web browser client shall support at a minimum, the following functions:
    b. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.
    c. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
    d. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
    e. Storage of the graphical screens shall be in the Network Area Controller (SNC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.

f. Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.

g. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:

1) Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
2) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
3) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
4) Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
5) View logs and charts
6) View and acknowledge alarms
7) Setup and execute SQL queries on log and archive information

h. The system shall provide the capability to specify a user’s (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.

i. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

2.4 NIAGARA 4 PROGRAMMABLE EQUIPMENT CONTROLLERS (PEC)

A. Programmable Equipment Controllers (PEC) shall have the same hardware, software and functionality as outlined above for the System Network Controllers (SNC) and shall use Niagara 4 FOX protocol over Ethernet for peer-to-peer communication and for communication with System Network Controllers (SNC).

B. PEC’s shall utilize plug-in 16 and/or 34 point IO modules, or Niagara^{AX} remote IO modules for, connection to field control devices. PEC shall be able to directly connect to two 16-Point and one 34-Point I/O Modules. I/O modules shall have:

1. Universal Inputs (Capable of accepting any combination of the following inputs)

a. Type 3 10k Thermistors
b. 0-1000 Ohm Platinum RTD’s
c. 0-5V DC
d. 0-10V DC
e. 0-20mA (with use of external load resistor)
f. Dry Contact

2. Analog Outputs

a. 0-10V DC

3. Digital Outputs

a. Form A contacts rated for 24V AC @ 0.5A
b. Status LED visible through front cover

C. All PEC's shall be fully application programmable. Controllers require a 10% spare point capacity to be provided for all applications. All control sequences within or programmed into the PEC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.

D. The BAS contractor shall provide documentation for each PEC, with the following information at a minimum:

1. IP and MAC address, name, type and HostID
2. Niagara Objects; name, type and instance number

E. The supplier of any programmable Niagara PEC shall ensure that the proper Niagara objects are provided in each PEC, as required by the Point Charts located in the POINTS LIST section.

2.5 BACNet APPLICATION SPECIFIC CONTROLLERS (ASC)

A. General:

1. Each ASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall provide standard applications and programmability to provide both reliability and flexibility. Each ASC shall be a microprocessor-based, multi-tasking, real-time digital control processor.
2. The Application Specific Controller Software shall be capable of BACnet communications. The BACnet Application Specific Controller (B-ASC) shall have demonstrated interoperability during at least one BTL Interoperability Workshop, have demonstrated compliance to BTL through BTL listing and shall substantially conform to BACnet Application Specific Controller (B-ASC) device profile as specified in ANSI/ASHRAE 135-2004.
3. Control product shall support the following BACnet Interoperability Building Blocks to facilitate an open and interoperable system:

BIBB	Name	Tested
DS-RP-B	Data Sharing-Read Property-B	●
DS-RPM-B	Data Sharing-Read Property Multiple-B	●
DS-WP-B	Data Sharing-Write Property-B	●
DM-DDB-B	Device Management-Dynamic Device Binding-B	●
DM-DOB-B	Device Management-Dynamic Object Binding-B	●
DM-DDC-B	Device Management-Device Communication Control-B	●

4. Each ASC shall include all point inputs and outputs necessary to perform the specified control sequences. The ASC shall accept input and provide output

signals that comply with industry standards. Controllers utilizing proprietary control output signals shall not be acceptable. Outputs utilized either for two-state, modulating floating, or proportional control, allowing for additional system flexibility.

5. ASC Space Temperature Sensors. Each controller performing space temperature control shall be provided with a matching room temperature sensor.

a.	Element Accuracy:	+ /- 1.0°F
b.	Operating Range:	55 to 95°F
c.	Set Point Adjustment Range:	55 to 95°F
d.	Auxiliary Communications Port:	as required
e.	Local LCD Temperature Display:	as required
f.	Setpoint Adjustment Dial :	as required
g.	Occupancy Override Switch:	as required

2.6 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. Thermistor Temperature Sensors and Transmitters:

1. Manufacturers:

   a. BEC Controls Corporation
   b. Ebtron, Inc.
   c. Heat-Timer Corporation
   d. I.T.M. Instruments Inc.
   e. MAMAC Systems, Inc.
   f. RDF Corporation

2. Accuracy: Plus or minus 0.5 deg Fat calibration point.
3. Wire: Twisted, shielded-pair cable.
4. Insertion Elements in Ducts: Single point, 18 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
5. Averaging Elements in Ducts: 72 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft.
6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches
7. Room Sensor Cover Construction: Manufacturer's standard locking covers except in locker room areas sensors shall have auxiliary keyed metal covers of color to match sensors.

   a. Set-Point Adjustment: Concealed
   b. Set-Point Indication: Concealed
   c. Without Thermometer
   d. Color: Architect shall select color from manufacturer's full range.
   e. Orientation: Horizontal

8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

C. RTDs and Transmitters:

1. Manufacturers:

    a. BEC Controls Corporation
    b. MAMAC Systems, Inc.
    c. RDF Corporation

2. Accuracy: Plus or minus 0.2 percent at calibration point.
3. Wire: Twisted, shielded-pair cable.
4. Insertion Elements in Ducts: Single point, 18 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
5. Averaging Elements in Ducts: 24 feet long, flexible; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
6. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
7. Room Sensor Cover Construction: Manufacturer's standard locking covers except in public spaces sensors shall have auxiliary keyed metal covers of color to match sensors.

    a. Set-Point Adjustment: Concealed
    b. Set-Point Indication: Concealed
    c. Without Thermometer
    d. Color Architect shall select color from manufacturer's full range.
    e. Orientation: Horizontal

8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
9. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

D. Humidity Sensors: Bulk polymer sensor element.

1. Manufacturers:

    a. BEC Controls Corporation.
    b. General Eastern Instruments.
    c. MAMAC Systems, Inc.
    d. ROTRONIC Instrument Corp.
    e. TCS/Basys Controls.
    f. Vaisala.

2. Accuracy**:** 2 percent full range with linear output.
3. Room Sensor Range: 20 to 80 percent relative humidity.
4. Room Sensor Cover Construction: Manufacturer's standard locking covers.

    a. Set-Point Adjustment: Concealed.
    b. Set-Point Indication: Concealed.
    c. Color: Architect selected color from manufacturer's full range.
    d. Orientation: Horizontal.

5. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.

6. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of minus 40 to plus 170 deg F.
7. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

E. Pressure Transmitters/Transducers:

1. Manufacturers:

   a. BEC Controls Corporation.
   b. General Eastern Instruments.
   c. MAMAC Systems, Inc.
   d. ROTRONIC Instrument Corp.
   e. TCS/Basys Controls.
   f. Vaisala.

2. Static-Pressure Transmitter: Non-directional sensor with suitable range for expected input, and temperature compensated.

   a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
   b. Output: 4 to 20 mA.
   c. Building Static-Pressure Range: 0- to 0.25-inch wg.
   d. Duct Static-Pressure Range: 0- to 5-inch wg.
   e. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.

3. Differential-Pressure Switch: Snap acting, with pilot-duty rating and with suitable scale range and differential.
4. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

F. Room Sensor Cover Construction: Manufacturer's standard locking covers.

1. Set-Point Adjustment: Exposed
2. Set-Point Indication: Exposed

G. Room sensor accessories include the following:

1. Insulating Bases: For sensors located on exterior walls.
2. Guards: Locking, solid metal, ventilated for locker room areas.
3. Adjusting Key: As required for calibration and cover screws.

2.7 THERMOSTATS

A. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.

1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.

2. Selector Switch: Integral, manual on-off-auto.

2.8 ACTUATORS

A. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1. Manufacturers:

   a. Belimo Aircontrols (USA), Inc.
   b. Johnson Controls, Inc.
   c. Honeywell, Inc.
   d. Siemens Building Technologies, Inc.
   e. Invensys Building Systems, Inc.

2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
3. Dampers: Size for running torque calculated as follows:

   a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
   b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
   c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft damper.
   d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
   e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
   f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.

4. Coupling: V-bolt and V-shaped, toothed cradle.
5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
7. Power Requirements (Two-Position Spring Return): 24 or 120-V ac.
8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
10. Temperature Rating: Minus 22 to plus 122 deg F.
11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.
12. Run Time: 12 seconds open, 5 seconds closed.

2.9 DAMPERS

A. Automatic Control Dampers: Furnished and installed by HVAC contractor. TCC shall coordinate with the HVAC contractor to establish details of damper, linkage and operator that shall be provided by the TCC.

2.10 CONTROL CABLE

A. Electronic and fiber-optic cables for control wiring are specified in Division 27 Section "Communications Horizontal Cabling."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that power supply is available to control units and operator workstation.

B. Verify that piping and duct, pipe and equipment mounted devices are installed before proceeding with installation.

C. Verify existing controls schematics, points, sequence and trends prior to removal and replacement of controls for existing equipment to remain.

3.2 INSTALLATION

A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.

B. Connect and configure equipment and software to achieve sequence of operation specified.

C. Verify location of thermostats, humidistats and other exposed control sensors with Drawings and room details before installation. Install devices 54 inches above the finished floor surface.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

2. Install air flow measuring stations in accordance with the manufacturer's recommendations to obtain specified performance.

D. Install guards on thermostats and temperature in the following locations:

1. Locker Room areas
2. Public toilet room areas
3. Where indicated on the drawings

E. HVAC Contractor shall furnish automatic control dampers. HVAC contractor shall install automatic control dampers according to Division 23 Section "Air Duct Accessories." TCC shall furnish and install damper operators and linkage.

F. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

G. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."

H. Install electronic and fiber-optic cables according to Division 27 Section "Communications Horizontal Cabling."

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Install signal and communication cable according to Division 27 Section "Communications Horizontal Cabling."

1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
2. Install exposed cable in raceway.
3. Install concealed cable in raceway.
4. Bundle and harness multi-conductor instrument cable in place of single cables where several cables follow a common path.
5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position unless noted otherwise.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
4. Test each point through its full operating range to verify that safety and operating control set points are as required.
5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
6. Test each system for compliance with sequence of operation.
7. Test software and hardware interlocks.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.

3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check temperature instruments and material and length of sensing elements.
5. Check control valves. Verify that they are in correct direction.
6. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
7. Check DDC system as follows:

    a. Verify that DDC controller power supply is from emergency power supply, if applicable.
    b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    c. Verify that spare I/O capacity has been provided.
    d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:

    a. Check analog inputs at 0, 50, and 100 percent of span.
    b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
    c. Check digital inputs using jumper wire.
    d. Check digital outputs using ohmmeter to test for contact making or breaking.
    e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

5. Temperature:

    a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
    b. Calibrate temperature switches to make or break contacts.

6. Stroke and adjust control valves and dampers, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
7. Provide diagnostic and test instruments for calibration and adjustment of system.
8. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls and provide 3 month inspections. The TCC shall provide a minimum of 40 hours of training and demonstration for the building Owner during installation and start up providing the building Owner personnel are available. If Owner personnel are not available, provide the training and demonstration after system is installed and put into operation at a time that the Owner personnel are available. In addition to the 40 hours described above, provide not less than 30 hours for inspection and written report every 3 months after the above training and demonstration during the first year of operation. During these 3 month inspections/reports, check that all system functions are operating per the contract sequence of operation and/or per the Owner’s requirements. Modify and/or create software logic and set points as required by the Owner. The 3 month inspections/reports are to occur 3, 6, 9 and 12 months after system turn over to the Owner and training and demonstration has been completed. Document number of hours used and function performed every two weeks of work and obtain the Owner’s signature that the Owner agrees to the reported hours used.

3.7 COMMISSIONING

A. Controls Contractor shall participate in the commissioning process. Establish and operate requested trends.

END OF SECTION 230900

SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Sections included under Division 2, General Requirements, and Section 230000 of this Division are included as a part of this Section as though bound herein.

B. Refer to the details and schedules on the Drawings for additional requirements.

1.2 SECTION INCLUDES

A. This Section includes the sequences of operation for the new HVAC equipment and systems.

B. The Temperature Control Contractor shall read all other Drawings and Specifications, become familiar with requirements and scope of the Project, and include such coordination work as may be required.

1.3 SUBMITTALS

A. Submittals are required and shall include detailed descriptions of the proposed sequence of operations for all new HVAC systems specific to the project.

1.4 BUILDING SET POINTS:

A. All Set points and other variables noted in the sequences with (adj.) as well as resetting of alarms are to be adjustable from the web accessible graphical user interface so that the owner does not have to go to the building or open any programming software to change the settings. Access to the adjustable settings shall be password protected and an audit log shall track who made what changes and when they were made.

Winter Design:

Occupied Mode	Unoccupied Mode
70 deg. F	60 deg. F

Summer Design:

Occupied Mode	Unoccupied Mode
74 deg. F, 40-60% RH	84 deg. F, 60 % RH

1.5 SEQUENCE OF OPERATION

A. Boiler Heating System, BLR-1 & BLR-2:

1. The Building Automation System shall enable and disable the boilers based on the outside air temperature and the condenser water supply temperature. The boiler plant is to enable whenever the outside air temperature is below an adjustable air temperature set point, set initially at 60 degrees Fahrenheit and the condenser water supply temperature is an adjustable water temperature set point, set initially at 75 degrees Fahrenheit.
2. Primary condenser water loop to provide heating hot water to maintain loop temperature set initially at 75 degrees Fahrenheit adjustable.
3. Secondary heating loop serves heating coils within the space new and existing. This loop to be provided set initially to 120 degree Fahrenheit water supply temperature adjustable.
4. The on/off control, firing rate control and control of the primary loop circulating pumps are to be accomplished by the integral controllers that are furnished by the boiler manufacturer. Refer to specification Section 235220 for additional control information for the heating system boilers.
5. The on/off control for the secondary loop circulating pump shall be enabled if the boilers are enabled.
6. The boiler alarm status shall be monitored and alarmed by the DDC system. The boiler firing status shall be monitored by the DDC system.

B. Closed Circuit Cooling Tower, CT-1:

1. The Building Automation System shall activate the cooling tower fan based on the condenser water loop's supply water, temperature set point. The cooling tower fan is to be activated when the condenser water supply temperature is above an adjustable set point, set initially at 90 degrees Fahrenheit. The cooling tower fan is to be deactivated when the condenser water supply temperature returns below the set point by an adjustable dead-band range, set initially at 5 degrees Fahrenheit, (ie. deactivated at 85 deg. F).
2. The cooling tower spray pump is to be activated by the BAS as a second stage of cooling based on the outside air temperature and the condenser water loop's supply water, temperature set point. The spray pump is to be enabled for operation whenever the outside air temperature is above an adjustable air temperature set point, set initially at 70 degrees Fahrenheit. The spray pump is to be activated when the condenser water supply temperature exceeds the set point for fan operation by an adjustable temperature range, set initially at 5 degrees Fahrenheit, ((ie. activated at 95 deg. F). The spray pump is to be deactivated when the condenser water supply temperature lowers to the set point for activating the fan operation, (ie. deactivated at 90 deg. F).
3. The control of the electric basin heater and the spray loop's make-up water valve are to be accomplished by the integral controls that are furnished by the cooling tower manufacturer. Refer to specification Section 236500 for additional control information for the cooling tower.

C. New Building Condenser Water Pumps:

1. Whenever any building water source heat pumps is permitted to operate, the condenser water pumping system shall be enabled. Upon enable, the lead pump shall start and be proven by the system differential pressure switch and the pump motor VFD. Upon lead pump failure, the standby pump shall be put into operation.
2. Provide automatic alternating lead/lag operation through the DDC system. The Building Automation System shall automatically start/stop and alternate pumps with the "off" pump as a backup, should the lead pump fail.
3. Upon enable:

    a. The lead pump shall start.
    b. The lead pump shall ramp up to maintain the desired fixed pump speed (adj.) that is established in conjunction with the project water balancing contractor to provide the design water flow for the operational heat pumps.
    c. Whenever the lead pump run status is not established within 5 minutes (adj.), place the lag pump into the lead operation and report an alarm. Whenever both pumps have not established a run status, report an alarm, and shut down the condenser water system until restarted by the system operator.
    d. If, after 5 minutes of flow has been proven, the water temperature in the secondary loop, as sensed by temperature transmitter, TT-CWS, is less than the desired heating setpoint, enable the heating plant.
    e. If, after 5 minutes of flow has been proven, the water temperature in the secondary loop, as sensed by temperature transmitter, TT-CWS, is greater than the desired cooling setpoint, activate the system cooling tower.
    f. For project alternate M-2, The DDC Controller shall monitor differential pressure between supply and return heating water lines as measured by DPT-CW-1. The DDC Controller shall increase or decrease the pump(s) speed to maintain the desired set point at DPT-CW-1.

D. Water Source Heat Pumps:

1. The water source heat pumps are to be controlled only by remote thermostat and integral controls. The base bid is to include the addition of a BACnet communication interface with all of the new heat pumps with control sequences as described in specification Section 238146.
2. The two-position, condenser water, control valve for most of the water source heat pumps is to be activated by the integral water source heat pump controls. Selected water source heat pumps are not to have a control valve in order to maintain the minimum flow requirements of the pumps and variable speed drives. Refer to the project drawings for description of the units that have control valves.

E. AHU-1

1. The BAS shall enable 100% outside air unit, AHU-1 during the respective occupied modes. When enabled, the unit supply fans shall be operated to provide constant air volume rates while the integral controls within the AHU unit to control heating, cooling and dehumidification operations.
2. During the unoccupied condition, AHU-1 shall be disabled.
3. The BAS shall monitor the alarm indication contacts that are provided by the AHU unit manufacturer.
4. The BAS shall monitor on/off status through a hardwired point.

5. The BAS shall control the on/off operation through a hardwired point.
6. The BAS shall be able to adjust the supply air temperature through a hardwired connection.

F RTU- Gym unit

7. The BAS shall enable RTU during the respective occupied modes. When enabled, the unit supply fans shall be operated to provide constant air volume rates while the integral controls within the RTU unit to control heating, cooling and dehumidification operations.
8. During the unoccupied condition, RTU-1 shall be disabled.
9. The BAS shall monitor the alarm indication contacts that are provided by the RTU unit manufacturer.
10. The unit shall have CO2 control. CO2 levels shall be set to alarm at 1000 ppm above outdoor air ambient conditions. Upon CO2 alarm the outdoor air damper shall open and provide fresh air until space levels are within set point.
11. The BAS shall monitor on/off status through a hardwired point.
12. The BAS shall control the on/off operation through a hardwired point.
13. The BAS shall be able to adjust the supply air temperature through a hardwired connection.

F. Dedicated Outside Air System unit, DOAS-1, 2

1. The BAS shall enable 100% outside air unit, DOAS-1 and 2 during the respective occupied modes. When enabled, the unit supply and exhaust fans shall be operated to provide constant air volume rates through an enthalpy energy recovery wheel while the integral controls within the DOAS unit control heating, cooling and dehumidification operations.
2. During the unoccupied condition, unit DOAS-1 AND 2 shall be disabled.
3. The BAS shall monitor the alarm indication contacts that are provided by the DOAS unit manufacturer.
4. The BAS shall monitor on/off status through a hardwired point.
5. The BAS shall control the on/off operation through a hardwired point.
6. The BAS shall be able to adjust the supply air temperature through a hardwired connection.

A. Variable Refrigerant Flow, (VRF) System served by Air Cooled Heat Pump, VRHP-#

1. The BAS shall monitor operation of the new VRF systems through a BacNet interface.
2. The BAS shall be equipped with graphics that include the new air cooled heat pumps and all indoor VRF terminal units. VRF points of interest such as room temperature, room operating mode (heating or cooling), heat pump operating mode, etc. shall be mapped to the BAS system and integrated into the graphics The BAS shall be used to define the occupancy mode schedules for the VRF system and to adjust all terminal unit heating and cooling room temperature set points for both the occupied and unoccupied modes.

3. The BAS shall monitor the status of all alarms that are generated by the VRF system controls.

B. Exhaust Fans:

1. EF-1,2, 3, 4, 5, 6. 7,8, 11, 12 and 13shall be operated by a wall switch and operated intermittently. BAS monitors status.

2. EF-9 serve the kiln rooms. BAS enables kiln exhaust whenever the building is occupied. BAS monitors status.

3. EF-10, 14 and 15 shall be operated to turn on when the light enables for the space.

4. EF-16 serve a fume hood and are operated via a factory provided fume hood switch. The BAS shall monitor fan status.

5. KEF-1 is the kitchen grease exhaust fan. On/off operation is via a factory provided switch at the hood operator panel. Fan status is monitored by the BAS. When KEF-1is enabled, the BAS shall enable F-1.

6. KEF-2 serves the warewasher and is automatically enabled by the warewasher factory controls. The BAS shall monitor fan status.

7. EF-ZZ-serves mechanical room B11. Fan to be enabled when space temp reaches desired set point. Connect to OA damper and damper shall open as fan is enabled to run.

8. Existing exhaust fans that are replaced as part of the alternate shall be controlled and monitored the same as existing. Contractor to verify sequence prior to fan replacement.

C. Electric/Hot Water Cabinet Unit Heaters

1. For wall mounted cabinet unit heaters: An integral return air, line voltage thermostat shall cycle the unit fan and heating element on a call for heating; (set initially at 60 Deg F).
2. For ceiling mounted cabinet unit heaters: A remote low voltage room thermostat (furnished by the Heating Unit Manufacturer) shall cycle the unit fan and heating element on a call for heating; (set initially at 60 Deg F). The thermostat is to have an integral “Summer” switch for continuous fan operation during the cooling season.

D. Domestic Hot Water Circulation Pump:

1. The building automation system shall enable the facility’s existing domestic hot water circulation pump based on time of day scheduling.

E. Day/Night Zones:

1. The following shall be the accepted zone control. Zone control shall include all existing air handling units, existing and new variable-volume terminals, and existing operational exhaust fans. All zones to include capabilities through the direct digital controller for override setting to full occupied cycle during unoccupied cycle.

F. Critical Alarms:

1. Critical alarms shall dial personal cell telephones, personal home telephones, and/or send email messages to the personnel as determined by the Owner. The following shall be considered critical alarms:

   a. Any condenser water pump failure.
   b. Any space temperature dropping below 55 degrees F, (adj.)
   c. Condenser water system supply temperature above 55 degrees F, (adj.).
   d. Any other alarm deemed critical by the Owner.

G. Snow Day

H. A “snow day” routine shall be provided to return all zones to unoccupied mode upon indication by system operator. Administration area zones are to remain in occupied mode during the “snow day” routine where specifically requested by the Owner.

I. Kitchen Cooler and Freezers

1. The temperature control contractor shall install temperature sensors in the cooler and both freezers to monitor temperatures through the BAS. Provide alarm if temperature rises above desired temperatures.

J. Critical Alarms

1. Critical alarms shall dial personal cell telephones, personal home telephones, and/or send email messages to school district employees as determined by the school district. The following shall be considered critical alarms:

a. Any VRF System Heat Pump Unit or DOAS Unit alarm.
b. Any space temperature dropping below 35 degrees F, (adj.)
c. Any other alarm deemed critical by school district and/or Architect/Engineer.
d. Kitchen freezer temperature rise above 30 degrees F, (adj.)
e. Cooler system temperature rise above 43 degrees F, (adj.)
f. Any other alarm deemed critical by school district and/or Architect/Engineer.

1.6 ALARMS

A. General

1. An alarm condition shall be indicated by showing red on the graphic display.
2. Alarms shall be displayed on the Event Page.

   a. WebCTRL shall notify the user with a printout and e-mail.
   b. Alarms shall be displayed on the appropriate properties pages and on the logic display.

A. The following list shall be the minimum alarms required of the BAS system. If additional items are required for the specified sequence of operation they shall also be provided.

1. DOAS units, AHU's (not all alarms applicable for all units)

Alarm ID	**Alarm Type**	**Alarm Condition**
Shutdown	Change of State	Signal Sent from Network
VFD Fault	Change of State	Supply Fan VFD Fault Tripped for 5 sec
Supply Fan Fail	Change of State	Run = On; Status = Off
Exhaust Fan Fail	Change of State	Run = On; Status = Off
Supply Air Temp. High	Off - Normal	SAT > SAT Set Point +20 deg F for 5 Minutes.
Supply Air Temp. Low	Off - Normal	SAT < SAT Set Point -20 deg F for 5 Minutes.

2. All Zones

Alarm ID	**Alarm Type**	**Alarm Condition**
Zone Temp. High	Off - Normal	ZT > Zone Set Point +4 deg F for 5 min.
Zone Temp. Low	Off - Normal	ZT < Zone Set Point -4 deg F for 5 min.

3. Miscellaneous

Alarm ID	**Alarm Type**	**Alarm Condition**
Fire Alarm	Change of State	Normal = Off; Alarm = On
Fire Alarm Panel Trouble	Change of State	Normal = Off, Alarm = On

1.7 TRENDING

A. General:

1. All I/O points shall be linked to a Trend Object, and additional trend objects shall be provided as shown below.

   a. The controller shall be able to record a trend sample every 20 minutes on each of the trend objects.
   b. The controller shall save the most recent 244 samples of each trended point in the control module for viewing or printing.
   c. The user shall be able to enable or disable trending of any of the points listed.

2. The user shall be able to save any or all trend point data in a trend database for up to one (2) year.

    a. The user shall be able to set the buffer size (the number of data samples held in the module) and the notification threshold (the number of data samples held in the module) and the notification threshold (number of data samples to be accumulated in the module before WebCTRL requests data from the module). The notification threshold must be less than the buffer size and greater than zero.
    b. Expired trend data shall be deleted once a day at 2:30 a.m.

END OF SECTION 230993

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes refrigerant piping used for air conditioning applications.

B. Related Requirements:

1. Section 017419 – “Construction Waste Management”.
2. Section 018113.14 – “Sustainable Design Requirements - LEED v4 / 4.1 BD+C: New Construction”.
3. Section 019113 – “General Commissioning Requirements”.

1.2 SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for thermostatic expansion valves, solenoid valves, and pressure-regulating valves.

B. Shop Drawings: The HVAC Contractor shall submit diagrams for all refrigerant piping systems that are either furnished or approved by the manufacturer of the refrigeration equipment. Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationship between piping and equipment.

1. Size piping and design the actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes, to ensure proper operation and compliance with warranties of connected equipment.

C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

D. Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals specified in Division 1.

1.3 QUALITY ASSURANCE

A. ASHRAE Standard: Comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

B. ASME Standard: Comply with ASME B31.5, "Refrigeration Piping."

C. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Non electrical"; or UL 429, "Electrically Operated Valves."

1.4 COORDINATION

A. Coordinate layout and installation of refrigerant piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate pipe sleeve installations for penetrations in exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 Section "Through-Penetration Firestop Systems" for materials and methods for sealing pipe penetrations through fire and smoke barriers.

C. Coordinate pipe fitting pressure classes with products specified in related Sections.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tube: ASTM B 280, Type ACR

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

2.2 VALVES

A. Diaphragm Packless Valves: 500-psig working pressure and 275 Deg F working temperature; globe design with straight-through or angle pattern; forged-brass or bronze body and bonnet, phosphor bronze and stainless-steel diaphragms, rising stem and hand wheel, stainless-steel spring, nylon seat disc, and with solder-end connections.

B. Packed-Angle Valves: 500 psig working pressure and 275 Deg F working temperature; forged-brass or bronze body, forged-brass seal caps with copper gasket, back seating, rising stem and seat, molded stem packing, and with solder-end connections.

C. Service Valves: 500 psig pressure rating; forged-brass body with copper stubs, brass caps, removable valve core, integral ball check valve, and with solder-end connections.

D. Solenoid Valves: Comply with ARI 760; 250 Deg F temperature rating and 400-psig working pressure; forged brass, with polytetrafluoroethylene valve seat, 2-way, straight-through pattern, and solder-end connections; manual operator; fitted with suitable NEMA 250 enclosure of type required by location, with 1/2” conduit adapter and holding coil.

2.3 REFRIGERANT PIPING SPECIALITIES

A. The Contractor shall provide all refrigerant piping accessories as indicated on the project design drawings and as recommended by the condensing unit, (or heat pump) manufacturer.

B. Straight- or Angle-Type Strainers: 500 psig working pressure; forged-brass or steel body with stainless-steel wire or brass-reinforced Monel screen of 80 to 100 mesh in liquid lines up to 1-1/8”, 60 mesh in larger liquid lines, and 40 mesh in suction lines; with screwed cleanout plug and solder-end connections.

C. Moisture/Liquid Indicators: 430 psig maximum working pressure and 200°F operating temperature; all-brass body with replaceable, polished, optical viewing window with color-coded moisture indicator; with solder-end connections.

D. Replaceable-Core Filter-Dryers: 350 psig maximum working pressure; heavy gage protected with corrosion-resistant-painted steel shell, flanged ring and spring, ductile-iron cover plate with steel cap screws; wrought-copper fittings for solder-end connections; with replaceable-core kit, including gaskets and the following:

2.4 REFRIGERANTS

A. ASHRAE R-410A

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Pipe: Type ACR drawn-copper tubing

B. Fittings: Wrought copper

3.2 VALVE APPLICATIONS

A. Install diaphragm packless or packed-angle valves in suction and discharge lines of compressor and on each side of strainers.

B. Install diaphragm packless or packed-angle valves on each side of strainers and dryers, in liquid and suction lines at evaporators, and elsewhere as indicated.

C. Install solenoid valves where required by the condensing unit manufacturer.

1. Install solenoid valves in horizontal lines with coil at top.
2. Electrical wiring for solenoid valves is specified in Division 26 Sections. Coordinate electrical requirements and connections.

3.3 SPECIALTY APPLICATIONS

A. Install liquid indicators in liquid line leaving condenser.

B. Install moisture-liquid indicators in liquid lines between filter-dryers and thermostatic expansion valves and in liquid line to receiver.

C. Install replaceable-core filter-dryers in vertical liquid line and before each solenoid valve.

D. Install solenoid valves in liquid line where required to stop flow of oil and refrigerant into suction line when system shuts down.

3.4 PIPING INSTALLATION

A. Install refrigerant piping according to ASHRAE 15. All refrigerant piping must be of size as required by the condensing unit, (or heat pump) manufacturer. Provide all required piping accessories as recommended and required by the condensing unit, (or heat pump) manufacturer.

B. Basic piping installation requirements are specified in Division 23 Section 230515 "General Piping Requirements".

C. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

D. Arrange piping to allow inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection.

E. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

F. Slope refrigerant piping as follows:

1. Install horizontal suction lines with a uniform slope downward to compressor.
2. Install traps and double risers to entrain oil in vertical runs.
3. Liquid lines may be installed level.

G. Install unions to allow removal of solenoid valves and pressure-regulating valves and at connections to compressors and evaporators.

H. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties.

I. Hanger, support, and anchor products are specified in Division 23 Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

J. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.

K. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2: Maximum span, 60”; minimum rod size, 1/4”.
2. NPS 5/8: Maximum span, 60”; minimum rod size, 1/4”.
3. NPS 1 & larger: Maximum span, 72”; minimum rod size, 1/4”.

3.5 PIPE JOINT CONSTRUCTION

A. Braze joints according to applicable Division 23 sections, or at the Contractor's option, provide ZoomLock refrigerant grade copper fittings with HNBR O-rings and mechanically crimped connections.

B. Fill pipe and fittings with nitrogen during brazing to prevent scale formation.

3.6 FIELD QUALITY CONTROL

A. Test and inspect refrigerant piping according to ASME B31.5, Chapter VI.

1. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure.
2. Test high and low pressure side piping of each system at not less than the lower of the design pressure or the setting of pressure relief device protecting high and low side of system.

    a. System shall maintain test pressure at the manifold gage throughout duration of test.
    b. Test joints and fittings by brushing a small amount of soap and glycerine solution over joint.
    c. Fill system with nitrogen to raise a test pressure of 150 psig or higher as required by authorities having jurisdiction.
    d. Remake leaking joints using new materials and retest until satisfactory results are achieved.

3.7 ADJUSTING

A. Adjust high and low pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

B. Adjust set point temperature of the conditioned air to the system design temperature.

C. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Check compressor oil level above center of sight glass.
2. Open compressor suction and discharge valves.
3. Open refrigerant valves, except bypass valves that are used for other purposes.

3.8 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter-dryer after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to a vacuum of 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Charge system with a new filter-dryer core in charging line. Provide full-operating charge.

END OF SECTION 232300

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2 to plus 4 inch w.g. Metal ducts are to include the following:

1. Rectangular ducts and fittings.
2. Single-wall, round spiral-seam ducts and formed fittings.
3. Duct liner.

B. Related Sections:

1. Section 017419 – “Construction Waste Management”.
2. Section 018113.14 – “Sustainable Design Requirements - LEED v4 / 4.1 BD+C: New Construction”.
3. Section 019113 – “General Commissioning Requirements”.

1.2 SYSTEM DESCRIPTION

A. Duct system design, as indicated, has been used to select size and type of air moving and distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by the Engineer. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.3 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports and AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. NFPA Compliance:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection.

1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.

2.2 SHEET METAL MATERIALS

A. Comply with the most current version of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653 and having G60 (Z180) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Carbon-Steel Sheets: ASTM A 366 cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.

D. Stainless Steel: ASTM A 480, Type 304, and having a No. 2D finish for concealed ducts and mill for exposed ducts.

E. Aluminum Sheets: ASTM B 209, alloy 3003, tempered H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

F. Exposed ductwork shall be suitable for painting (paint grip) in field by General Contractor.

G. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

H. Tie Rods: Galvanized steel, 1/4 inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 SEALANT MATERIALS

A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.

B. Joint and Seam Tape: 2 inches wide; glass-fiber-reinforced fabric.

C. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.

D. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.

E. Solvent-Based Joint and Seam Sealant: One-part, non-sag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.

F. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

G. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.4 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

B. Hanger Materials: Galvanized sheet steel or threaded steel rod.

1. Strap and Rod Sizes: Comply with the most current version of SMACNA's "HVAC Duct Construction Standards-Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
2. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36.

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.

2.5 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to the most current version of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

1. Manufacturers:

a. Ductmate Industries, Inc.
b. Nexus Inc.
c. Ward Industries, Inc.

C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.

1. Duct Size: Maximum 30 inches wide and up to 2-inch wg pressure class.
2. Longitudinal Seams: Pittsburgh lock sealed with non-curing polymer sealant.

D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of non-braced panel area unless ducts are lined.

2.6 ROUND DUCT AND FITTING FABRICATION

A. Round, Spiral Lock Seam Ducts: Fabricate supply ducts of galvanized steel according to the most current version of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

1. Manufacturers:

a. Eastern
b. McGill AirFlow Corporation.
c. SEMCO Incorporated.

B. Duct Joints:

1. Minus 2 inches wg to plus 2 inches wg pressure class

a. Ducts up to 20 inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
b. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two (2) internal flanges with sealant and one (1) external closure band with gasket.
c. Joints shall be made with pop rivets or sheet metal screws and sealed.

2. Less than minus 2 inches wg or more than plus 2 inches wg pressure class

a. All fitting ends shall come factory equipped with a double lipped, U-profile, EPDM rubber gasket. Gasket shall be manufactured to gauge and flexibility so as to insure that system will meet all of the performance criteria set forth in the manufacturer’s literature. Gasket shall be classified by Underwriter’s Laboratories to conform to ASTM E84-91a and NFPA 90A flame spread and smoke developed ratings of 25/50.
b. All fitting ends shall be calibrated to manufacturer’s published dimensional tolerance standard and associated spiral duct.
c. All fitting ends from 3" to 24" Dia. shall have rolled over edges for added strength and rigidity.
d. All elbows from 3" to 12" Dia. shall be 2-piece die stamped and continuously stitch welded. All elbows 14" Dia. and larger shall be standing seam gorelock construction and internally sealed.
e. The radius of all 90° and 45° elbows shall be 1.5 times the elbow diameter.
f. All fittings that are of either spot welded or button punched construction shall be internally sealed.

g. Fittings shall be connected with self tapping sheet metal screws or pressure proof pop rivets in quantity and procedure per manufacturer's recommendations.

C. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "1985 HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.

D. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

E. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:

1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
2. Die-Formed Elbows for Sizes through 12 Inches in Diameter with 2-piece welded construction, 24 ga.
3. Round Elbows Larger Than 14 Inches in Diameter: Fabricate gored elbows 22 ga. for 16 inches through 26 inches, 20 ga. for 28 inches and above.

F. All tees and crosses shall be conical fittings.

G. Round connections to rectangular ducts shall be made with bellmouth fittings.

H. All connections to round ductwork shall be made with full body fittings. Side taps and saddles are not acceptable.

2.7 DUCT LINER EXPOSED TO AIR STREAM U

A. Closed Cell Elastomeric Foam .

1. Manufacturers:

a. Armacell
b. K-Flex
c. Aeroflex

2. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C534/C534M, Type II, Grade 1; and with NFPA 90A or NFPA 90B.

2.8 APPLICATION OF LINER IN RECTANGULAR DUCTS

A. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

B. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

C. Butt transverse joints without gaps and coat joint with adhesive.

D. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

E. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.

F. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.

G. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

H. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

1. Fan discharges.
2. Intervals of lined duct preceding unlined duct.
3. Upstream edges of transverse joints in ducts where air velocities are greater than 2500 fpm or where indicated.

I. Terminate inner ducts with build-outs attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated build-outs (metal hat sections) or other build-out means are optional; when used, secure build-outs to duct walls with bolts, screws, rivets, or welds.

PART 3 – EXECUTION

3.1 DUCT APPLICATIONS

A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:

1. Supply Ducts (from air handling units to air devices), (Positive Pressure): 2 inch w.g. pressure class.
2. Supply Ducts: (from heat pumps to air devices), (Positive Pressure): 2-inch w.g. pressure class.
3. Return Ducts: (from air devices to air handling units or terminal units) (Negative Pressure): 2-inch w.g. pressure class.
4. Exhaust Ducts, (Negative Pressure): 2-inch w.g. pressure class.
6. Outside Air Ducts, (Positive Pressure): 2-inch pressure class.
7. Transfer Air (Positive Pressure): 2 inch pressure class.

B. All ducts shall be of galvanized steel construction except for dishwasher and clothes dryer exhaust ducts which shall be of aluminum construction and Type 1 exhaust hood ductwork which shall be welded 304 stainless steel. Type 1 exhaust hood exhaust ductwork shall comply with the requirements of the Ohio Mechanical Code.

3.2 DUCT INSTALLATION

A. Construct and install ducts according to the most current version of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

B. Install round ducts in lengths not less than 10 feet unless interrupted by fittings.

C. Install ducts with fewest possible joints.

D. Install fabricated fittings for changes in directions, size, and shape and for connections. Fittings indicated on drawings are diagrammatic and are for information purposes only.

E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of three (3) screws in each coupling.

F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

J. Coordinate layout with suspended ceiling, fire-dampers, lighting layouts, and similar finished work.

K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws. Longitudinal joints shall be on the top side of horizontal ducts.

L. Electrical Equipment Spaces: Route ducts to avoid passing through electrical equipment spaces and enclosures.

M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.

N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant.

O. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction." All ductwork is to be maintained at the SMACNA Intermediate Cleanliness level.

P. This Contractor shall paint interiors of metal ducts, that do not have duct liner, for 24 inches upstream and downstream of duct mounted registers and grilles. Apply one (1) coat of flat, black, latex finish coat over a compatible galvanized-steel primer.

Q. Duct dimensions on drawings are inside clear dimensions.

3.3 SEAM AND JOINT SEALING

A. Seal all duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.

B. Seal ducts before external insulation is applied.

3.4 HANGING AND SUPPORTING

A. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.

B. Support vertical ducts at maximum intervals of 6 feet and at each floor.

C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

D. Install concrete inserts before placing concrete.

E. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors.

B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:

1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test the entire system at the maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven (7) days' advance notice for testing.
3. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2 inch w.g. (both positive and negative pressures) and leakage class 6 for pressure classes above 2 inch w.g.
4. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Backdraft dampers.
2. Volume dampers.
3. Fire dampers.
4 Smoke Dampers.
5. Outside air intake and exhaust air hoods.
6 Turning vanes.
7. Duct-mounting access doors.
8. Flexible connectors.
9. Flexible ducts.
10. Duct accessory hardware.

B. The motorized automatic control dampers are supplied by the Automatic Temperature Control Contractor. The HVAC contractor shall install the motorized automatic control dampers.

C. Related Requirements:

1. Section 017419 – “Construction Waste Management”.
2. Section 018113.14 – “Sustainable Design Requirements - LEED v4 / 4.1 BD+C: New Construction”.
3. Section 019113 – “General Commissioning Requirements”.

1.2 SUBMITTALS

A. Product Data: For the following:

1. Backdraft dampers.
2. Volume dampers.
3. Fire dampers.
4 Smoke dampers.
5. Outside air intake exhaust air hoods.
6 Turning vanes.
7. Duct-mounting access doors.
8. Flexible connectors.
9. Flexible ducts.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. HVAC systems, equipment and ductwork are to be sealed per requirements of ASHRAE 90.1

PART 2 – PRODUCTS

2.1 SHEET METAL MATERIALS

A. Comply with the most current version of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653 and having G60 (Z180) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Stainless Steel: ASTM A 480.

D. Aluminum Sheets: ASTM B 209, alloy 3003, tempered H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 BACKDRAFT DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. Nailor
3. Greenheck.
4. Prefco Products, Inc.
5. Ruskin Company. (low velocity basis of design)

B. Description: Multiple-blade, parallel action gravity balanced, with center-pivoted blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.

C. Frame: galvanized steel, with mitered corners and mounting flange.

D. Blades: 0.025-inch-thick, roll-formed aluminum.

E. Blade Seals: Vinyl.

F. Blade Axles: Galvanized steel.

G. Tie Bars and Brackets: Galvanized steel.

H. Return Spring: Adjustable tension.

2.3 VOLUME DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. Nailor
3. Greenheck
4. Ruskin Company

B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include dial type quadrant handle locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class. Provide stand-off assembly for all balancing dampers that are installed in insulated ducts.

C. Standard Volume Dampers: Single-blade up to 6" blade width and opposed multi-blade on 8" and larger blade width, standard leakage rating, and suitable for horizontal or vertical applications.

1. Steel Frames: 22 gauge, hat-shaped, galvanized sheet steel channels, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
2. Roll-Formed Steel Blades: 22 gauge galvanized sheet steel.
3. Blade Axles: Galvanized steel.
4. Bearings: Molded synthetic.
5. Tie Bars and Brackets: Aluminum.
6. Tie Bars and Brackets: Galvanized steel.

D. Low velocity rectangular: Ruskin Model MD25

E. Low velocity round: Ruskin Model MDRS25

F. Medium velocity round: Lindab Model DRU

2.4 FIRE DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. Greenheck.
3. Prefco Products, Inc.
4. Ruskin Company.
5. Nailor
6. ***Sure Clamp Access.***

B. Fire dampers shall be labeled according to UL 555.

C. Fire Rating: 1-1/2 hours.

D. Frame: Curtain type with blades and frame outside airstream; fabricated with roll-formed, 0.034-inch thick galvanized steel; with mitered and interlocking corners. Rectangular: Style "C". Round: Style "CR".

E. Mounting Sleeve: Factory or field-installed, galvanized sheet steel, mounted outside airstream.

1. Minimum Thickness: 0.052 or 0.138 inch thick as indicated and of length to suit application.
2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Roll-formed, interlocking, 0.034-inch thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch thick, galvanized-steel blade connectors.

H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

I. Fusible Links: Replaceable, 165 deg F.

2.5 SMOKE DAMPERS

D. Manufacturers: Subject to compliance with requirements, provide products by one of the following.

1. Air Balance, Inc.
2. Greenheck.
3. Prefco Products, Inc.
4. Ruskin Company.
5. Nailor.

E. General Requirements: Label according to UL 555S by an NRTL.

F. Smoke Detector: Integral, factory wired for single-point connection.

G. Frame: Curtain type with blades inside airstream, fabricated with roll-formed, 0.034 inch thick galvanized steel; with mitered and interlocking corners.

H. Blades: Roll-formed, horizontal, interlocking, 0.034 inch thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034 inch thick, galvanized-steel blade connectors.

I. Leakage: Class I.

J. Rated pressure and velocity to exceed design airflow conditions.

K. Mounting Sleeve: Factory-installed, 0.052 inch thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

L. Damper Motors: two-position action.

M. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf .
7. Electrical Connection: 115 V, single phase, 60 Hz.

N. Accessories

1. Resetable by means of fire alarm system.

2.6 OUTDOOR AIR INTAKE AND EXHAUST AIR HOODS

A. Manufacturers:

2. Greenheck
3. Nailor
4. Cook

A. General Description:

1. Ventilator shall be low silhouette for exhaust or intake applications
2. Units for ducted application.

B. Hood and Base:

1. Material Type: Aluminum.
2. Hood Constructed of formed, arched panels with interlocking seams
3. Vertical end panels shall be fully locked into hood end panels
4. Base height minimum 5 inches
5. Curb cap shall be six inches larger than throat size
6. Curb cap shall have pre-punched mounting holes for installation

C. Birdscreen:

1. Constructed of ½ inch aluminum mesh.
2. Mounted horizontally across the intake or exhaust area of the hood.

D. Hood Support:

1. Constructed of galvanized steel and fastened so the hood can either be removed completely from the base or hinged open.

E. Accessories:

1. Roof Curbs: Provide 24 inch high insulated roof curb per requirements of Section 230500 and as detailed on the project drawings.

2. Hinged Access: Provide hinged connection from hood to base suitable for roof access to the connecting ductwork. Provide hinge assembly complete with locking device that secures the hood in the open position.

2.7 TURNING VANES

A. Fabricate to comply with the most current version of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

B. Manufactured Turning Vanes: Fabricate 1-1/2 inch wide, airfoil-vane, curved blades of galvanized sheet steel set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.

1. Manufacturers:
   a. Ductmate Industries, Inc.
   b. Duro Dyne Corp.
   c. METALAIRE, Inc.

2.8 DUCT-MOUNTING ACCESS DOORS

A. General Description: Fabricate doors airtight and suitable for duct pressure class.

B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include piano hinge and cam latches.

1. Manufacturers:
   a. Nailor.
   b. CESCO Products.
   c. Ductmate Industries, Inc.
   d Greenheck.
   e. McGill AirFlow Corporation.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Provide number of hinges and locks as follows:
   a. Less Than 12 Inches square: Secure with two (2) sash locks.
   b. Up to 18 Inches Square: Two (2) sash locks.
   c. Up to 24 by 48 Inches: Secure with two (2) compression locks.

C. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

C. Insulation: 1-inch thick, fibrous-glass or polystyrene-foam board.

2.9 FLEXIBLE CONNECTORS

A. Manufacturers:

1. Ductmate Industries, Inc.
2. Duro Dyne Corp.
3. Ventfabrics, Inc.

B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3" to 6" wide attached to two strips of 2-3/4-inch wide, 0.028-inch thick, galvanized sheet steel or 0.032-inch thick aluminum sheets. Select metal compatible with ducts.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd..
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

2.10 FLEXIBLE DUCTS

A. Manufacturers:

1. Flexmaster U.S.A., Inc.
2. Hart & Cooley, Inc.
3. McGill AirFlow Corporation.

B. Non-insulated-Duct Connectors: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire.

1. Pressure Rating:5-inch wg positive and 0.5-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 175 deg F.

C. Insulated-Duct Connectors: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor barrier film.

1. Pressure Rating: 5-inch wg positive and 0.5-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 175 deg F.
4. Minimum k-value for insulation to be .23.

D. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 through 18 inches to suit duct size.

PART 3 – EXECUTION

3.1 APPLICATION AND INSTALLATION

A. Install duct accessories according to applicable details in the most current version of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers on exhaust fans or exhaust ducts where indicated.

D. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two (2) duct widths from branch takeoff. Locking quadrants shall be easily accessible and shall be installed on the outside of the duct insulation.

E. Install fire dampers, with fusible links, according to manufacturer's UL-approved written instructions.

F. Install all intake or exhaust air hoods on insulated roof curbs per all requirements of the hood manufacturer. The HVAC contractor is to provide flashing for all roof hoods.

G. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:

1. On both sides of duct coils.
2. Downstream from volume dampers and equipment.
3. Adjacent to fire dampers, providing access to reset or reinstall fusible links.
4. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot spacing. Duct mounted grilles will replace access doors for duct cleaning.
5. On sides of ducts where adequate clearance is available.

H. Install the following sizes for duct-mounting, rectangular access doors: Based on the following maximum duct dimensions:

1. 9" and smaller: 6" x 8" door size.
2. 10" to 12": 9" x 12" door size.
3. 13" to 16": 12" x 16" door size.
4. 18" and larger: 14" x 14" door size.

I. Label access doors according to Division 23 Section "Mechanical Identification."

J. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.

K. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

L. Connect diffusers to low pressure ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place. See detail on drawings.

M. Connect flexible ducts to metal ducts with draw bands.

3.2 ADJUSTING

A. Adjust duct accessories for proper settings.

B. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION 233300

SECTION 233423 – HVAC FANS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Provide exhaust fans, as specified in this Section and indicated on the drawings.

B. Related Requirements:

1. Section 017419 – “Construction Waste Management”.
2. Section 018113.14 – “Sustainable Design Requirements - LEED v4 / 4.1 BD+C: New Construction”.
3. Section 019113 – “General Commissioning Requirements”.

1.2 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base air ratings on 800 feet above sea level.

B. Operating Limits: Classify according to AMCA 99.

C. Fan noise levels shall not exceed 55 DBA in the daytime and 50 DBA in the nighttime at any occupied locations within the building.

1.3 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material gages and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

C. Maintenance Data: For exhaust fans and combustion air fans, provide maintenance manuals as specified in Division 1.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall

be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.6 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.7 EXTRA MATERIALS

A. Furnish under provisions of Division 1.

B. Provide two sets of belts for each belt driven fan.

PART 2 – PRODUCTS

2.1 MANUFACTURERS – EXHAUST FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.

1. Greenheck (Basis of Design)
2. Twin City
3. Cook

2.2 ROOF MOUNTED CENTRIFUGAL FANS

A. General:

1. Down-blast or up-blast fan as indicated on drawings. Fan shall be suitable for roof mounted applications.

B. Wheel:

1. Constructed of aluminum.
2. Non-overloading, backward inclined centrifugal.
3. Statically and dynamically balanced in accordance to AMCA Standard 204-05.

4. The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency.

C. Motors:

1. Motors to be open drip-proof or ECM type as scheduled on the drawings.
2. Motors shall permanently lubricated, heavy duty ball bearing type to match with the fan load and furnished at the specific voltage and phase.
3. Mounted on vibration isolators, out of the airstream.
4. For motor cooling there shall be fresh air drawn into the motor compartment through an area free of discharge contaminants.
5. Accessible for maintenance.

D. Shafts and bearings:

1. Fan shaft shall be ground and polished solid steel with an anti corrosive coating.
2. Permanently sealed bearings or pillow block ball bearings.
3. Bearing shall be selected for a minimum L10 life in excess of 100,000 hours at maximum cataloged operating speed.
4. Bearings are 100 percent factory tested.
5. Fan Shaft first critical speed is at least 25 percent over maximum operating speed.

E. Housing:

1. Motor cover, shroud, curb cap, and windband shall be constructed of heavy gauge aluminum.
2. Shroud shall have an integral rolled bead for extra strength.
3. Shroud shall be drawn from a disc.
4. Lower windband shall have a formed edge for added strength.
5. Motor cover shall be drawn from a disc.
6. All housing components shall have final thicknesses equal to or greater then preformed thickness.
7. Curb cap shall have pre-punched mounting holes to ensure correct attachment.
8. Rigid internal support structure.
9. Leak proof.

F. Housing Supports And Drive Frame:

1. Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators.

G. Vibration Isolation:

1. Double studded or pedestal mount true isolators.
2. No metal to metal contact.
3. Sized to match the weight of each fan.

H. Disconnect Switches:

1. NEMA rated: 4X
2. Positive electrical shut-off.

3. Wired from fan motor to junction box installed within motor compartment.

I. Drive Assembly:

1. Direct drive or belt driven with belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower.
2. Belts: Static free and oil resistant.
3. Pulleys: Fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
4. The motor pulley shall be adjustable for final system balancing.
5. Readily accessible for maintenance.

J. Accessories:

1. Auto Belt Tensioner for belt driven units: Automatic tensioning device that adjusts for the correct belt tension, only for single drives.
2. Provide backdraft damper where scheduled on the drawings.
3. Speed Control: Provide adjustable manual speed control or solid state speed controller as scheduled on the drawings.
4. For exhaust fan, EF-9 provide UL-762 listed fan with grease trap suitable for use with Type 1 kitchen hood.
5. Birdscreen:

   a. Material Type: Aluminum.
   b. Protects fan discharge

6. Roof Curbs:

   a. Types: Suitable for pitched roof, welded straight side curb with 2 inch flashing flanges and wood nailer
   b. Mounted onto roof with fan
   c. Material: Aluminum.
   d. Insulation thickness: 1.5 inches

7. Curb Seal:

   a. Rubber seal between the fan and the roof curb.

K. Refer to the exhaust fan schedule on the drawings for performance requirements.

2.3 IN-LINE CABINET EXHAUST FANS

A. Duct mounted, forward curved, centrifugal, direct drive type exhaust fan.

B. Fan housing shall be constructed of heavy gauge galvanized steel. The housing interior shall be lined with 1/2" acoustical insulation. Outlet duct collar shall include an aluminum balanced back-draft damper. Outlet collar shall be adaptable for horizontal or vertical discharge.

C. Motor shall be mounted on vibration isolators. Access for wiring shall be external. Motor disconnect shall be an internal, plug in type.

D. Fan shall bear the AMCA Certified Ratings Seal for sound and air performance and shall be UL rated.

E. Fan shall be furnished with the following accessories: Vibration isolation kit, integral inlet grille (where indicated) and items as scheduled on drawings.

F. See exhaust fan schedule on the drawings for performance requirements.

2.4 CEILING MOUNTED CABINET FANS

A. General Description:

1. Base fan performance at standard conditions.
2. Ceiling mounted applications.
3. Fans shall be UL/cUL listed 507 - Electric Fans.

B. Wheel:

1. Forward curved centrifugal wheel.
2. Constructed of galvanized steel or calcium carbonate filled polypropylene.
3. Statically and dynamically balanced in accordance to AMCA Standard 204-05.

C. Motors:

1. Motor enclosures shall be open drip-proof (ODP), opening in the frame body and or end brackets.
2. Motors shall be permanently lubricated sleeve bearing type to match with the fan load and furnished at the specific voltage and phase.
3. Motor shall be mounted on vibration isolators and be accessible for maintenance.
4. Thermal overload protection.

D. Housing:

1. Constructed of galvanized steel.
2. Interior shall be lined with 0.5 inches of acoustical insulation.

E. Outlet:

1. Type of outlet: Round.
2. Field rotatable from horizontal to vertical discharge.
3. Duct collar shall include an aluminum backdraft damper.

F. Grille:

1. Constructed of high impact polystyrene.

G. Accessories:

1. Disconnect Switches:

a. NEMA rated: 1
b. Positive electrical shut-off.
c. Wired from fan motor to junction box installed within motor compartment.

2. Transformers:

a. Manufacturer to furnish 277 to 115 volt step-down transformer suitable for field installation and wiring by the project electrical contractor.

H. Refer to the exhaust fan schedule on the drawings for performance requirements.

2.4 MOTORS

A. Refer to Division 23 Section "Motors" for general requirements for factory-installed motors.

B. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B.

2.5 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install exhaust fans level and plumb.

B. Vibration control devices are specified in Division 23 Section "Mechanical Vibration Controls."

C. For units with integral inlet grilles mounted in ceiling tiles, install with grilles centered in ceiling tiles.

D. Support suspended units from structure using threaded steel rods and vibration spring isolators. Vibration control devices are specified in Division 23 Section “Controls for HVAC Piping and Equipment”.

E. Install units with clearances for service and maintenance.

F. Label units according to requirements specified in Division 23 Section "For HVAC Piping and Equipment."

G. Installed flexible connections between fan inlet and discharge ductwork. Ensure metal bands between connectors are parallel with minimum one-inch flex between ductwork

and fan while running.

H. Provide fixed sheaves required for final air balance.

I. Provide safety screen where inlet or outlet is exposed.

J. Provide backdraft dampers on discharge of exhaust fans and as indicated.

3.2 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Duct Accessories."

B. Install ducts adjacent to exhaust fans to allow service and maintenance.

C. Ground equipment.

D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Equipment Startup Checks:

1. Verify that shipping blocking and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices, and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Verify lubrication for bearings and other moving parts.
6. Verify that manual and automatic volume control and fire dampers in connected ductwork systems are in fully open position.

B. Starting Procedures:

1. Energize motor and adjust fan to indicated rpm.
2. Measure and record motor voltage and amperage.

C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.

D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Shut unit down and reconnect automatic temperature-control operators.

F. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.

G. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust motor speed for direct drive fans and adjust belt tension for belt driven fans.

C. Lubricate bearings.

3.5 CLEANING

A. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.

B. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

END OF SECTION 233423

SECTION 233713 - DIFFUSERS, REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 REFERENCE

A. SCOPE OF WORK

1. Provide grilles, diffusers, air devices and appurtenances with size and capacities as shown on drawings.

B. Related Requirements:

1. Section 017419 – “Construction Waste Management”.
2. Section 018113.14 – “Sustainable Design Requirements - LEED v4 / 4.1 BD+C: New Construction”.
3. Section 019113 – “General Commissioning Requirements”.

1.2 SUBMITTALS

A. Product Data: For each product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish and mounting details; and performance date including throw and drop, static-pressure drop and noise ratings.
2. Diffuser, Register and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size and accessories furnished.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified:

1. Price (Basis of Design)
2. Krueger
3. Titus
4. Anemostat
5. Nailor

2.2 NOT USED

2.3 SQUARE PLAQUE FACED CEILING DIFFUSERS, CD-1:

A. Ceiling diffusers of sizes and mounting types designated by the plans and air device schedule. Diffusers shall consist of a precision formed back cone of one piece seamless construction which incorporates a round inlet collar of sufficient length for connecting rigid or flexible duct. An inner plaque assembly shall be incorporated that drops no more than 1/4" below the ceiling plane to assure proper air distribution performance. The inner plaque assembly shall be completely removable from the diffuser face to allow full access to any dampers or other ductwork components located near the diffuser neck. The diffuser is to include an integral opposed blade damper that is adjustable from the face of the air device. Finish shall be white powder coat

2.4 NOT USED

2.5 SUPPLY REGISTERS, SR-1:

A. Supply registers of the sizes and mounting types indicated on the plans and outlet schedule. Registers shall be double deflection type with two sets of fully adjustable deflection blades spaced 3/4" on center. The front set of blades shall run parallel to the short or long dimension of the register as indicated in the air device schedule. The integral volume control damper shall be of the opposed blade type and shall be constructed of cold rolled steel. The damper shall be operable from the register face. The damper shall be coated steel. Registers are to be suitable for surface mounting or duct mounting as indicated on the drawings. Registers mounted in walls shall have steel plaster frames. Provide 1-1/4 “ margin with countersunk screw mounting for drywall and masonry surfaces complete with mounting frame. Units in equipment rooms shall be a mill finish. All other registers shall have a white powder coat finish.

2.6 LINEAR BAR SUPPLY REGISTERS, SR-2

A. Supply registers of the sizes and mounting types indicated on the plans and air device schedule. Registers shall be thirty degree deflection extruded aluminum blades spaced 1/2" on center. The core shall be of extruded aluminum construction with reinforcement supports and extruded frame with mitered corners. The blades shall run parallel to the long dimension of the register. Registers are to have integral volume control dampers that area of the opposed blade type and shall be constructed of cold rolled steel. The damper shall be operable from the register face. The damper shall be coated steel. Registers mounted in walls shall have steel plaster frames. Provide 1-1/4 “ margin with countersunk screw mounting for drywall and masonry surfaces complete with mounting frame. All registers shall have a white powder coat finish

2.7 HEAVY DUTY BAR TYPE EXHAUST GRILLES AND RETURN REGISTERS, RG-3

A. Exhaust grilles and return registers of the sizes and mounting types indicated on the plans and air device schedule. Registers shall be zero degree deflection extruded aluminum blades spaced 1/2" on center. The blades shall have mandrel support tubes for reinforcement that are spaced at a maximum of 12 inch on center. The blades shall run parallel to the horizontal dimension of the register for wall mounted units. Units designated as registers are to have integral volume control dampers that area of the opposed blade type and shall be constructed of cold rolled steel. The damper shall be operable from the register face. The damper shall be coated steel. Registers mounted in walls shall have steel plaster frames. Provide 1-1/4 " margin with countersunk screw mounting for drywall and masonry surfaces complete with mounting frame. All registers shall have a white powder coat finish.

2.8 EGGCRATE GRILLES AND REGISTERS, RR-1, RG-1, RG-2 & RG-3, ER-1, ER-2, ER-3, EG-1, EG-2, EG-3 & TG-1:

A. Exhaust registers and grilles of the sizes and mounting types indicated on the plans and air device schedule. Units shall be of aluminum construction, consisting of aluminum 1/2" x 1/2" x 1/2" eggcrate core and an extruded aluminum border. Units designated as registers shall be equipped with integral volume control damper of the opposed blade type and shall be constructed of heavy gauge cold rolled steel. The damper shall be operable from the register face. The damper shall be coated steel. Units in equipment rooms shall be a mill finish. All other units shall have white powder coat finish.

2.9 LINEAR DIFFUSERS LD-1:

B. Linear diffusers of the sizes and mounting types indicated on the plans and linear diffuser schedule. Units shall be of extruded aluminum construction with frame and support bars of extruded aluminum. The pattern controller shall be of steel construction with sliding design adjustable from the face of the diffuser and initially set to discharge vertically downward. Units shall be complete with insulated steel plenums that are to be constructed with round flanged side duct connections. Diffusers shall have a white powder coat finish with pattern controllers and interior visible components painted black.

2.10 LOUVERS AND BRICK VENTS

A. All louvers and brick vents shall be provided by the General Contractor. Information shown on the HVAC drawings is for reference of performance requirements only.

2.11 ALUMINUM WALL HOOD, DV-1

A. Wall hood shall be constructed of aluminum with round inlet duct connection complete with backdraft damper and rated for use with clothes dryer exhaust.

2.12 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install grilles, registers, diffusers and air devices level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw and pressure drop. Make final locations where indicated as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install grilles, registers, diffusers and air devices with airtight connections to ducts and to allow service and maintenance of dampers, air extractors and fire dampers.

3.3 ADJUSTING

A. After installation, adjust grilles, registers, diffusers and air devices to air patterns indicated, or as directed before starting air balancing.

END OF SECTION 237313

SECTION 233813 - COMMERCIAL-KITCHEN HOODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Commercial-kitchen hoods, Type I.
2. Commercial-kitchen hoods, Type II.

B. Related Requirements:

1. Section 017419 – “Construction Waste Management”.
2. Section 018113.14 – “Sustainable Design Requirements - LEED v4 / 4.1 BD+C: New Construction”.
3. Section 019113 – “General Commissioning Requirements”.
4. Section 233533 "Listed Kitchen Ventilation System Exhaust Ducts" for fire-rated ducts connecting to kitchen hoods.

1.3 DEFINITIONS

A. Listed Hood: A hood, factory fabricated and tested for compliance with UL 710 by a testing agency acceptable to authorities having jurisdiction.

B. Standard Hood: A hood, usually field fabricated, that complies with design, construction, and performance criteria of applicable national and local codes.

C. Type I Hood: A hood designed for grease exhaust applications.

D. Type II Hood: A hood designed for heat and steam removal and for other nongrease applications.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [**Project site**] <**Insert location**>.

1. Required Attendance:

a. <**Insert personnel by title**>.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Standard hoods.
2. Filters/baffles.
3. Fire-suppression systems.
4. Luminaires.

B. Shop Drawings: Signed and sealed by a qualified professional engineer.

1. Shop Drawing Scale: [**1/4 inch = 1 foot**] <**Insert scale**>.
2. Show plan view, elevation view, sections, roughing-in dimensions, service requirements, duct connection sizes, and attachments to other work.
3. Show cooking equipment plan and elevation to confirm minimum code-required overhang.
4. Indicate performance, exhaust and makeup air airflow, and pressure loss at actual Project-site elevation.
5. Show water-supply and drain piping connections.
6. Show control cabinets.
7. Show fire-protection cylinders, piping, actuation devices, and manual control devices.
8. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
9. Design Calculations: Calculate requirements for selecting seismic restraints.
10. Include diagrams for power, signal, and control wiring.
11. Duct Connections: Detail connections between ducts and hoods, including access doors and panels.
12. Piping Diagrams: Detail fire-suppression piping and components and differentiate between manufacturer-installed and field-installed piping. Include roughing-in requirements for drain connections. Show cooking equipment plan and elevation to illustrate fire-suppression nozzle locations.

    a. Piping Diagram Scale: [**1/4 inch = 1 foot**] <**Insert scale**>.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Coordination Drawing Scale: [**1/4 inch = 1 foot**] <**Insert scale**>.
2. Suspended ceiling assembly components.
3. Structural members to which equipment will be attached.
4. Roof framing and support members for duct penetrations.
5. Items penetrating finished ceiling including the following:

a. Luminaires.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
f. Moldings on hoods and accessory equipment.
g. <**Insert item**>.

B. Welding certificates.

C. Seismic Qualification Data: Submit certification that commercial-kitchen hoods, accessories, and components will withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[**and the unit will be fully operational after the seismic event**]."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Field quality-control reports.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Grease Filters/Baffles: [**One**] <**Insert number**> complete set(s).

1.8 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D 1.1M, "Structural Welding Code - Steel," for hangers and supports; and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for joint and seam welding.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 HOOD MATERIALS

A. Stainless-Steel Sheet: ASTM A666, Type 304.

1. Minimum Thickness: [**0.037 inch**] [**0.050 inch**] <**Insert dimension**>.
2. Finish: Comply with SSINA's "Finishes for Stainless Steel" for recommendations for applying and designating finishes.

a. Finish shall be free from tool and die marks and stretch lines and shall have uniform, directionally textured, polished finish indicated, free of cross scratches. Grain shall run with long dimension of each piece.

3. Concealed Stainless-Steel Surfaces: ASTM A480/A480M, No. 2B finish (bright, cold-rolled, unpolished finish).
4. Exposed Surfaces: [**ASTM A480/A480M, No. 2B finish (bright, cold-rolled, unpolished)**] [**ASTM A480/A480M, No. 3 finish (intermediate polished surface)**] [**ASTM A480/A480M, No. 4 finish (directional satin)**] [**ASTM A480/A480M, No. 6 finish (dull satin)**] [**ASTM A480/A480M, No. 7 finish (reflective, directional polish)**] [**ASTM A480/A480M, No. 8 finish (mirrorlike reflective, nondirectional polish)**].
5. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

B. Carbon-Steel Sheets: ASTM A1008/A1008M, cold-rolled sheets; commercial quality; with oiled, exposed matte finish.

1. Minimum Thickness: [**0.043 inch**] [**0.0478 inch**] <**Insert dimension**>.

C. Galvanized-Steel Sheet: Lock-forming quality; ASTM A653/A653M, G90 coating designation.

1. Minimum Thickness: [**0.052 inch**] <**Insert dimension**>.

D. Zinc-Coated Steel Shapes: ASTM A36/A36M, zinc coated according to ASTM A123/A123M requirements.

E. Sealant: ASTM C920; Type S, Grade NS, Class 25, Use NT. Elastomeric sealant shall be NSF certified for commercial-kitchen hood application. Sealants, when cured and washed, shall comply with requirements in 21 CFR 177.2600, for use in areas that come in contact with food.

1. Color: As selected by Architect from manufacturer's full range.
2. Backer Rod: Closed-cell polyethylene, in diameter larger than joint width.

F. Sound Dampening: NSF-certified, non-absorbent, hard-drying, sound-deadening compound for permanent adhesion to metal in minimum 1/8-inch thickness that does not chip, flake, or blister.

G. Gaskets: NSF certified for end-use application indicated; of resilient rubber, neoprene, or PVC that is nontoxic, stable, odorless, nonabsorbent, and unaffected by exposure to foods and cleaning compounds, and that passes testing according to UL 710.

2.3 GENERAL HOOD FABRICATION REQUIREMENTS

A. Welding: Use welding rod of same composition as metal being welded. Use methods that minimize distortion and develop strength and corrosion resistance of base metal. Make ductile welds free of mechanical imperfections such as gas holes, pits, or cracks.

1. Welded Butt Joints: Full-penetration welds for full-joint length. Make joints flat, continuous, and homogenous with sheet metal without relying on straps under seams, filling in with solder, or spot welding.
2. Grind exposed welded joints flush with adjoining material and polish to match adjoining surfaces.
3. Where fasteners are welded to underside of equipment, finish reverse side of weld smooth and flush.
4. Coat concealed stainless-steel welded joints with metallic-based paint to prevent corrosion.
5. After zinc-coated steel is welded, clean welds and abraded areas and apply SSPC-Paint 20, high-zinc-dust-content, galvanizing repair paint to comply with ASTM A780/A780M.

B. For metal butt joints, comply with SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines."

C. Where stainless steel is joined to a dissimilar metal, use stainless-steel welding material or fastening devices.

D. Form metal with break bends that are not flaky, scaly, or cracked in appearance; where breaks mar uniform surface appearance of material, remove marks by grinding, polishing, and finishing.

E. Sheared Metal Edges: Finish free of burrs, fins, and irregular projections.

F. In food zones, as defined in NSF, fabricate surfaces free from exposed fasteners.

G. Cap exposed fastener threads, including those inside cabinets, with stainless-steel lock washers and stainless-steel cap (acorn) nuts.

H. Fabricate pipe slots on equipment with turned-up edges sized to accommodate service and utility lines and mechanical connections.

I. Fabricate enclosures, including panels, housings, and skirts, to conceal service lines, operating components, and mechanical and electrical devices including those inside cabinets unless otherwise indicated.

J. Fabricate seismic restraints according to SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines," Appendix A, "Seismic Restraint Details."

K. Fabricate equipment edges and backsplashes according to SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines."

L. Fabricate enclosure panels to ceiling and wall as follows:

1. Fabricate panels on [**one**] [**two**] [**three**] [**four**] [**all exposed**] side(s) with same material as hood, and extend from ceiling to top of hood canopy and from canopy to wall.
2. Wall Offset Spacer: Minimum of 3 inches.
3. Wall Shelves and Overshelves: Fabricate according to SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines," with minimum 0.0625-inch-thick, stainless-steel shelf tops.

2.4 EXHAUST HOOD FABRICATION, TYPE I HOOD

A. Weld all joints exposed to grease with continuous welds, and make filters/baffles or grease extractors and makeup air diffusers easily accessible for cleaning.

1. Fabricate hoods according to NSF 2, "Food Equipment."
2. Hoods shall be listed and labeled, according to UL 710, by a testing agency acceptable to authorities having jurisdiction.
3. Hoods shall be designed, fabricated, and installed according to NFPA 96.
4. Include access panels as required for access to fire dampers and fusible links.
5. Duct Collars: Minimum 0.0598-inch-thick steel at least 3 inches long, continuously welded to top of hood and at corners.[**Fabricate a collar with a 0.5-inch-wide duct flange.**]
6. Duct-Collar Fire Dampers: Collar and damper shall comply with UL 710 testing and listing required for the entire hood.

   a. Collar: Minimum 0.0598-inch-thick stainless steel, at least 3 inches long, continuously welded to top of hood and at corners.[**Fabricate a collar with a minimum 0.5-inch-wide duct flange.**]
   b. Blades: Minimum 0.1046-inch-thick stainless steel, counterbalanced to remain closed after actuation.
   c. Blade Pivot and Spring: Stainless steel.
   d. Fusible Link: Replaceable, 212 deg F rated.

7. Makeup Air Fire Dampers: Labeled, according to UL 555, by a testing agency acceptable to authorities having jurisdiction.

   a. Fire Rating: 1-1/2 hours.

b. Frame: SMACNA [**Type A**] [**Type B**], with blades in airstream; fabricated with roll-formed, [**galvanized**] [**stainless**] steel; with mitered and interlocking corners.
c. Blades: Roll-formed, interlocking or folded, minimum 0.034-inch-thick, galvanized-steel sheet.
d. Horizontal Dampers: Include a blade lock and stainless-steel closure spring.
e. Fusible Link: Replaceable, [**165 deg F**] [**212 deg F**] rated.

B. Hood Configuration: Exhaust [**only**] [**and makeup air**].

1. Makeup air shall be introduced by [**induction**] [**combination of induction and diffusion**] inside canopy. If makeup air is not heated, insulate interior of makeup air plenum with high-density insulation having maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
2. Makeup air shall be introduced through [**front**] [**and**] [**bottom**] of canopy through [**perforated diffusers**] [**supply-air registers with adjustable guide vanes**].
3. Makeup air shall be introduced through laminar-flow-type, perforated metal panels on front of hood canopy.
4. Makeup air shall be introduced through laminar-flow-type, perforated metal diffusers mounted in the ceiling in front of hood canopy. Furnish laminar-flow-type diffusers with baked [**white**] <**Insert color**> enamel finish and volume-control dampers.
5. Makeup air shall be introduced through plenum at rear of hood, extending down below appliance cooking surfaces.

C. Hood Style: [**Wall-mounted canopy**] [**Single-island canopy**] [**Double-island canopy**] [**Back shelf**] [**Eyebrow**] [**Pass over**].

D. Filters/Baffles: Removable, [**stainless-steel**] [**aluminum**][**, with spring-loaded fastening**]. Fabricate stainless steel for filter frame and removable collection cup and pitched trough. Exposed surfaces shall be pitched to drain to collection cup. Filters/baffles shall be tested according to UL 1046, "Safety for Grease Filters for Exhaust Ducts," by an NRTL acceptable to authorities having jurisdiction.

E. Removable Water-Wash Grease Extractor: Stainless steel, tested with hood according to UL 710.

F. Stationary Water-Wash Grease Extractor: Integral, automatically self-cleaning, spraying hot water and detergent over the entire length of exhaust plenum. Fabricate to supply 140 deg F water at 1.25 gpm/ft. of hood length, at 40- to 60-psig inlet pressure.

1. Water Piping: ASTM A270/A270M, Type 304 stainless steel.
2. Fabricate to drain water and detergent to a collection trough having stainless-steel drain fittings.
3. Single, [**hood**] [**wall**]-mounting control panel with a solid-state, programmable controller shall control all hoods on Project. Wash cycle shall be factory set to operate for 10 minutes after fans stop.
4. Detergent shall be supplied by an adjustable-flow, 120-V ac injection pump from a reservoir with a minimum capacity of 2.5 gal..

G. Water-mist option shall supply a maximum of 0.1 gpm/ft. of hood length through stainless-steel piping and nozzles.

1. Water Piping: ASTM A270/A270M, Type 304 stainless steel.

H. Luminaires: [**Recessed**] [**Surface-mounted**], [**LED**] [**fluorescent**] [**incandescent**] luminaires and lamps with lenses sealed vapor tight. Wiring shall be in conduit on hood exterior. Number and location of luminaires shall provide a minimum of 70 fc at 30 inches above finished floor.

1. Light switches shall be mounted [**on front panel of hood canopy**] [**on wall adjacent to hood**] [**in hood control panel**].
2. Luminaires: [**LED**] [**Fluorescent**] [**Incandescent**] complying with UL 1598.

I. Comply with hood control requirements in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."

J. Hood Controls: [**Hood**] [**Wall**]-mounting control cabinet, [**factory wired to control groups of adjacent hoods, and**]fabricated of stainless steel.

1. Exhaust Fan: On-off switches shall start and stop the exhaust fan. [**Interlock exhaust fan with makeup air supply fan to operate simultaneously.**]Interlock exhaust fan with fire-suppression system to operate fan(s) during fire-suppression-agent release and to remain in operation until manually stopped. Include red pilot light to indicate fan operation.

   a. Exhaust Fan Motor Starter: [**Comply with Section 262913.03 "Manual and Magnetic Motor Controllers."**] [**Fan Motor Starter: Comply with Section 262913.06 "Soft-Start Motor Controllers."**]

2. Exhaust Fan Interlock: Factory wire the exhaust fan starters in a single control cabinet for adjacent hoods to operate together.
3. Photocell and Temperature Control, Cycling: Cycle makeup air and exhaust-air fans on and off, based on temperature at hood discharge and opacity of smoke in hood. Interlock fan control with fire-suppression system to operate during fire-suppression-agent release and to remain in operation until manually stopped. Provide air-purge fan and conduit to photocell and reflector to avoid grease accumulation that will negatively affect performance of system.
4. Photocell and Temperature Control, Two Speed: Change speed (off, low, and high) of makeup air and exhaust-air fans with speed switch, based on temperature at hood discharge and opacity of smoke in hood. Interlock fan control with fire-suppression system to operate at high speed during fire-suppression-agent release and to remain in high-speed operation until manually stopped. Provide air-purge fan and conduit to photocell and reflector to avoid grease accumulation that will negatively affect performance of system. Controller shall limit exhaust-duct velocity between <**Insert minimum velocity**> and <**Insert maximum velocity**>. Controller shall limit supply quantity to <**Insert minimum quantity**> for proper operation of makeup air unit.
5. Photocell and Temperature Control, Variable Speed: Vary speed of makeup air and exhaust-air fans with variable-frequency controllers, based on temperature at hood discharge and opacity of smoke in hood. Interlock fan control with fire-

suppression system to operate at high speed during fire-suppression-agent release and to remain in high-speed operation until manually stopped. Provide air-purge fan and conduit to photocell and reflector to avoid grease accumulation that will negatively affect performance of system. Controller shall limit exhaust-duct velocity between <**Insert minimum velocity**> and <**Insert maximum velocity**>. Controller shall limit supply quantity to <**Insert minimum quantity**> for proper operation of makeup air unit.

6. High-Temperature Control: Alarm shall sound and cooking equipment shall shut down before hood discharge temperature rises to actuation temperature of fire-suppression system.
7. Water-Wash Timer: [**24-hour clock**] [**365-day, programmable timer**] shall control sequential wash of multiple hood sections.
8. Water Mist: Solenoid valve interlocked with exhaust fan to open with hood operation.

K. Capacities and Characteristics:

1. Nominal Hood Length: <**Insert inches**>.
2. Nominal Hood Width: <**Insert inches**>.
3. Canopy Height: <**Insert inches**>.
4. Exhaust Airflow: <**Insert cfm**>.
5. Exhaust-Air Pressure Loss: <**Insert inches wg**>.
6. Makeup Air Airflow: <**Insert cfm**>.
7. Makeup Air Pressure Loss: <**Insert inches wg**>.
8. Water-Supply Connection: <**Insert NPS**>.
9. Washdown Water Flow: <**Insert gpm**>.
10. Minimum Water Pressure: <**Insert psig**>.
11. Mist Water Flow: <**Insert gpm**>.
12. Sanitary Drain Connection: <**Insert NPS**>.

2.5 EXHAUST HOOD FABRICATION, TYPE II HOOD

A. Fabricate hoods according to NSF 2, "Food Equipment."

B. Fabricate hoods to comply with SMACNA's "HVAC Duct Construction Standards: Metal and Flexible."

C. Hood Configuration: Exhaust [**only**] [**and makeup air**].

1. Makeup air shall be introduced by [**induction**] [**combination of induction and diffusion**] inside canopy. If makeup air is not heated, insulate interior of makeup air plenum with high-density insulation having maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
2. Makeup air shall be introduced through [**front**] [**and**] [**bottom**] of canopy through supply-air registers.
3. Makeup air shall be introduced through laminar-flow-type, perforated metal panels on front of hood canopy.
4. Makeup air shall be introduced through plenum at rear of hood, extending down below appliance cooking surfaces.

D. Hood Type: [**Heat and vapor**] [**Condensate**] removal.

E. Hood Style: [**Wall-mounted canopy**] [**Single-island canopy**] [**Double-island canopy**] [**Back shelf**] [**Eyebrow**] [**Pass over**].

F. Condensate Hood Baffles: Removable, stainless-steel baffles to drain into a hood drain trough, and stainless-steel drain piping.

G. Luminaires: [**Recessed**] [**Surface-mounted**], [**LED**] [**fluorescent**] [**incandescent**] luminaires and lamps with lenses sealed vapor tight. Wiring shall be installed in stainless-steel conduit on hood exterior. Number and location of luminaires shall provide a minimum of 70 fc at 30 inches above finished floor.

1. Light switches shall be mounted [**on front panel of hood canopy**] [**on wall adjacent to hood**] [**in hood control panel**].
2. Luminaires: [**LED**] [**Fluorescent**] [**Incandescent**] complying with UL 1598.

H. Capacities and Characteristics:

1. Nominal Hood Length: <**Insert inches**>.
2. Nominal Hood Width: <**Insert inches**>.
3. Canopy Height: <**Insert inches**>.
4. Exhaust Airflow: <**Insert cfm**>.
5. Exhaust-Air Pressure Loss: <**Insert inches wg**>.
6. Makeup Air Airflow: <**Insert cfm**>.
7. Makeup Air Pressure Loss: <**Insert inches wg**>.

2.6 FIRE-SUPPRESSION SYSTEM, WET CHEMICAL

A. Description: Engineered distribution piping designed for automatic detection and release or manual release of fire-suppression agent by hood operator. Fire-suppression system shall be listed and labeled for complying with NFPA 17A, "Wet Chemical Extinguishing Systems," by a qualified testing agency acceptable to authorities having jurisdiction.

1. Steel Pipe, NPS 2 and Smaller: ASTM A53/A53M, Type S, Grade A, Schedule 40, plain ends.
2. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.
3. Piping, fusible links and release mechanism, tank containing the suppression agent, and controls shall be factory installed. Controls shall be in stainless-steel control cabinet mounted on [**hood**] [**or**] [**wall**]. Furnish manual pull station for wall mounting. Exposed piping shall be covered with chrome-plated aluminum tubing. Exposed fittings shall be chrome plated.
4. Liquid Extinguishing Agent: Noncorrosive, low-pH liquid.
5. Furnish electric-operated gas shutoff valve; see [**Section 231123 "Facility Natural-Gas Piping."**] [**Section 231126 "Facility Liquefied-Petroleum Gas Piping."**]
6. Furnish electric-operated gas shutoff valve with clearly marked open and closed indicator for field installation.

7. Fire-suppression system controls shall be integrated with controls for fans, lights, and fuel supply and located in a single cabinet for each group of hoods immediately adjacent.
8. Wiring shall have color-coded, numbered terminal blocks and grounding bar. Spare terminals for fire alarm, optional wiring to start fan with fire alarm, red pilot light to indicate fan operation, and control switches shall all be factory wired in control cabinet with relays or starters. Include spare terminals for fire alarm, and wiring to start fan with fire alarm.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before equipment installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Coordinate equipment layout and installation with adjacent Work, including luminaires, HVAC equipment, plumbing, and fire-suppression system components.

B. Complete field assembly of hoods where required.

1. Make closed butt and contact joints that do not require filler.
2. Grind field welds on stainless-steel equipment smooth, and polish to match adjacent finish. Comply with welding requirements in "General Hood Fabrication Requirements" Article.

C. Install hoods and associated services with clearances and access for maintaining, cleaning, and servicing hoods, filters/baffles, grease extractor, and fire-suppression systems according to manufacturer's written instructions and requirements of authorities having jurisdiction.

D. Make cutouts in hoods where required to run service lines and to make final connections, and seal openings according to UL 1978.

E. Securely anchor and attach items and accessories to walls, floors, or bases with stainless-steel fasteners unless otherwise indicated.

F. Install hoods to operate free from vibration.

G. Install seismic restraints according to SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines," Appendix A, "Seismic Restraint Details."

H. Install trim strips and similar items requiring fasteners in a bed of sealant. Fasten with stainless-steel fasteners at 48 inches o.c. maximum.

I. Install sealant in joints between equipment and abutting surfaces with continuous joint backing unless otherwise indicated. Provide airtight, watertight, vermin-proof, sanitary joints.

J. Install lamps, with maximum recommended wattage, in equipment with integral lighting.

K. Set initial temperatures, and calibrate sensors.

L. Set field-adjustable switches.

3.3 CONNECTIONS

A. Where installing piping adjacent to hoods, allow space for service and maintenance.

B. Install reduced-pressure backflow preventer on washer-water supply. Backflow preventer is specified in Section 221119 "Domestic Water Piping Specialties."

C. Install washer-water drain piping full size of hood connection to an adjacent floor drain or a floor sink.

D. Makeup Water Connection: Comply with applicable requirements for valves and accessories on piping connections to water-cooled units in Section 221119 "Domestic Water Piping Specialties."

E. Connect ducts according to requirements in Section 233300 "Air Duct Accessories." Install flexible connectors on makeup air supply duct. Weld exhaust-duct connections with continuous liquidtight joint.

F. Install fire-suppression piping for remote-mounted suppression systems according to NFPA 17A, "Wet Chemical Extinguishing Systems."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections[**with the assistance of a factory-authorized service representative**]:

1. Test each equipment item for proper operation. Repair or replace equipment that is defective, including units that operate below required capacity or that operate with excessive noise or vibration.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Test water, drain, gas, and liquid-carrying components for leaks. Repair or replace leaking components.
4. Perform hood performance tests required by authorities having jurisdiction.
5. Perform fire-suppression system performance tests required by authorities having jurisdiction.

D. Commercial-kitchen hoods will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. [**Engage a factory-authorized service representative to train**] [**Train**] Owner's maintenance personnel to adjust, operate, and maintain commercial-kitchen hoods.

END OF SECTION 233813

SECTION 237413 - PACKAGED ROOFTOP UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:

1. Direct-expansion cooling.
2. Gas furnace.
3. Economizer outdoor and return air damper section.
4. Integral, space temperature controls.
5. Roof curbs or curb adaptors.

B. Related Requirements:

1. Section 017419 – “Construction Waste Management”.
2. Section 018113.14 – “Sustainable Design Requirements - LEED v4 / 4.1 BD+C: New Construction”.
3. Section 019113 – “General Commissioning Requirements”.

1.3 DEFINITIONS

A. DDC: Direct-digital controls.

B. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

C. Supply Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air conditioning, heating, or ventilating apparatus.

D. Supply Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

1.4 SUBMITTALS

A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members to which RTUs will be attached.
2. Roof openings
3. Roof curbs and flashing.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For new RTUs include in operation and maintenance manuals.

F. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. ARI Compliance:

1. Comply with ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies for RTUs.
2. Comply with ARI 270 for testing and rating sound performance for RTUs.

B. ASHRAE Compliance:

1. Comply with ASHRAE 15 for refrigeration system safety.
2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
3. Comply with applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

E. UL Compliance: Comply with UL 1995.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion.
3. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than three years from date of Substantial Completion.
4. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.
5. Warranty Period for Parts: Manufacturer’s standard, but not less than one year from date of Substantial Completion.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set of filters for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the basis of design or a comparable product by one of the following:

1. Daikin. (Basis of Design)
2. Trane.
3. Carrier
4. Lennox

2.2 CASING

A. General Fabrication Requirements for Casings: 2” Double wall insulated panels with R-13 injected foam , fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

B. Casing Material: 24 gauge Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs. Interior casing shall be 24 gauge galvanized steel.

C. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

1. Materials: ASTM C 1071, Type I.
2. Thickness: not less than 2 inch.

D. Condensate Drain Pans: Formed sections of stainless-steel sheet, a minimum of 2 inches deep, and complying with ASHRAE 62.1-2004.

1. Construction: double sloped removable drain pan, insulated and sealed moisture tight.
2. Drain Connections: Threaded nipple.
3. Pan-Top Surface Coating: Corrosion-resistant compound.

E. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

2.3 FANS

A. Direct Driven Supply Air Fans: Direct Drive plenum with permanently lubricated, ECM motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls. Provide fan quantities as scheduled.

B. Section Removed .

C. Condenser Coil Fan: Propeller, mounted on shaft of permanently lubricated TEAO motor with built-in thermal overload protection.

D. Powered Exhaust Fan: 0-100% fully modulating ECM Direct drive plenum fan shaft mounted on permanently lubricated motor.

E. Fan Motor: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment." Provide ECM, variable speed supply fan motors as scheduled on the project drawings.

2.4 COILS

A. Supply Air Refrigerant Coil:

1. Aluminum plate fin and seamless internally grooved copper tube in stainless steel casing with equalizing-type vertical distributor.
2. Coil Split: Interlaced.
3. Condensate Drain Pan: Stainless steel formed with pitch and drain connections complying with ASHRAE 62.1-2004.

B. Outdoor Condenser Coil:

1. Microchannel aluminum fin or Aluminum plate fin and seamless internally grooved copper tube in steel casing with equalizing-type vertical distributor.
2. Outdoor condenser coils to be complete with factory installed hail guards.

C. Hot gas Reheat coil: fully modulating aluminum microchannel

2.5 REFRIGERANT CIRCUIT COMPONENTS

A. Compressor(s): Hermetic, digital scroll type with centrifugal type oil pumps, mounted on vibration isolators; suction gas cooling, with internal over-current and high-temperature protection and internal pressure relief.

B. Refrigeration Specialties:

1. Refrigerant: R-410A.
2. Expansion valve with replaceable thermostatic element.
3. Refrigerant filter/dryer.
4. Manual-reset high-pressure safety switch.
5. Automatic-reset low-pressure safety switch.
6. Minimum off-time relay.
7. Automatic-reset compressor motor thermal overload.
8. Brass service valves installed in compressor suction and liquid lines.
9. Service pressure ports.
10. Hot Gas bypass each circuit.

2.6 AIR FILTRATION

A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Glass Fiber: Minimum 80 percent arrestance, 2” MERV 8 and 4” MERV 13 combination

2.7 GAS FURNACE

A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47 and NFPA 54.

B. Burners: Stainless steel.

1. Fuel: Natural gas.
2. Ignition: Electronically controlled electric spark.

C. Power Vent: Integral, motorized centrifugal fan interlocked with gas valve

D. Safety Controls:

1. Gas Control Valve: Modulating 10:1 turndown ratio
2. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

2.8 DAMPERS

A. Outdoor and Return Air Mixing Dampers: Parallel or opposed blade galvanized steel dampers mechanically fastened to cadmium plated for galvanized steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.

1. Damper Motor: Modulating with adjustable minimum position.
2. Relief Air Damper: Gravity actuated or motorized, as required by ASHRAE/IESNA 90.1-2004, with bird screen and hood.
3. Thermal dispersion airflow monitoring station outdoor air.

2.9 ELECTRICAL POWER CONNECTION

A. Provide for single connection of power to unit accessible from outside unit and control-circuit transformer with built-in over-current protection. Unit to be suitable for unit mounted disconnect switch by electrical contractor.

2.10 CONTROLS:

A. Unit Controls:

1. Control voltage transformer.
2. Integral return air mounted CO2 sensor for units as indicated on the project drawings.
3. Integral return air mounted smoke detector for units as indicated on the project drawings.
4. Wall mounted thermostat and unit controls with the following features:

a. Heat-cool-off switch.
b. Fan on-auto switch.
c. Automatic changeover.
d. Adjustable dead band.
e. Concealed set point.
f. Concealed indication.
g. Degree F indication.
h. Demand controlled ventilation for minimum outside air set point.
j. Low Discharge Temperature: Stop fan and close outdoor-air damper if supply air temperature is less than 40 deg F.
k. Supply Fan Operation:

1) Occupied Periods: Run fan continuously.
2) Unoccupied Periods: Cycle fan to maintain setback temperature.

l. Refrigerant Circuit Operation:

1) Occupied Periods: Cycle or stage compressors to provide cooling load to maintain room temperature. Cycle condenser fans to maintain maximum hot-gas pressure.
2) Unoccupied Periods: Compressors off.

m. Gas Furnace Operation:

1) Occupied Periods: Modulate burner to maintain room temperature.
2) Unoccupied Periods: Cycle burner to maintain setback temperature.

n. Bacnet Interface:

1) Unit to include Bacnet interface suitable for interface with the facility BAS. The Bacnet interface shall allow for remote adjustment of room temperature set points and selection of the occupancy mode.

2) The Bacnet interface shall also allow for remote adjustments to the minimum outside air set point and the outside air set point range that is used for the demand controlled ventilation mode.

5. Economizer Outdoor Air Damper Controller Operation:

a. Occupied Periods: Open to scheduled percent fixed minimum intake, and maximum 100 percent of the fan capacity to comply with ASHRAE Cycle II. Controller shall permit air side economizer operation when outdoor air is less than 60 deg F. Use outdoor air temperature to adjust mixing dampers. Start relief-air fan with end switch on outdoor-air damper. During economizer cycle operation, lock out cooling.
b. Unoccupied Periods: Close outdoor air damper and open return air damper.
c. CO2 monitoring- Upon detection of elevated CO2 levels setting adjustable the outdoor air damper shall open until acceptable levels are obtained.

2.11 ROOF CURBS

A. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.

1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

a. Materials: ASTM C 1071, Type I or II.
b. Thickness: 1-1/2 inches.

2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.

a. Liner Adhesive: Comply with ASTM C 916, Type I.
b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
c. Liner materials applied in this location shall have air stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
d. Liner Adhesive: Comply with ASTM C 916, Type I.

B. Curb Height: 14 inches.

2.12 CAPACITIES AND CHARACTERISTICS

A. See schedule on design drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.

B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs for suitable conditions where RTUs will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Roof Curb: Install on roof structure, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts. Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Division 07 Section "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing.

3.3 CONNECTIONS

A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

B. Install piping adjacent to RTUs to allow service and maintenance.

C. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:

1. Install ducts to termination at top of roof curb.
2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
3. Connect supply ducts to RTUs with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."
4. Install return air duct continuously through roof structure.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.

C. Tests and Inspections:

1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE

A. Engage a factory authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to furnace combustion chamber.
3. Inspect for visible damage to compressor, coils, and fans.
4. Inspect internal insulation.
5. Verify that labels are clearly visible.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean condenser coil and inspect for construction debris.
10. Clean furnace flue and inspect for construction debris.
11. Connect and purge gas line.
12. Remove packing from vibration isolators.
13. Inspect operation of barometric relief dampers.
14. Verify lubrication on fan and motor bearings.
15. Inspect fan wheel rotation for movement in correct direction without vibration and binding.
16. Adjust fan belts to proper alignment and tension.
17. Start unit according to manufacturer's written instructions.

    a. Start refrigeration system.
    b. Do not operate below recommended low-ambient temperature.
    c. Complete startup sheets and attach copy with Contractor's startup report.

18. Inspect and record performance of interlocks and protective devices; verify sequences.
19. Operate unit for an initial period as recommended or required by manufacturer.
20. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.

    a. Measure gas pressure on manifold.
    b. Inspect operation of power vents.
    c. Measure combustion air temperature at inlet to combustion chamber.

d. Measure flue gas temperature at furnace discharge.
e. Measure supply air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.

21. Calibrate thermostats.
22. Adjust and inspect high temperature limits.
23. Inspect outdoor air dampers for proper stroke and interlock with return air dampers.
24. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:

    a. Coil leaving air, dry and wet bulb temperatures.
    b. Coil entering air, dry and wet bulb temperatures.
    c. Outdoor air, dry bulb temperature.
    d. Outdoor air coil, discharge air, dry bulb temperature.

25. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
26. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.

    a. Supply air volume.
    b. Return air volume.
    c. Relief air volume.
    d. Outdoor air intake volume.

27. Simulate maximum cooling demand and inspect the following:

    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.

28. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.6 CLEANING AND ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.

B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs.

END OF SECTION 237413

SECTION 237433 - DEDICATED OUTDOOR-AIR UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes factory-packaged unit, DOAS-1 capable of supplying 100 percent outdoor air and providing both cooling and heating. Unit to include supply and exhaust air fans, filters, integral fixed plate energy recovery heat exchange, gas fired heating section and hot gas bypass.

1.3 SUBMITTALS

A. Product Data: For each type of product. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Prepare the following by or under the supervision of a qualified professional engineer:

   a. Mounting Details: For securing and flashing roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
   b. Include diagrams for power, signal, and control wiring.

C. Coordination Drawings: Roof-curb mounting details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Size and location of unit-mounted rails and anchor points and methods for anchoring units to roof curb.
2. Required roof penetrations for ducts, pipes, and electrical raceways, including size and location of each penetration.

D. Startup service reports.

E. Sample Warranty: For special warranty.

F. Operation and Maintenance Data: Include operation and maintenance manuals.

1.4 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One additional set for each unit.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carrier, (Basis of Design).

2. Innovent

3. Trane

4. Greenheck

5. Or approved equal by EOR and owner.

2.2 PERFORMANCE REQUIREMENTS

A. General Fabrication Requirements: Comply with requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Start-up."

B. Cabinet Thermal Performance:

1. Maximum Overall U-Value: Comply with requirements in ASHRAE/IESNA 90.1.

C. Cabinet Surface Condensation:

1. Cabinet shall have additional insulation and vapor seals if required to prevent condensation on the interior and exterior of the cabinet.
2. Portions of cabinet located downstream from the cooling coil shall have a thermal break at each thermal bridge between the exterior and interior casing to prevent condensation from occurring on the interior and exterior surfaces. The thermal break shall not compromise the structural integrity of the cabinet.

D. Maximum Cabinet Leakage: One percent of the total supply air flow at a pressure rating equal to the fan shut-off pressure.

E. Cabinet Deflection Performance

1. Walls and roof deflection shall be within 1/250 of the span at the design working pressure equal to the fan shut-off pressure. Deflection limits shall be measured at any point on the surface.
2. Floor deflections shall be within 1/300 of the span considering the worst-case condition caused by the following:

   a. Service personnel.
   b. Internal components.
3. Design working pressure defined for the walls and roof.

F. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Capacities and Characteristics:

1. As scheduled on the project drawings.

2.3 CABINET

A. Construction: Two inch double wall.

B. Exterior Casing Material: 18 gage galvanized steel with 0.15 mils painted enamel finish.

C. Interior Casing Material: 22 gauge galvanized steel.

D. Lifting and Handling Provisions: Factory-installed shipping skids and lifting lugs.

E. Base: Construct base of minimum 10 ga. welded structural steel with cross supports integral lifting lugs. Bolted bases are unacceptable. Base shall be insulated and provided with a minimum 22 ga. galvanized G90 steel subfloor. Coat base with 2 part epoxy primer and urethane modified enamel top coat.

F. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.

1. Service Doors: Provide double wall doors insulated with 2 lb/ft^3 polyurethane foam. Door shall be a full thermal break design with aluminum extruded frames. Doors shall be full height with stainless steel piano hinges and Allegis corrosion resistant compression latches (tool lockable in fan sections). Supply and exhaust air streams shall not be covered by a single door. Provide doors for access to any area requiring routine maintenance. Access panels in lieu of access door are unacceptable. Access doors shall be provided with 9"x9" double plane Plexiglas windows in all sections. Provide a test port for each access door.

G. Floor: Provide 2” double wall floor construction. Walk on floor material shall be a minimum of 0.125" aluminum tread plate. Subfloor shall be 22ga galvanized G90 steel. Floor panels shall be foam injected for optimal support strength and eliminate "oil-canning". Floor panels shall be secured to the unit base frame with flush screws for a smooth walk-on surface and sealed with butyl tape to minimize sound transmission to spaces located below the unit.

H. Cabinet Insulation:

1. Type: All interior walls, floor, and roof shall be double wall and insulated. Walls, roof and floor are insulated with 2 lb/ft^3 polyurethane foam insulation, minimum R value of 13.
2. Thickness: 2 inches.
3. Insulation Adhesive: Comply with ASTM C 916, Type I.
4. Mechanical Fasteners: Suitable for adhesive, mechanical, or welding attachment to casing without damaging liner and without causing air leakage when applied as recommended by manufacturer.

I. Condensate Drain Pans:

1. Shape: Rectangular, with one percent slope in at least two planes to direct water toward drain connection.
2. Size: Large enough to collect condensate from cooling coils including coil piping connections, coil headers, and return bends.

   a. Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
   b. Depth: A minimum of 2 inches deep.

3. Configuration: Single wall.
4. Material: Stainless-steel sheet.
5. Drain Connection:

   a. Located on one end of pan, at lowest point of pan.
   b. Terminated with threaded nipple.

6. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

J. Surfaces in Contact with Airstream: Comply with requirements in ASHRAE 62.1 for resistance to mold and erosion.

2.4 SUPPLY AND EXHAUST FANS

A. Fan Type:

1. Plenum fan type. Fans shall be provide in an array as indicated on the drawings. Fan quantities shown on the drawings are the minimum amount of fans that are to be provided. Fan quantities less that what is shown shall not be acceptable.

2. Standard of Quality. Fans shall be Greenheck APH, Twin City EPQN, or Cook model PLC with construction details as specified below.

3. Wheel. The fan wheel shall be non-overloading centrifugal type. Wheel shall be statically and dynamically balanced to balance grade G6.3 per ANSI S2.19.

4. Wheel shall be manufactured with a minimum of 12 continuously welded aluminum airfoil blades to move the blade pass frequency into the mid-octave bands.

5. The entire wheel shall be constructed of aluminum to reduce the rotational weight of the wheel and reduce vibration. Blades shall be constructed of 6063-T5 extruded aluminum to ensure precision blade tolerances, improve efficiency and reduce vibration. Wheel hubs shall be cast of 319 aluminum alloy.

6. Fan wheel shall not require finish coating.

7. The wheel and fan inlet shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency.

8. Construction. Plenum fans shall be of the unhoused direct drive centrifugal type.

9. Fan plate shall be aerodynamically designed with high-efficiency inlet, engineered to reduce incoming air turbulence.

10. Panels and framework shall be constructed of heavy gauge, precision laser cut and die formed ASTM A-569 low carbon steel to provide a rigid structure to support the motor, shaft, bearings and wheel and reduce low frequency vibration.

11. After fabrication, all carbon steel components shall be cleaned and chemically treated by a phosphatizing process to insure proper removal of grease, oil, scale, etc. Panels and framework shall be coated with a minimum of 2-4 mils of Permatector (Polyester Urethane), electrostatically applied and baked. Finish color shall be RAL 7023, concrete grey. Coating shall exceed 1,000-hour salt spray under ASTM B117 test method. No uncoated steel fan parts shall be allowed.

12. Accessories:

    a. Fan inlet screens
    b. Manual blank off plates for multiple fan applications.
    c. Airflow probes shall be provided around the fan inlet cone. Probes shall be provided for each fan by the fan manufacturer to ensure accurate airflow measurement & zero resistance to airflow. All electronics and controls required to output airflow measurement are provided by the unit manufacturer.

B. Motors: Motors shall meet or exceed EISA (Energy Independence and Security Act) efficiencies. Motors shall be 3-phase NEMA T-frame, 60 Hz, with RPM as scheduled.

1. Enclosure shall be Totally Enclosed Fan Cooled (TEFC).

2. Motor housing shall be cast iron.

3. Service factor shall be 1.15.

4. Insulation shall be Class F.

5. Motors shall be variable frequency drive (VFD) compatible.

6. Motors shall be provided with shaft grounding rings.

7. Performance. Conform to ANSI/AMCA Standards 210 and 300. Fans shall be tested in accordance with AMCA Publications 211 and 311 in an AMCA accredited laboratory and certified for air and sound performance. Fans shall be licensed to bear the AMCA ratings seal for air performance (AMCA 210) and sound performance (AMCA 300).

8. Fan brake horsepower shall not exceed the scheduled brake horsepower at the total static pressure and airflow scheduled.

9. Provide the number of fans scheduled, no exceptions.

10. Fan motors shall be selected to run at no more than 90 Hz at design conditions.

11. Mounting. Blower and motor shall be mounted on a unitary isolation base.

12. Structural steel fan/motor base shall be designed by the manufacturer to properly support the fan/motor assembly to mitigate vibration.

13. 1” deflection housed seismic rated spring isolators shall be provided.

14. Fan inlets shall be connected to a double wall foam injected plenum wall.

2.5 HEATING / COOLING COILS

A. Capacity Ratings: Comply with ASHRAE 33 and ARI 410.

B. Coil Casing Material: 16 guage 304 stainless steel.

C. Tube Material: 0.025 inch copper.

D. Tube Header Material: Manufacturer's standard material.

E. Fin Material: 0.0095 inch aluminum.

F. Fin and Tube Joints: Mechanical bond.

G. Leak Test: Coils shall be leak tested to 600 psi with nitrogen, under water.

H. Refrigerant Coil Capacity Reduction: Circuit coils for interleaved control.

I. Refrigerant Coil Suction and Distributor Header Materials: Seamless copper tube with brazed joints.

2.6 HOT GAS REHEAT COIL

A. Capacity Ratings: Comply with ASHRAE 33 and ARI 410 and coil bearing the ARI label.

B. Coil Casing Material: 16 guage galvanized steel

C. Tube Material: 5/8” diameter, 0.016” copper tube.

D. Tube Header Material: Copper.

E. Fin Material: 0.0075” aluminum.

F. Fin and Tube Joints: Mechanical bond.

G. Leak Test: Coils shall be leak tested with 250 psig air underwater.

H. Refrigerant Coil Capacity Reduction: Circuit coils for face control.

I. Refrigerant Coil Suction and Distributor Header Materials: Seamless copper tube with brazed joints.

J. Misc: Coil is dehydrated with 140°F DB/40°F dew point air before shipment. Core is tested with 315-psig air pressure under warm water and guaranteed for 250 psig working pressure. Provide coil with a three-way modulating control valve.

K. The hot gas reheat coil shall be piped in the factory as part of the integral compressor section

2.7 REFRIGERATION SYSTEM

A. Comply with requirements in ASHRAE 15, "Safety Standard for Refrigeration Systems."

B. General: Remote air cooled condenser system: Provide remote air cooled condenser system with factory piped, wired, charged, and tested integral compressor section. The entire compressor section and remote condenser must be assembled by the unit manufacturer. Utilizing a different manufacturer's remote air cooled condenser as part of the system is not acceptable. Refrigerant Charge: The compressor system shall be factory charged with refrigerant and filled with oil. Charge is a holding charge only. Additional refrigerant is to be supplied by the installing contactor.

C. Refrigerant Charge: Factory charged with refrigerant and filled with oil for compressors only.

D. Compressors: Scroll compressors with integral vibration isolators, internal over-current and over-temperature protection, internal pressure relief.

1. A minimum of 2 compressors must be used with a minimum of two independent refrigerant circuits.
2. Compressors shall be integral to the air handling unit system and shall be factory piped to the direct expansion cooling coil and hot gas reheat coil. Compressors shall not be mounted external to the unit cabinet and shall not be provided in the remote air cooled condenser.

E. Refrigerant: R-410A.

1. Classified as Safety Group A1 according to ASHRAE 34.
2. Provide unit with operating charge of refrigerant.

F. Refrigeration System Specialties:

1. Expansion valve with replaceable thermostatic element.
2. Removeable core refrigerant dryer.
3. Sight glass
4. Oil filter
5. High-pressure switch.
6. Low-pressure switch.
7. Thermostat for coil freeze-up protection during low ambient temperature operation or loss of air.
8. Brass service valves installed in discharge and liquid lines.

G. Capacity Control:

1. Inverter driven scroll compressor for modulated capacity control. Digital scroll compressors are **not** acceptable. Evaporator coil shall be continuously active for dehumidification.
2. Compressors with evaporator and condenser coil within the refrigerant section to provide initial pre-cooling and to reheat for humidity control.

H. Remote Air Cooled Condenser:

1. Remote air cooled condenser shall be designed and constructed by the unit manufacturer. Providing a third party or different manufacturer's remote air cooled condenser as part of the system is not acceptable.

2. CONSTRUCTION

a. Unit shall be constructed for outdoor installation on a roof curb, framing, or concrete pad.
b. Unit base shall be constructed of 10 gage galvanized steel.
c. Unit casing and exterior panels shall be constructed of 18 gage painted steel rated for 1,000 hours in accordance with ASTM B117 and ASTM D1654.
d. Condenser coils

1) Provide condenser coils with galvanized casing, seamless copper tubes, and aluminum fins.
2) Coil casing shall be constructed of 16 gauge galvanized steel.

3) Coil tubes shall be constructed of 5/16" diameter, 0.016" thick seamless copper tubing.
4) Coil fins shall be constructed of 0.0060" thick aluminum fins.
5) Condensing coils shall include corrosion-resistant, electrostatically-applied coating rated for 5,000 hours in accordance with ASTM B117.
6) Condensing coils shall include factory provided and installed condenser coil guards for hail protection

e. Condensing fans with Active Head Pressure Control

1) Condensing section shall be equipped with high-performance 1200 rpm condensing fans.
2) Condensing fan blades shall be constructed out of a polymer, sickle-shaped blades with serrated trailing edges for sound reduction. Individual fans shall be capable of an Lw(A) of 75 dB as tested to ISO 5801.
3) Condensing fan motor shall be electrically-commutated and capable of modulation without the need of an external variable frequency drive.
4) All condensing fans shall modulate in unison to maintain the head pressure set point.

f. ELECTRICAL

1) Units shall be factory wired with a single point power connection.
2) Units shall be wired according to NEC and listed per ETL.
3) ETL listing shall cover all components of the ventilator and not be limited to the control panel.
4) All major electrical components shall be UL or ETL listed.
5) Unit shall be constructed with an integral control center isolated condensing airflow and refrigerant piping.
6) The following items shall be provided and wired within the control center by the factory:

a) Non-fused disconnect.
b) Sub-circuit fusing.
c) Low voltage transformers.
d) Control circuit fusing.
e) Terminal block.

7) Electrical panel must house all high voltage components such as terminal blocks, variable frequency drives, and fuse blocks.

3. The installing contractor shall be responsible for all piping material between the air cooled condenser and indoor compressor section.

I. Safety Controls:

1. Compressor motor and condenser coil fan motor low ambient lockout.
2. Over-current protection for compressor motor.

J. Base Rails: Galvanized steel rails for mounting on roof curb or pad as indicated.

2.8 INDIRECT FIRED DUCT FURNACE

A. Standard of Quality. Provide in-shot gas heat sections as manufactured by Heatco, LLC. Alternate manufacturers shall be considered only if ALL of the requirements in this section are met. Comply with all mounting and access provisions specified in this section. Drum type gas heaters shall not be allowed.

B. Agency Listings: Provide gas heaters with the following Agency listings:

1. Listed by Intertek Testing Services (ITS / ETL), a Nationally Recognized Testing Laboratory (NRTL) as a Recognized Component, to the current edition of ANSI Z83.8 / CSA 2.6 Standard for Gas-Fired Duct Furnaces for installation on the positive pressure side of the circulating air blower only.
2. Listed for application downstream of refrigeration and cooling systems
3. Listed for outdoor installation, or for indoor installation in accordance with Category I and Category III venting systems without need for additional power venting
4. Duct Furnace shall incorporate a Direct Spark Ignition control module that is design certified by a NRTL to ANSI Z21.20 and CAN/CSA-C22.2

C. Construction. Provide heat exchanger tubes with the following features, material types and thicknesses:

1. Tubes: 0.044" thick 409 stainless steel
2. Features: Module design shall provide means for removal of condensate that can occur in the heat exchanger tubes during cooling season. Heat exchanger tubes shall have integral formed dimpled restrictors or formed turbulators to provide for an unobstructed drainage path and tubes shall be formed to provide a positive pitch to promote condensate drainage. Drainage shall be configured so that in-shot burners are not exposed to condensate.

D. Performance. Provide heat section meeting the following performance parameters:
1. System parameters:
2. Fuel: Natural gas
3. Maximum Inlet Gas Pressure:13.5 “ w.c., Natural Gas or Propane. Pressure reducing valves, if required, shall be by others.
4. Minimum Inlet Gas Pressure: 5.0” w.c. for input ratings 400 MBH or less, 6.0" w.c. for input ratings greater than 400 MBH
5. Capacity: Input and output capacities shall be as scheduled. Scheduled capacity shall include a de-rate if the project altitude is greater than 2000 feet above sea level.
6. Turndown: Provide heater section with minimum turndown no less than the turndown scheduled.
7. Air Pressure Drop: Maximum 0.50” w.c. per bank, but shall not exceed the scheduled value.

E. Venting requirements. An induced-draft fan shall be provided for positive venting of combustion gases. Venting provisions shall be provided as follows:

1. Venting shall be provided and installed per heater module by the installing contractor:

    a. For vertical venting, provide a Category 1 B Vent sized per ANSI Z223.1/NFPA 54
    b. For horizontal venting, provide a Category III vent with maximum equivalent length of 50 feet. Use approved Category III materials, and size the pipe per the heater IOM.
    c. Combustion air shall be provided to the heater per module. The source of the combustion air shall be designated by the Engineer of Record, either from the mechanical room or directly from outdoors (separated combustion), sized per the heater manufacturer's recommendations for airflow and pressure drop.
    d. The air handler manufacturer shall provide standard collars for connecting the vent pipe and combustion air duct (when required). Transitions to the collars shall be provided by the installing contractor.

2. Mounting in the Air Handler: The following requirements shall be met at a minimum and demonstrated in the submittal:

    a. A removable, fastener free and self- retaining access panel shall be provided for full access to all serviceable components. The panel shall be removable without requiring the use of tools.
    b. A combustion air intake shall be provided and sized appropriately for the heater capacity per the heater manufacturer's recommendation.
    c. Heater section shall be configured to provide adequate temperature rise across the heaters to limit condensation of flue gases.
    d. The air tunnel shall be configured such that airflow through the heater shall not change direction within the heater to prevent uneven heat transfer and hot spots. Heaters shall not be mounted over supply duct connections.
    e. Hinged access doors shall be provided for access both upstream and downstream of heater section.

F. Warranty: The heat exchanger shall be provided with a 20 year non-prorated parts warranty. Burners and all other components shall be provided with the standard manufacturer's parts warranty.

2.9 ENERGY RECOVERY WHEEL

A. Exchanger rotor shall be constructed of alternate layers of corrugated and flat aluminum or synthetic formed material.

B. Enthalpy wheel shall be coated with permanently bonded 4 angstrom molecular seive desiccant adsorbent specifically developed for the selective transfer of water vapor. Polymer wheels shall not be acceptable.

C. Support rotor on grease-lubricated ball bearings with extended grease fittings.

D. Drive: Fractional horsepower motor and gear reducer, with speed changed by variable frequency controller.

E. Adjustable purge sector shall be installed to prevent carryover of contaminated exhaust air into the supply air stream.

F. Sensible and latent recovery performance and leakage must be clearly measured and certified through ARI in accordance with the 1060 standard.

G. Factory mounted variable speed control shall provide soft-start/stop, rotation detection and alarm, and self-cleaning jog functions.

H. Minimum sensible and latent heat recovery performance shall be as scheduled.

I. Provide wheel with removeable matrix sections to facilitate maintenace without have to remove the entire wheel for cleaning.

J. Provide electronic speed control with motor control center and drive motor. Control center incorporates functions for purging, speed detection, motor protection and alarm. Control center shall receive 0-10VDC or 4-20 mA input from a temperature sensor. Provide temperature controller to automatically modulate rotor speed to prevent frost build-up.

2.10 FILTERS

A. General Requirements for Air Filtration Section:

1. Comply with NFPA 90A.
2. Provide minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
3. Provide filter holding frames arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
4. Provide a total of (2) three sets of filters

B. Disposable Panel Filters:

1. Comply with NFPA 90A.
2. Factory-fabricated, dry, extended-surface type.
3. Thickness: 2 inches.
4. Minimum Efficiency: MERV 7 according to ASHRAE 52.2.
5. Media: Fibrous material formed into deep-V-shaped pleats with antimicrobial agent and held by self-supporting wire grid.

C. Extended-Surface, Disposable Panel Filters:

1. Factory-fabricated, dry, extended-surface type.
2. Thickness: 12 inches.
3. Recommended Final Resistance: 1 inch wg.
4. MERV (ASHRAE 52.2): 13.
5. Media: Fibrous material formed into deep-V-shaped pleats and held by self-supporting wire grid.
6. Media-Grid Frame: Galvanized steel.

D. Mounting Frames:

1. Panel filters arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or from access plenum.
2. Extended surface filters arranged for flat orientation, removable from access plenum.
3. Galvanized or stainless steel with gaskets and fasteners, suitable for bolting together into built-up filter banks.

E. Filter Gage:

1. 3-1/2-inch- (90-mm-) diameter, diaphragm-actuated dial in metal case.
2. Vent valves.
3. Black figures on white background.
4. Front recalibration adjustment.
5. 2 percent of full-scale accuracy.
6. Range: 0- to 2.0-inch wg (0 to 500 Pa).

F. Accessories: Static-pressure tips with integral compression fittings, 1/4-inch (6-mm) plastic tubing, and 2- or 3-way vent valves

2.11 ELECTRICAL POWER CONNECTIONS

A. General Electrical Power Connection Requirements: Factory-installed and -wired switches, motor controllers, transformers, and other necessary electrical devices shall provide a single-point field power connection to unit.

B. Enclosure: NEMA 250, mounted in unit with hinged access door in unit cabinet having a lock and key or padlock and key.

C. Wiring: Numbered and color-coded to match wiring diagram.

D. Wiring Location: Install factory wiring outside an enclosure in a raceway.

E. Power Interface: Non-fused disconnect switch.

F. Factory Wiring: Branch power circuit to each motor and to controls with one of the following disconnecting means:

1. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
2. NEMA KS 1, heavy-duty, nonfusible switch.
3. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

G. Factory Mounted, Over-current Protection Service: For each motor.

H. Transformer: Factory mounted with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.

I. Controls: Factory wire unit mounted controls where indicated.

J. Control Relays: Auxiliary and adjustable time-delay relays.

K. Lights: Provide vapor proof marine lights in [all access sections/fan sections/filter sections]. Wire lights to a single light switch. Mount light switch near the electrical panel and wire switch to a terminal strip in the electrical panel. A transformer will be provided to provide power to the lighting circuit.

L. A phase/voltage protection relay shall be provided for each unit. Upon sensing a loss of phase or voltage the unit shall be de-energized.

M. A door safety kill switch shall be provided on all blower section access doors. The door safety kill switch shall de-energize the blower motor if the access door is opened. The kill switch shall prevent motor startup if the blower section access door is open.

2.12 CONTROLS

A. Control equipment and sequence of operation are specified in Section 230900 "Instrumentation and Control for HVAC."

B. Manufacturer must provide a stand-alone programmable digital control system for complete temperature & humidity control of the delivered air. The manufacturer will provide a standard sequence of operation for the type of equipment provided per this specification. The controller will be programmed to control discharge temperature & humidity or space temperature & humidity. The sequence of operation will include the following
   1. Temperature control for all heating & cooling devices.
   2. Humidity control for all cooling devices.
   3. Economizer control for "free cooling”.
   4. Defrost control for all energy recovery devices.

C. Control Valves: Comply with requirements in Section 230900 "Instrumentation and Control for HVAC."

D. Control Wiring: Factory wire connection for controls' power supply.

E. Control Devices: Sensors, transmitters, relays, switches, detectors, operators, actuators, and valves shall be manufacturer's standard items to accomplish indicated control functions.

F. Unit Mounted Status Panel:

   1. Cooling/Off/Heating Controls: Control operational mode.
   2. Damper Position: Indicate position of outdoor-air dampers in terms of percentage of outdoor air.

   3. Digital Numeric Display:

      a. Outdoor airflow.
      b. Supply airflow.

c. Return / exhaust airflow
d. Outdoor dry-bulb temperature.
e. Outdoor dew point temperature.
f. Space temperature.
g. Discharge air temperature.
h. Space relative humidity.
i. Discharge air humidity
j. Return air temperature.
k. Return air humidity
l. Dirty filter indication
m. Source water supply temperature
n. Source water return temperature

G. Remote Mounted Status Panel:

1. Cooling/Off/Heating Controls: Control operational mode.
2. Status Lights:

a. Fan operating.
b. Cooling operating.
c. Heating operating.
d. General alarm.

3. Digital Numeric Display:

a. Outdoor/Supply airflow.
b. Outdoor dry-bulb temperature.
c. Space temperature.
d. Supply air temperature.
e. Space relative humidity.

H. Control Dampers:

1. Damper Location: Factory installed inside unit for ease of blade axle and bushing service.
2. Damper Leakage: Comply with requirements in AMCA 500-D. Leakage shall not exceed 6.5 cfm per sq. ft. at a static-pressure differential of 4.0 inches water column when a torque of 5 inch pounds per sq. ft. is applied to the damper jackshaft.
3. Damper Rating: Rated for close-off pressure equal to the fan shutoff pressure.
4. Damper Label: Bear the AMCA seal for both air leakage and performance.
5. Blade Configuration: Unless otherwise indicated, use parallel blade configuration for two-position control
6. Blade Seals: Replaceable, continuous perimeter vinyl seals and jambs with stainless-steel compression-type seals.
7. Bearings: Thrust bearings for vertical blade axles.

I. Damper Operators:

1. Factory-installed electric operator for each damper assembly with one operator for each damper assembly mounted to the damper frame.

2. Operator capable of shutoff against fan pressure and able to operate the damper with sufficient reserve power to achieve smooth modulating action and proper speed of response at the velocity and pressure conditions to which the damper is subjected.
3. Spring-return operator to fail-safe; either closed or open as required by application.
4. Operator Type: Direct coupled, designed for minimum 60,000 full-stroke cycles at rated torque.
5. Circuitry: Electronic overload or digital rotation-sensing circuitry.

J. Refrigeration System Cooling Controls:

1. Unit mounted enthalpy controller shall lock out refrigerant system when outdoor-air temperature is less than 55 deg F (adjustable).
2. Outdoor-air sensor de-energizes dehumidifier operation when outdoor-air temperature is less than 55 deg F (adjustable).
3. Relative-humidity sensor energizes dehumidifier operation when relative humidity is more than 50% (adjustable).
4. Factory mounted sensor in supply outlet with sensor adjustment located in control panel to modulate compressor cooling to control leaving air temperature set point and maintain space temperature.

K. Heating Controls:

1. Factory mounted sensor in supply outlet with sensor adjustment located in control panel to modulate electric heat to control leaving air temperature set point and maintain space temperature.
2. Capacity Control: Modulating SCR.

L. Damper Controls: Inlet damper to be open when unit fan is in operation and closed when unit fan is not operational.

M. Interface with BAS for HVAC: Factory-installed hardware and software to enable the BAS for HVAC to monitor, control, and display unit status and alarms.

1. Hardwired Points:

a. Monitoring: On-off status.
b. Control: On-off operation.
c. Supply temperature set-point adjustment.

2. ASHRAE 135 (BACnet) communication interface with the BAS for HVAC shall enable the BAS for HVAC operator to remotely control and monitor the unit from an operator workstation. Control features and monitoring points displayed locally at unit control panel shall be available through the BAS for HVAC.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.

C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.

B. Curb Support: Install roof curb on roof structure according to "The NRCA Roofing Manual."

1. Install and secure units on curbs and coordinate roof penetrations and flashing with roof construction.
2. Coordinate size, installation, and structural capacity of roof curbs, equipment supports, and roof penetrations.
3. Coordinate size, location, and installation of unit manufacturer's roof curbs and equipment supports with roof Installer.

C. Install wall and duct mounted sensors furnished by manufacturer for field installation. Install control wiring and make final connections to control devices and unit control panel.

D. Install fiberglass batt insulation inside roof curb.

E. Install separate devices furnished by manufacturer and not factory installed.

F. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

G. Install drain pipes from unit drain pans to roof drain.

1. Drain Piping: Schedule 40 PVC pipe complying with ASTM D 1785, with solvent-welded fittings.
2. Pipe Size: Same size as condensate drain pan connection.

3.3 CONNECTIONS

A. Where installing piping adjacent to units, allow space for service and maintenance.

B. Duct Connections:

1. Comply with requirements in Section 233113 "Metal Ducts."
2. Drawings indicate the general arrangement of ducts.
3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 233300 "Air Duct Accessories."

C. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in electrical Sections.

1. Install electrical devices furnished by unit manufacturer but not factory mounted.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify operation of remote panel including pilot-light operation and failure modes.
3. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.
4. Start refrigeration system when outdoor-air temperature is within normal operating limits and measure and record the following:

    a. Cooling coil leaving air, dry and wet bulb temperatures.
    b. Cooling coil entering air, dry and wet bulb temperatures.
    c. Condenser coil entering air dry bulb temperature.
    d. Condenser coil leaving air dry bulb temperature.

5. Simulate maximum cooling demand and inspect the following:

    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.

6. Inspect casing insulation for integrity, moisture content, and adhesion.
7. Verify that clearances have been provided for servicing.
8. Verify that controls are connected and operable.
9. Verify that filters are installed.
10. Clean coils and inspect for construction debris.
11. Inspect and adjust vibration isolators and seismic restraints.
12. Verify bearing lubrication.
13. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
14. Adjust fan belts to proper alignment and tension.
15. Start unit.
16. Inspect and record performance of interlocks and protective devices.
17. Operate unit for run-in period.
18. Calibrate controls.
19. Adjust and inspect high-temperature limits.
20. Inspect outdoor-air dampers for proper stroke.

21. Verify operational sequence of controls.
22. Measure and record the supply/outdoor air flows. Plot fan volumes on fan curve.

B. After startup, change filters, verify bearing lubrication, and adjust belt tension.

C. Remove and replace components that do not properly operate and repeat startup procedures as specified above.

D. Prepare written report of the results of startup services.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 237433A

SECTION 238166 – VARIABLE REFRIGERANT FLOW SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. Related Requirements:

1. Section 017419 – “Construction Waste Management”.
2. Section 018113.14 – “Sustainable Design Requirements - LEED v4 / 4.1 BD+C: New Construction”.
3. Section 019113 – “General Commissioning Requirements”.

1.2 SUMMARY

A. Types of variable refrigerant flow system units specified in this section include the following:

1. Outdoor Air Cooled Heat Pump Units
2. Indoor Horizontal Ducted Units
3. Indoor Wall Mounted Cassette Units
4. Indoor Exposed Ceiling Cassette Units

B. Refer to Division 26 sections for the following work; not work of this section.

1. Power supply wiring from power source to power connection on Air Conditioning units. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

C. Provide the following electrical work as work of this section, complying with requirements of Division 26 sections:

1. Interlock and Control wiring between field-installed controls, indicating devices, and unit control panels.

1.3 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.
2. Refrigerant Piping Diagram: Provide complete with all required pipe sizes and system accessories.

C. Field quality-control test reports.

D. Operation and Maintenance Data: Provide operation, and maintenance manuals.

E. Warranties: Submit all warranty certificates.

1.4 QUALITY ASSURANCE

A. Test and rate systems in accordance with ARI 210/240.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. The units shall be listed by Electrical Laboratories (ETL) and bear the cETL label.

D. The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.

E. The outdoor heat pump unit will be factory charged with R-410A.

1.5 INSTALLATION REQUIREMENTS

A. The system must be installed by a factory trained contractor/dealer. The bidders shall be required to submit training certification proof with bid documents. The mechanical contractor’s installation price shall be based on the systems installation requirements. Untrained contractors who wish to bid this project will have to contact their local representation to arrange training prior to bid day.

1.6 WARRANTY

A. Unit Warranty: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, motors/compressors with inadequate or defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Warranty shall include parts only. Labor warranty is not to be included for the period following the initial one year project warranty.

B. Warranty Period: 10 years from date of owner acceptance for indoor fan coil terminal units and 10 years from date of owner acceptance for air cooled heat pump units.

1.7 SPARE PARTS

A. General: Furnish to Owner, with receipt, the following spare parts for AC unit:

1. Provide initial plus one extra filter set for each terminal unit disposable or washable filter.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Subject to compliance with requirements, provide variable refrigerant flow system of the following manufacturer:

1. Daikin (Basis of Design)
2. Mitsubishi by Trane
3. Carrier by Habegger
4. ***LC Multi V 5 VRF Equipment***

2.2 OUTDOOR AIR COOLED HEAT PUMP UNITS

A. General

1. The outdoor unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the heat pump unit shall consist of inverter scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and refrigerant regulator. High/low pressure gas line, liquid and suction lines must be individually insulated between the outdoor and indoor units.
2. The connection ratio of indoor units to outdoor unit shall be permitted up to 130%. Connection ratios higher than 130% shall not be acceptable.
3. Each outdoor system shall be able to support the connection of up to 56 indoor units dependent on the model of the outdoor unit.
4. The sound pressure level standard shall be 64 dBA or lower as measured at 3 feet from the front of the unit. The outdoor unit shall be capable of operating automatically at further reduced noise during night time.
5. The unit shall incorporate an auto-charging feature and a refrigerant charge check function. The unit shall be capable of metering the refrigerant charge as additional refrigerant is added to the system and will calculate how much additional refrigerant is to added to the system.
6. Oil recovery cycle shall be automatic occurring 2 hours after start of operation and then every 8 hours of operation. Each system shall maintain continuous heating during oil return operation. Reverse cycle (cooling mode) oil return during heating operation shall not be permitted due to the potential reduction in space temperature.
7. <u>The outdoor unit shall be capable of providing 100% of the scheduled heating capacity as shown on the drawings at 0°F dry bulb ambient temperature and continuous heating capability at -13°F dry bulb ambient temperature. Manufacturers that cannot provide 100% of the heating capacity at 0°F shall provide additional low ambient heating components in the condensing unit or in addition to the condensing to allow for 100% of the scheduled heating capacity at 0°F. All additional engineering, electrical, and installation costs shall be by the unit manufacturer</u>.
8. The system shall continue to provide heat to the indoor units in heating operation while in the defrost mode. Reverse cycle (cooling mode) defrost during heating operation shall not be permitted due to the potential reduction in space temperature. Manufacturers that cannot provide heat while in defrost mode shall

provide supplemental electric heat equal to the unit full load heating output. All additional engineering, electrical, and installation costs shall be by the unit manufacturer.

9. Provide either a multi-circuit condensing coil or an auxiliary pan heater for defrost operation.

B. Unit Cabinet

1. Unit cabinet shall be constructed of galvanized steel, bonderized and coated with a baked-enamel finish.
2. Unit access panels shall be removable with minimal screws and shall provide full access to the compressor, fan, and control components.
3. Outdoor compartment shall be isolated and have an acoustic lining to assure quiet operation.

C. Fans

1. Outdoor fans shall be direct-drive propeller type, and shall discharge air vertically. Fans shall below air through the outdoor coil.
2. The heat pump unit fan motor shall have multiple speed operation of the DC (digitally commutating) inverter type, and be of high external static pressure and shall be factory set as standard at 0.12 in. WG. A field setting switch to a maximum 0.32 in. WG pressure is available to accommodate field applied duct for indoor mounting of condensing units.
3. The fan motor shall have inherent protection and permanently lubricated bearings and be mounted. The fan motor shall be provided with a fan guard to prevent contact with moving parts.
4. Fan blades shall be corrosion resistant and shall be statically and dynamically balanced.
5. Night setback control of the fan motor for low noise operation by way of automatically limiting the maximum speed shall be a standard feature. Operation sound level shall be selectable from 3 steps as shown below.
6.

Operation Sound (dB)	Night Mode Sound Pressure Level (dB)
Step 1 max.	55
Step 2 max.	50
Step 3 max.	45

D. Compressor

1. The inverter scroll compressors shall be variable speed (PVM inverter) controlled which is capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the condensing unit. In addition, samplings of the evaporator and condenser temperatures shall be made so that the high/low pressures detected are read every 20 seconds and calculated. With each reading, the compressor capacity (INV frequency or STD ON/OFF) shall be controlled to eliminate deviation from target value.

2. Neodymium magnets shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type. At complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.
3. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
4. The capacity control range shall be 4% to 100%.
5. Oil separators shall be standard with the equipment together with an intelligent oil management system.
6. Compressor assembly shall be installed on spring or rubber vibration isolators and shall have internal spring isolation.
7. Compressors shall be single-phase or 3-phase a specified on the contract drawings.
8. In the event of compressor failure for multiple compressor units, the remaining compressors shall continue to operate and provide heating or cooling as required at a proportionally reduced capacity. The microprocessor and associated controls shall be designed to specifically address this condition.
9. For multiple condenser modules, conjoined operation hours of the compressors shall be balanced by means of equalized run time, ensuring sequential starting of each module at each start/stop cycle, completion of oil return, completion of defrost or every 8 hours

E. Outdoor Coil

1. Coil shall be constructed of aluminum fins mechanically bonded to internally enhanced, seamless copper tubes which are cleaned, dehydrated, and sealed. The heat exchanger coil shall be of a waffle louver fin and rifled bore tube design to ensure high efficiency performance. The heat exchanger on the condensing units shall be manufactured from Hi-X seamless copper tube with N-shape internal grooves mechanically bonded on to aluminum fins to an e-Pass Design. The fins are to be covered with an anti- corrosion acrylic resin and hydrophilic film. The pipe plates shall be treated with powdered polyester resin for corrosion prevention. The thickness of the coating must be between 2.0 to 3.0 microns.

F. Refrigeration Safeties

1. The following safety devices shall be included on the condensing unit; high pressure switch, control circuit fuses, crankcase heaters, fusible plug, high pressure switch, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.

G. Electrical Requirements

1. Unit electrical power shall be a single point connection.
2. Unit control voltage to the indoor-fan coil shall be 16 volt DC
3. All power and control wiring must be installed per NEC and all local building codes.
4. High and low voltage terminal block connections.
5. The control wiring shall be a two-wire multiplex transmission system, making it possible to connect multiple indoor units to one outdoor unit with one 2-cable wire.

2.3 HEAT RECOVERY TERMINAL BOXES

A. General

1. The heat recovery terminal boxes are designed specifically for use with variable refrigerant volume heat recovery system components.
2. Selector boxes shall be factory assembled, wired, and piped. Branch controllers must be run tested at the factory. Selector boxes must be mounted indoors.

B. Unit Cabinet

1. Units shall have a galvanized steel plate casing. Each cabinet shall house multiple refrigeration control valves and a liquid gas separator. The cabinet shall contain a heat exchanger shall be tube in tube type constructed from ACR copper. Cabinet insulation shall be sound absorption thermal insulation material made of flame and heat resistant foamed polyethylene. Nominal sound pressure levels shall be 44 dBA or lower as measured at 5 ft. If a manufacturer's heat recovery box cannot meet this sound level, the manufacturer shall provide a removeable acoustical attenuation package consisting of high density fiberglass mat with a mass-loaded vinyl sandwiched inside a weather-proof jacketing. The unit shall not require any condensate drainage connection.

C. Refrigerant Valves

1. The unit shall be furnished with electronic expansion valves to control the direction of refrigerant flow. Solenoid valves shall not be acceptable. Refrigerant connections must be of the braze type.
2. The heat recovery terminal boxes can have up to a maximum of twelve ports of independent heating/cooling operation. Manufacturers who utilize a multi-port heat recovery box with a "master" or single set of solenoid valves at the inlet or outlet of the heat recovery box that can fail and shutdown the entire box shall only use a single port heat recovery box. Manufacturer shall provide a schematic diagram of the heat recovery box internal piping to the engineer as part of the submittal documents for verification of the non-use of an inlet solenoid valves. Heat recovery boxes can be piped in series with one another and can have the piping trunk main pass through the box as long as there is not a single set of solenoid or expansion valves that can shutdown the entire box upon failure. The heat recovery boxes shall be located as shown on the drawings for serviceability.

3. Manufacturers that require a condensate drain connection for the heat recovery box shall provide a stainless steel secondary drain pan with condensate overflow switch.

2.4 INDOOR FAN COIL TERMINAL UNITS

A. Horizontal Concealed Ducted Units

1. General

   a. Units shall be a horizontal ceiling concealed fan coil unit as indicated on the project drawings. All units shall be operable with refrigerant R-410A, equipped with an electronic expansion valve, for installation into the ceiling cavity. It is constructed of a galvanized steel casing. Ceiling concealed fan coil units shall be a horizontal discharge air with horizontal return air configuration and shall feature a low height cabinet making them applicable to ceiling pockets that tend to be shallow. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature. The indoor units sound pressure shall be 48 dB(A) at low speed measured 5 feet below the ducted unit. The drain pipe can be fitted to from either left or right sides.
   b. The indoor unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have an adjustable external static pressure switch
   c. A mildew-proof, polystyrene air filter and condensate drain pan shall be included as standard equipment.

2. Unit Cabinet

   a. The cabinet shall be floor mounted or located above the ceiling as indicated on the drawings and ducted to the supply and return openings..
   b. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

3. Fans

   a. The fan shall be direct-drive Sirocco type fan, statically and dynamically balanced impeller with high and low fan speeds available.
   b. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz, with a motor output of 0.51 HP.
   c. The airflow rate shall be available in high and low settings.
   d. The fan motor shall be thermally protected.
   e. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.

4. Coil:

    a. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
    b. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
    c. The coil shall be a 3 row cross fin copper evaporator coil with 13 fpi design completely factory tested.
    d. The refrigerant connections shall be flare connections and the condensate will be 1-5/16 inch outside diameter PVC.
    e. A thermistor will be located on the liquid and gas line.

5. Motors

    a. Motors shall be open drip-proof, permanently lubricated ball bearing with inherent overload protection. Fan motors shall be 3-speed.

6. Controls

    a. Controls shall consist of a microprocessor-based control system, which shall control space temperature, determine optimum fan speed, and run self diagnostics. The temperature control range shall be from 64F to 84F.
    b. Provide hard wired programmable local controller and a return air sensor for each unit.
    c. Controls shall be 24 volt, and shall be easily operated by the user from a wall-mounted control unit.
    d. The unit shall be compatible with interfacing with a BMS system via optional BACnet gateway and a HTML 5 based web portal.

7. Filters

    a. Unit shall have filter track with factory-supplied cleanable filters featuring a washable net resin filter mounted in the return air stream.

8. Electrical Requirements

    a. Unit shall operate on 208/230 volt, 60 Hz power supply as specified on the equipment schedule. Power and control connections shall have terminal block connections. The acceptable voltage range shall be 187 to 253 volts.

9. Accessories (Field Installed)

    a. Condensate Pump

        1) The condensate pump shall remove condensate from the drain pan when gravity drainage cannot be used. Pump shall be designed for quiet operation. Pump shall consist of two parts: an internal reservoir/sensor assembly, and a remote sound-shielded pump assembly. The lift capability of the condensate pump shall be 1 to 10 ft for units 3/4 ton and less and 3 to 25 ft for units 1 ton and larger.

b. Condensate Overflow Switch

1) A level sensor on the condensate pan shall stop cooling operation if the level in the condensate pan is unacceptable.

B. Indoor Exposed Wall Mounted Units:

1. Description: Factory-assembled complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.
2. Cabinet:

a. Material: Painted steel, or coated steel frame covered by a plastic cabinet, with an architectural acceptable finish suitable for tenant occupancy on exposed surfaces.
b. Insulation: Manufacturer's standard internal insulation**,** complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
c. Mounting: Manufacturer-designed provisions for field installation.
d. Internal Access: Removable panels of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

3. DX Coil Assembly:

a. Coil Casing: Aluminum, galvanized, or stainless steel.
b. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
c. Coil Tubes: Copper, of diameter and thickness required by performance.
d. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
e. Unit Internal Tubing: Copper tubing with brazed joints.
f. Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
g. Field Piping Connections: Manufacturer's standard.
h. Factory Charge: Dehydrated air or nitrogen.
i. Testing: Factory pressure tested and verified to be without leaks.

4. Drain Assembly:

a. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
b. Condensate Removal: Gravity.
c. If a floor drain is not available at unit, provide unit with field-installed condensate pump accessory.

1) Field Piping Connection: Non-ferrous material.

5. Fan and Motor Assembly:

    a. Fan(s):

        1) Direct-drive arrangement.
        2) Single or multiple fans connected to a common motor shaft and driven by a single motor.
        3) Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
        4) Wheels statically and dynamically balanced.

    b. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
    c. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
    d. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
    e. Vibration Control: Integral isolation to dampen vibration transmission.

6. Filter Assembly:

    a. Access: Front, to accommodate filter replacement without the need for tools.
    b. Washable Media: Manufacturer's standard filter with antimicrobial treatment.

7. Grille Assembly: Manufacturer's standard discharge grille with field-adjustable air pattern mounted in top or front face of unit cabinet.
8. Accessories:

    a. Condensate Pump: Integral reservoir and control with electrical power connection through unit power

9. Unit Controls:

    a. Controls shall consist of a microprocessor-based control system, which shall control space temperature, determine optimum fan speed, and run self diagnostics. The temperature control range shall be from 64F to 84F.
    b. Provide hard wired programmable local controller and a return air sensor for each unit.
    c. Controls shall be 24 volt, and shall be easily operated by the user from a wall-mounted control unit.
    d. The unit shall be compatible with interfacing with a BMS system via optional BACnet gateway and a HTML 5 based web portal.

C. Exposed Suspended Ceiling Cassette Units

1. General

a. The indoor unit shall be a ceiling cassette fan coil unit, operable with R-410A refrigerant, equipped with an electronic expansion valve, for installation into the ceiling cavity equipped with an air panel grille. Units are to be suitable for exposed ceiling mounting or recessed ceiling units as indicated on the project drawings. Units shall be a four-way air distribution type, ivory white, impact resistant, and washable decoration panel. The supply air is distributed via motorized louvers which can be horizontally and vertically adjusted from 0 to 90 degrees. Computerized PID control shall be used to maintain room temperature within 1 Deg F. Unit shall include a programmed drying mechanism that dehumidifies while inhibiting changes in room temperature. The indoor units sound pressure shall range from 28 dB(A) to 33 dB(A) at low speed measured at 5 feet below the unit.

b. The 2 ft x 2 ft cassette shall allow for fit into a standard ceiling grid system with no edges of the unit extending beyond the standard grid framing system.

2. Unit Cabinet

a. Cabinet shall be constructed of zinc-coated steel. Fully insulated discharge and inlet grilles shall be attractively styled, high-impact polystyrene. Cabinet shall have filter tracks and cleanable filters which shall be accessible from below with a 1/4 turn fastener.

b. Three auto-swing positions shall be available to choose, which include standard, draft prevention and ceiling stain prevention. The airflow of the unit shall have the ability to shut down one or two sides allowing for simpler corner installation. Fresh air intake shall be possible by way of a fresh intake kit. A branch duct knockout shall exist for branch ducting supply air.

3. Fan

a. The fan shall be direct-drive fan with statically and dynamically balanced impeller with high and low fan speeds available. The airflow rate shall be available in high, medium, and low settings. The fan motor shall be thermally protected. Air louvers shall be adjustable for 2, 3, or 4-way discharge.

4. Coil

a. Coil shall be a 2-row copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion. Fin spacing shall no greater than 17 fins per inch. A drip pan under the coil shall have a factory-installed condensate pump (minimum 21 inches of lift) and drain connection for hose attachment to remove condensate.

5. Motors

a. Motor shall be totally enclosed and permanently lubricated with inherent protection. Fan motor shall be 3-speed.

6. Filters

a. Unit shall have filter track with either a MERV 4 washable filter with extra filter set
b. For larger 3x3 cassettes, provided a self-cleaning filter system including rotating filter with integral cleaning brush and dust collection box.

7. Controls

a. Controls shall consist of a solid-state electromechanical control system which shall control space temperature and determine optimum fan speed. The temperature control range shall be from 64 F to 84 F. The unit shall have the following functions as a minimum.
b. Provide hard wired programable local controller and a return air sensor for each unit.
c. Controls shall be 24 volt, and shall be easily operated by the user from a wall-mounted control unit.
d. For larger 3x3 cassettes, the unit shall be provided with a thermal imaging sensor. The sensor shall control the unit discharge louvers to direct air as needed in the space to satisfy all thermal zones as measured by the thermal imaging sensor.
e. Provide an occupancy sensor within the unit to provide occupancy status for space
f. Provide interface with the BMS via Bacnet and a HTML 5 based web portal.

8. Electrical Requirements

a. Unit shall operate on 208/230 volt, 60 Hz power supply as specified on the equipment schedule. Power and control connections shall have terminal block connections. The acceptable voltage range shall be 187 to 253 volts.

9. High Water Alarm

a. Provide sensor in cooling drain pan that will alarm and shut down unit on high condensate levels for ceiling mounted unit. The sensor will be provide and installed by the temperature controls contractor. The sensor will be wired back the BMS for unit shutdown.

PART 3 - CONTROLS

3.1 PHYSICAL CHARACTERISTICS:

A. General: The control system shall be a neutral color plastic material. Each control may have a Liquid Crystal Display (LCD.

3.2 ELECTRICAL CHARACTERISTICS

A. General: From each circuit board to the controls, the electrical voltage shall be 16 volts DC.

B. Wiring: Wiring: Control wiring shall be installed in a daisy chain configuration from indoor unit to indoor unit then to the branch selector box and outdoor unit. Control wiring shall run from the indoor unit terminal block to the specific controller for that unit. The wire shall be a non-shielded, 2-core sheathed vinyl cord or cable, size AWG18-2.

3.3 CONTROLLER CHARACTERISTICS:

A. Local Remote Controller (Room Thermostat)

1. The Local Remote Controller shall be mounted into a standard 2” x 4” junction box.
2. Unit Display

a. The Local Remote Controller shall be approximately 4.75” x 4.75” in size with a backlit 2.75” x 1.75” LCD display. Display information shall be selectable from English, French, or Spanish.
b. Provide a backlit LCD display with contrast adjustment and auto off after 30 seconds.
c. The controller shall display Operation Mode, Setpoint, and Fan Speed. The controller shall display temperature setpoint in one degree increments with a range of 60-90°F (0-32°C). Detailed display will reflect room temperature (0-176°F/-17-80°C range in one degree increments). Display of temperature information shall be configurable for Fahrenheit or Celsius.
d. On/Off status shall be displayed with an LED.
e. Error codes will be displayed in the event of system abnormality/error with a two digit code.
f. The following system temperatures can be displayed to assist service personnel in troubleshooting:

1) Return air temperature
2) Liquid line temperature
3) Gas line temperature
4) Discharge air temperature (if available on the unit)
5) Remote temperature sensor temperature
6) Indoor temperature setpoint

3. Operation

a. The unit shall be capable of controlling a group of up to 16 indoor units. The following operation groups shall be controlled:

1) On/Off, Operation Mode (Cool, Heat, Fan, Dry and Auto* (*with VRF Heat Recovery System))
2) Independent cooling and heating setpoints in the occupied mode
3) Independent cooling setup and heating setback
4) Fan speed
5) Airflow direction
6) The controller shall be able to limit the user adjustable setpoint ranges individually for cooling and heating in the occupied period
7) Lock out key settings
8) Indoor unit group assignment

4. Program Functions

a. Controller shall support schedule settings with selectable weekly pattern options.

1) Seven day week
2) Weekday + weekend
3) Weekday + Saturday + Sunday
4) Independently settable Cooling and/or Heating setpoints when unit is on (occupied).
5) Setup (Cooling) and Setback (Heating) setpoints when unit is off (unoccupied)
6) A maximum of 5 operations can be schedulable per day
7) Time setting in 1-minute increments

b. The Controller shall support auto-changeover mode for heat pump and heat recovery systems allowing the optimal room temperature to be maintained by automatically switching the indoor unit's mode between Cool and Heat according to the room temperature and temperature setpoint.

1) Changeover to cooling mode shall occur at cooling setpoint + 1°F (0.5^{o}C).
2) Changeover to heating mode shall occur at heating setpoint - 1°F (0.5^{o}C).

c. The Controller shall support an Auto-Off-Timer for temporarily enabling indoor unit operation during the unoccupied period.

1) When the Off Timer is enabled and when the unit is manually turned on at the remote controller, the controller shall shut off the unit after a set time period.
2) The time period shall be configurable in the controller menu with a range of 30-180 minutes in 10 minute increments.

d. The space temperature shall be capable of being sensed at either the local controller, the return air temperature sensor mounted in the unit, or a remote temperature sensor.

B. Multi-Zone Controller- Centralized Remote Controller (Front End Controller)

1. General

a. The centralized remote controller shall provide control for all indoor units. It shall be capable of controlling a maximum or 64 indoor unit groups and 128 indoor units connected to a maximum of 10 outdoor units. The centralized remote controller shall support operations superseding that of the local remote controller, system configuration, daily/weekly scheduling, monitoring of operation status, and malfunction monitoring.

b. The controller wiring shall consist of a non-polar two-wire connection to the indoor unit at terminals of the outdoor unit. The centralized remote controller is wall mounted and can be adjusted to maintain the optimal operation of the connected indoor unit(s).

c. The centralized remote controller can be used in conjunction with BACnet, and Modbus interfaces to control the same indoor unit groups. No more than 2 remote controllers can be placed in the same group. The remote controller shall require daisy chain wiring for grouping multiple indoor units (up to 16) together. Manual addressing is required of each indoor unit group associated with the centralized remote controller.

d. The centralized remote controller shall be remotely accessible through a secure cloud platform that allows for system control and configuration. The controller shall also be accessible from all major web browsers and via native mobile phone app on iOS and Android.

e. Optional software functions shall be available so that facility staff can securely log into each centralized remote controller via web browser to support monitoring, scheduling, error email, and general user functions. The control platform shall be scalable for multi-site and multi-system applications and shall provide unlimited storage of trend date and be capable of email and text message alarm notifications. Additional optional software functions of individual unit power usage and distribution, Tenant Billing, energy optimization services, and HTTP Interface shall also be available. .

f. The unit as standard shall have a BacNET IP and MSTP communication port for integration into the building automation system. The front end controller shall control all aspects of the variable volume refrigerant system and allow the BAS to have functions such as change of set point, alarm, trending, etc.

g. Unit shall have the ability to serve as a BACnet Server, BACnet Client and Modbus Client simultaneously for other devices within the building. Centralized controller shall be capable of controller 10 pieces of third part equipment over BACnet IP and BACnet MSTP. A BACnet client front end controller is able to send service requests to a BACnet server machine that then performs the services and reports the results to the client. By registering equipment and sensors connected to a BACnet server as management points, equipment and sensors can be monitored and controlled by the intelligent Touch Manager.

1) A maximum of 50 BACnet servers, 1536 objects, and 512 management points, including BACnet management points, external management points, internal Ai management points, AHU management points, and Chiller management points can be

monitored and/or controlled by one front end controller. A maximum of 1536 objects can be monitored and/or controlled by one front end controller.

h. The controller shall be provided with an interface that will allow the controller to reside on a Niagara Frame control network. All control points, pre-defined graphics, and control parameters associated with the VRF system shall be seamlessly integrated into the Niagara front end interface.

2. Mounting

a. The centralized remote controller shall be mounted on the wall or into a recessed fixing box.

3. Display Features

a. The centralized remote controller shall be approximately a 10” LCD display. Display information shall be selectable from English, French, Italian, German, or Spanish.
b. Featured backlit LCD with contrast adjustment and auto off after 30 minutes (default) is adjustable between 1 to 60 minutes.
c. Area and Group configuration

1) Area contains one (1) or more Area(s) or Group(s)
2) A Group may be an indoor unit, Di, Do point that has a network address.

d. An Area is a tiered group where management points (indoor unit, digital input/output, and analog input groups) can be monitored and controlled by global settings. Up to 650 Areas can be created. Area hierarchy can have up to 10 tiered levels. Area configuration shall classify levels of monitoring and control for each management point.
e. The Controller shall display Date (mm/dd/yyyy or dd/mm/yyyy format selectable) and day of the week along with the time of day (12hr or 24hr display selectable).
f. The Controller shall adjust for daylight savings time (DST) automatically.
g. Display information shall be updated every 3 seconds to show the latest status of the indoor unit groups.
h. System status icons shall display On/Off (color coded), Malfunction/Error (color coded), Forced Stop, Set Schedule/Setback/Auto-changeover, Filter, and Screen Lock.
i. The controller shall display the temperature setpoint in one degree increments with a range of 60^0F - 90^0F (16^0C - 32^0C). Display of temperature setpoint information shall be configurable for Fahrenheit or Celsius.
j. Display shall reflect room temperature 0^0F - 176^0F (-18^0C - 80^0C) range in one degree increment.

1) Display of room temperature information shall be configurable for Fahrenheit or Celsius.

k. The system setting mode shall be used to configure options and display information for each Zone or Group.
l. Zone configuration shall display Setpoint Range Limitation, Setback Temperature setting, and Auto-changeover for each Zone.
m. Floor plan layout: Capable of displaying site floor plan as the background for visual navigation. Indoor unit, DIII-NET Di and Dio, and External Di, DO, and Ai icons with operational status can be placed on the floor layout. Up to 4 status points can be assigned to the indoor unit icon (room name, room temperature, setpoint, and mode). Digital input and output icons will display On/Off status. Analog input icons will display analog value. The system shall have the ability to create up to 60 floor layout sections.
n. Indoor units shall be capable of being displayed by Zone or Group.

1) Zones configuration via the centralized remote controller shall consist of a single indoor unit group or a collection of indoor unit groups blocked together for control and monitoring purposes.
2) Groups shall consist of 1 to 16 indoor units daisy chained together via the remote control wiring to the indoor unit terminal block for control and monitoring purposes.
3) Groups and Zones may be assigned names (ex. Office 101, Lobby, North Hallway, etc…)

o. Error status shall be displayed in the event of system abnormality/error with one of three color coded icons placed over the indoor unit icon.

1) System errors are generated when the centralized remote control system with other VRV controls systems combined or power proportional distribution calculation errors occur. The centralized remote control system shall display the error with a red triangle placed on the lower task bar. Unit errors occurring within the VRV system shall be displayed with a yellow triangle placed over the indoor unit icon. Limit errors are based upon preconfigured analog input upper and lower limit settings and are generated when the limits have been met. When limit error is generated a yellow triangle will be placed over the unit icon. Communication errors between the centralized remote control system and the indoor units shall be displayed with a blue triangle placed over the indoor unit icon. Error history shall be available for viewing for up to 500,000 errors/abnormality event.

4. Basic Operation:

a. Capable of controlling Zone(s) or Group(s) of up to 64 indoor unit groups (128 indoor units).
b. Controller shall control the following group operations.

1) On/Off
2) Operation Mode (Cool, Heat, Fan, Dry, and Auto)
3) Independent Cooling and Heating setpoints in the occupied mode

a) Cooling setpoint shall be maintained higher than or equal to the heating setpoint
b) Adjustable minimum setpoint differential 0 - 7^0F (0 - 4^0C) between cooling and heating setpoint
c) Selectable single setpoint mode

4) Independent Setup (Cooling) and Setback (Heating) setpoints in the unoccupied mode adjustable to 40 - 95^0F (5 - 35^0C).

a) Setup and Setback setpoints shall be set outside of the occupied setpoint range.
b) The recovery differential shall be 4^0F (default) and adjustable between 2 – 10^0F.
c) Settings shall be applied based upon the Zone configurations.

5) Fan Speed

a) Up to 3 speeds (dependent upon indoor unit type).

6) Airflow direction

a) 5 fixed positions or swing position.

7) The controller shall be able to limit the user adjustable setpoint ranges individually for cooling and heating based upon the Zone configurations.
8) Remote controller permit/prohibit of On/Off, Mode, and Setpoint.

c. Capable of providing battery backup power for up to 1 years in total time for the clock. All settings shall be stored in non-volatile memory.

5. Programmability

a. Controller shall support weekly schedule settings.

1) Selectable weekly patterns

a) 7-day
b) Weekday + Weekend
c) Weekday + Saturday + Sunday

2) The schedule shall support unit On/Off.
3) 100 independent schedules configurable with up to 20 events settable for each schedule.

a) Each scheduled event shall specify time and target Zone or Group
b) Each scheduled event shall include On/Off, Operation Mode, Occupied Cooling Setpoint, Occupied Heating Setpoint, Setup (Cooling) Setpoint, Setback (Heating) Setpoint, Remote Controller On/Off Prohibit, Remote Controller Mode Prohibit,

Remote Controller Setpoint Prohibit, and Timed Override Enable.

c) Independently settable Cooling and Heating setpoints when unit is On (occupied).
d) Setup (Cooling) and Setback (Heating) setpoints when unit is Off (unoccupied) by Zone.
e) Time setting in 1-minute increments.
f) A 2 hour override shall be provided for use enabling indoor unit operation during the unoccupied period.

4) A maximum of 40 exception days can be schedule on the yearly schedule.

a) Exception days shall be used to override specified days on the weekly schedule based upon irregular occupied/unoccupied conditions.
b) Exception days can be configured on a set date (Jan 1) or floating date (1st Monday in September).

b. The controller shall support auto-changeover

1) Auto-change shall provide Individual, Fixed, and Averaging changeover methods for both Heat Pump and Heat Recovery systems based upon the Zone configurations. This will allow for the optimal room temperature to be maintained by automatically switching the indoor unit's mode between Cool and Heat in accordance with the room temperature and setpoint temperature.
2) Individual method (recommended for Heat Recovery Systems)

a) Changeover evaluated by room temperature and setpoints of the individual indoor unit group in the Zone.
b) Changeover affects individual indoor unit group in the Zone.

3) Fixed method

a) Changeover evaluated by room temperature and setpoints of the representative unit (first registered unit) in the Zone.
b) Changeover affects all indoor unit groups in the Zone.

4) Average method

a) Changeover evaluated by the average of all indoor unit group's room temperatures and setpoints in the Zone.
b) Changeover affects all indoor unit groups in the Zone.

5) Changeover shall change the operation mode of the indoor unit that is set as the Changeover Master. The Changeover Master indoor unit shall then change the operation mode of all indoor unit groups daisy chained to the same outdoor unit in the Heat Pump system or branch selector box in the Heat Recovery system.

6) Changeover to cooling mode shall occur when the room temperature is great than or equal to the cooling setpoint, and the room temperature is greater than or equal to the average of the cooling and heating setpoints + 2.7 Deg F.
7) Changeover to heating mode shall occur when room temperature is less than or equal to the heating setpoint, and the room temperature is less than or equal to the average of the cooling and heating setpoints - 2.7 Deg F.
8) One hour guard timer

    a) Upon changeover, guard timer will prevent another changeover during this period.
    b) Guard timer is ignored by a change of setpoint manually from either centralized remote controller, local remote controller or by schedule.
    c) 60 minutes as default, configurable to 15, 30, or 90 minutes.

9) Third party devices

    a) Interlock feature for use with 3rd party equipment (DOAS, dampers, occupancy sensing, etc…) to automatically control groups or zones corresponding to the change of the operation states or the On/Off states of any group.
    b) Requires digital input/output unit.
    c) On/Off based monitoring and control of equipment.
    d) Manual or scheduled operation of equipment.
    e) Operation based upon interlock with VRV indoor unit group(s).
    f) Monitor equipment error/alarm status.

10) Controller shall support force shutdown of associated indoor unit groups.
11) Interlock with other equipment

    a) Interlock feature for use with third party equipment (DOAS, dampers, occupancy sensing, etc.) to automatically control groups or zones corresponding to the change of the operation states or the On/Off states of any group.
    b) Requires digital input/output unit.

6. Software

    a. Licensed per option, per centralized remote controller shall be required. All PCs shall be field supplied.

        1) Web/Email software

            a) Each centralized remote controller shall be capable of monitoring, operating, and scheduling a maximum of 64 indoor unit groups (128 indoor unit groups with the addition of an expansion module) from a networked PC's web browser. It shall also be capable of creating general user access and

sending detailed error emails to a customized distribution list (up to 3 email addresses).

2) Power Proportional Distribution (PPD)

a) The tenant billing option shall be capable of calculating VRF Controls Network equipment energy usage in kWh based on the energy consumption of the outdoor unit(s) divided among the associated indoor units. This software is used in conjunction with the centralized remote controller and a Watt Hour Meter (WHM). A maximum of 3 Watt Hour Meters can be connected to the centralized remote controller.

b) The Power Proportional Distribution results data can be saved to a PCMCIA card, or on a PC with the use of the web option software. Data is saved in the CSV format. Results can be stored up to 12 months.

3) HTTP Interface

a) This option shall be capable of creating a software interface between the VRV Controls Network and Home Automation control systems.

PART 4 - EXECUTION

4.1 INSPECTION

A. Examine areas and conditions under which air conditioning units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

4.2 INSTALLATION OF INDOOR/OUTDOOR UNITS

A. General: Install units in accordance with manufacturer’s installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Support: Install exterior units on roof on equipment curb with flashing to roof. Provide curb type and flashing per roofing manufacturer requirements.

C. The air cooled heat pumps shall be installed a minimum of 10’-0” from any roof edge regardless of location indicated on plans, unless a screen wall or railing is installed per the local building code. See the architectural plans for coordination.

D. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

E. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment Installer.

F. Drain Piping: Connect unit drain to nearest indirect waste connection. Provide trap at drain pan; construct at least 1" deeper than fan pressure in inches of water.

G. Both refrigerant lines shall be insulated from the outdoor unit.

4.3 START-UP AND COMMISSIONING

A. Manufacturer's Field Service: Engage VRF HVAC system manufacturer's service representative to advise and assist installers; witness testing; and observe and inspect components, assemblies, and equipment installations, including controls and connections.

1. Field service shall be performed by a factory-trained and -authorized service representative of VRF HVAC system manufacturer whose primary job responsibilities are to provide direct technical support of its products.
2. Manufacturer shall provide on-site visits during the course of construction at installation milestones indicated. System Installer shall coordinate each visit in advance to give manufacturer sufficient notice to plan the visit.

    a. First Visit: Kick-off meeting
    b. Second Visit: At approximately 25 percent completion of system(s).
    c. Third Visit: At approximately 50 percent completion of system(s).
    d. Fourth Visit: At approximately 75 percent completion of system(s).
    e. Fifth Visit: Final inspection before system startup.

3. Kick-off Meeting

    a. Meeting shall include system Installer and other related trades with sole purpose of reviewing VRF HVAC system installation requirements and close coordination required to make a successful installation.
    b. Meeting shall be held at Project site and scheduled at a mutually agreed to time that occurs before the start of any part of system installation.

4. Site Visits: Activities for each site visit shall include the following:

    a. Meet with VRF HVAC system Installer to discuss field activities, issues, and suggested methods to result in a successful installation.
    b. Offer technical support to Installer and related trades as related to VRF system(s)being installed.
    c. Review progress of VRF HVAC system(s) installation for strict compliance with manufacturer's requirements and design.
    d. Advise and if necessary assist Installer with updating related refrigerant calculations and system documentation.
    e. Issue a report for each visit, documenting the visit.

5. Final Inspection before Startup

a. Before inspection, Installer to provide written request to manufacturer stating the system is fully installed according manufacturer's requirements and ready for final inspection.
b. Installer shall confirm that all changes to the VRF piping system have been noted by the manufacturer’s representatives. Manufacturer’s representatives shall update the VRF design program to reflect the “as-built” piping condition. As-built VRF design program files and proper refrigerant charge shall be calculated and communicated to the startup technician.
c. All system equipment and operating components shall be inspected. If components are inaccessible for inspection, they shall be made accessible before the final inspection can be completed.
d. Manufacturer shall provide a comprehensive inspection of all equipment and each operating component that comprise the complete system(s). Inspection shall follow a detailed checklist specific to each equipment and operating component.
e. Upon completing the on-site inspection, manufacturer shall provide a written report with complete documentation describing each inspection step, the result, and any corrective action required.
f. If corrective action is required by Installer that cannot be completed during the same visit, provide additional visits, as required, until deficiencies are resolved and systems are deemed ready for startup.

B. Perform the following tests and inspections with the assistance of manufacturer's service representative:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Refrigerant Tubing Positive Pressure Testing (By Installing Contractor):

1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
2. After completion of tubing installation, pressurize tubing systems to a test pressure prescribed by manufacturer using dry nitrogen.
3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of 24 hours or manufacturer’s requirement, whichever is greater. Allowance for pressure changes attributed to changes in ambient temperature are acceptable.
4. Prepare test report to record the following information for each test.

D. System Refrigerant Charge (By Installing Contractor):

1. Installer shall charge system following VRF HVAC system manufacturer's written instructions.
2. System refrigerant charging shall be witnessed by system manufacturer's representative.
3. Total refrigerant charge shall be recorded and permanently displayed at the system's outdoor unit.

E. Products will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports

G. Manufacturer’s local sales representative shall be onsite with manufacturer’s service representative for the entire duration of all five scheduled site visits. In addition, manufacturer’s local sales representative shall be onsite for one intermediate 2 hour site visit in between each site visit of the manufacturer’s service representative. During the site visits, sales representative shall verify that VRF piping and equipment are installed per the design. Any deviations from the design shall be noted by sales representative and contractor shall be directed by sales representative to change the installation to match the design. If a change to the design is necessary, the contractor shall provide detailed explanation and description of changes required. The contractor shall update the VRF piping diagram with any field changes such as re-routing, shortening, lengthening or changing diameter of a pipe segment, adding or eliminating elbows and or fittings, resizing adding or eliminating indoor units, changing the mounting height, or moving the location of a device or fitting during installation. Those changes shall be communicated to the VRF manufacturer’s sales and service representatives. The manufacturer’s representatives upon receipt of those changes shall enter them into the manufacturer’s VRF design program. If the VRF design program indicates that the deviations do not meet the program’s criteria for proper system piping the manufacturer’s representatives shall inform the contractor of any associated problems and resolution for those problems. The contractor shall correct piping to eliminate piping problems.

H. Start-up Service

1. Engage a VRF HVAC system manufacturer's service representative to perform system(s) startup service.

    a. Service representative shall be a factory-trained and -authorized service representative of VRF HVAC system manufacturer.
    b. Complete startup service of each separate system.
    c. Complete system startup service according to manufacturer's written instructions.

2. Startup checks shall include, but not be limited to, the following:

    a. Check control communications of equipment and each operating component in system(s).
    b. Check each indoor unit's response to demand for cooling and heating.
    c. Check each indoor unit's response to changes in airflow settings.
    d. Check each indoor unit, HRCU, and outdoor unit for proper condensate removal.

3. Installer shall accompany mannufacturers service representative during start-up service and provide manufacturer's service representative with requested documentation and technical support during startup service.

    a. Installer shall correct deficiencies found during startup service for reverification.

4. System Operation Report:

    a. After completion of startup service, manufacturer shall issue a report for each separate system to owner, architect, and commissioning agent.
    b. Report shall include complete documentation describing each startup check, the result, and any corrective action required.
    c. Manufacturer shall electronically record not less than four hours of continuous operation of each system and submit with report for historical reference.

5. System Adjustments

    a. Adjust equipment and components to function smoothly, and lubricate as recommended by manufacturer.
    b. Adjust initial temperature and humidity set points. Adjust initial airflow settings and discharge airflow patterns.
    c. Set field-adjustable switches and circuit-breaker trip ranges according to VRF HVAC system manufacturer's written instructions, and as indicated.
    d. Occupancy Adjustments: Within 12 months from date of Substantial Completion, manufacturer's service representative shall provide on-site assistance in adjusting system to suit actual occupied conditions. Provide at least four visits to Project (including other-than-normal occupancy hours) for this purpose. Site visits shall be at least 2 hours in duration. Site visits shall occur during heating and cooling seasons.

4.4 MAINTENANCE SERVICE:

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 24 months' full maintenance by the manufacturers service agency or the manufacturer's authorized service representative. Include four service visits per year for preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper equipment and system operation. One visit shall coincide with commissioning authority's 10 month walk-through. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years

4.5 TRAINING OF OWNER'S PERSONNEL:

A. Engage a VRF HVAC system manufacturer's factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain entire system.

B. Instructor:

1. Instructor shall be factory trained and certified by VRF HVAC system manufacturer with current training on the system(s), equipment, and controls that are installed.
2. Instructor's credentials shall be submitted for review by Architect before scheduling training.
3. Instructor(s) shall have not less than three years of training experience with VRF HVAC system manufacturer and past training experience on at least three projects of comparable size and complexity.

C. Schedule and Duration:

1. Schedule training with Owner at least 20 business days before first training session.
2. Training shall occur before Owner occupancy.
3. Training shall be held at mutually agreed date and time during normal business hours.
4. Each training day shall not exceed eight hours of training. Daily training schedule shall allow time for one-hour lunch period and 15-minute break after every two hours of training.
5. Perform not less than eight total hours of training.

D. Location: Owner shall provide a suitable on-site location to host classroom training.

E. Training Attendees: Assume four people.

F. Training Format: Individual training modules shall include classroom training followed by hands- on field demonstration and training.

1. Include instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
2. Video record each classroom training session and submit an electronic copy to Owner before requesting Owner acceptance of training.

G. Acceptance: Obtain Architect, Commissioning Agent, or Owner written acceptance that training is complete and requirements indicated have been satisfied.

END OF SECTION 238166

SECTION 238238 - CABINET UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide cabinet unit heaters, as specified and scheduled on drawings.

1.2 SUBMITTALS

A. Shop Drawings: Submit the following for each unit type and configuration:

1. Equipment schedules to include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.

C. Field Test Reports: Written reports of tests specified in Part 3 of this Section.

D. Maintenance Data: For cabinet unit heaters to include in maintenance manuals specified in Division 1. Include the following:

1. Maintenance schedules and repair parts lists for motors, coils, integral controls, and filters.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 CABINET UNIT HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified:

1. Daikin (Basis of Design)
2. Vulcan
3. Airtherm
4. Sterling
5. Trane
6. JCI

B. Description: An assembly including filter, chassis, coil, fan and motor in blow-through configuration with heating coil.

C. Configuration: Provide the following configuration as indicated on the drawings:

1. Recessed wall mounted:

a. Air Outlet: Front Top discharge grille.
b. Air Inlet: Front Bottom inlet grille.

2. Recessed ceiling mounted.

a. Air Outlet: Bottom discharge grille.
b. Air Inlet: Bottom inlet grille.

D. Cabinet

1. Chassis: Galvanized steel, with flanged edges.
2. Coil Section Insulation: 1-inch duct liner complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.

a. Fire-Hazard Classification: Duct liner and adhesive shall have a maximum flame-spread rating of 25 and smoke-developed rating of 50 when tested according to ASTM E 84.

3. Construction: 16 gauge, galvanized steel front panel, 18 gauge galvanized steel side and back panels, with removable panels fastened with tamperproof fasteners and key-operated access door. Ceiling mounted units face panels shall have continuous hinge to provide full swing through 90 degrees. Provide safety chain on face panel.
4. Cabinet Finish: Bonderized, phosphatized, and flow-coat with manufacturer's available paint, in color as selected by the project Architect, applied to factory-assembled and tested cabinet unit heater before shipping.

E. Coils

1. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1-inch and with manual air vent. Coils shall be rated for a minimum working pressure of 300 psig and a maximum entering water temperature of 275 deg F, with manual air vent.
2. Provide left or right hand coil connections as required to connect piping as shown on the project drawings.
3. Capacity: As scheduled on drawings.

F. Fan

1. Centrifugal, with forward-curved, double-width wheels and fan scrolls made of galvanized steel or thermoplastic material; directly connected to motor.

G. Fan Motors

1. Permanent split capacitor, multi-speed motor with integral thermal overload protection and resilient mounts. Connect motor to chassis wiring with plug connection.

H. Accessories

1. Filters: 1/2-inch-thick, cleanable aluminum-mesh media.
2. Factory installed electrical disconnect switch.

I. Controls

1. Control Devices: Unit-mounted fan-speed switch.
2. Unit fans serving vertical wall mounted units are to be cycled by an integral line voltage thermostat. Unit fans serving horizontal ceiling recessed units are to be cycled by the Building Automation System. Remote temperature sensors for ceiling units are to be provided by the Automatic Temperature Control Contractor.
3. Unit hot water control valves shall be cycled by the building temperature control system.

J. Source Quality Control

1. Test cabinet unit heater coils according to ASHRAE 33.

K. Capacity and Size: Refer to the equipment schedule on the project drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive cabinet unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping and electrical connections to verify actual locations before cabinet unit heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install cabinet unit heaters level and plumb.

B. Install cabinet unit heaters to comply with NFPA 90A.

C. Suspend cabinet unit heaters from structure with rubber-in-shear vibration isolators. Vibration isolators are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment".

3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Ground equipment.

D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing and report results in writing:

1. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safeties.

B. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

3.5 CLEANING

A. After installing units, inspect unit cabinet for damage to finish. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. After installing units, clean cabinet unit heaters internally according to manufacturer's written instructions.

C. Install new filters in each cabinet unit heater within two weeks after Substantial Completion.

END OF SECTION 238238

SECTION 238239 – ELECTRIC HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Requirements:

1. Section 017419 – “Construction Waste Management”.
2. Section 018113.14 – “Sustainable Design Requirements - LEED v4 / 4.1 BD+C: New Construction”.
3. Section 019113 – “General Commissioning Requirements”.

1.2 SUMMARY

A. Section Includes:

1. Electric Cabinet unit heaters with fans and electric resistance heating coils.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. CWP: Cold working pressure.

C. PTFE: Polytetrafluoroethylene plastic.

D. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.

B. LEED Submittal:

1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Plans, elevations, sections, and details.
2. Location and size of each field connection.

3. Details of anchorages and attachments to structure and to supported equipment.
4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.
5. Location and arrangement of integral controls.
6. Wiring Diagrams: Power, signal, and control wiring.
7. Perimeter moldings for exposed or partially exposed cabinets.

D. Samples for Initial Selection: Finish colors for units with factory-applied color finishes.

E. Operation and Maintenance Data: For electric heaters to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Cabinet Unit Heater Filters: Furnish one spare filter(s) for each filter installed.

PART 2 - PRODUCTS

2.1 ELECTRIC CABINET UNIT HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. QMark Electric Heating; a division of Marley, (Basis of Design).
2. Brasch
3. Chromalox.
4. Daikin.
5. Markel Products; a division of TPI Corporation.

B. Description: A factory-assembled and -tested unit complying with ARI 440.

1. Comply with UL 2021.

C. Coil Section Insulation: ASTM C 1071; surfaces exposed to airstream shall be aluminum-foil facing to prevent erosion of glass fibers.

1. Thickness: not less than 1/2 inch.
2. Thermal Conductivity (k-Value): 0.26 Btu x in./h x sq. ft. at 75 deg F mean temperature.
3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
4. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

D. Cabinet: Steel with baked enamel finish with manufacturer's standard paint, in color selected by Architect. Units are to be suitable for surface wall mounting or recessed ceiling mounting as indicated on the design drawings.

1. Exposed Front Panels: Minimum 0.0528-inch thick, sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
2. Control Access Door: Key operated.
3. False Back: Minimum 0.0428-inch- thick steel, finished to match cabinet.
4. Glass Fiber Treated with Adhesive: minimum ½ inch thickness.

E. Electric Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with fuses in terminal box or circuit breakers for over-current protection and limit controls for high-temperature protection. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.

F. Fan and Motor Board: Removable.

1. Fan: Forward curved, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
3. Wiring Terminations: Connect motor to chassis wiring with plug connection.

G. Basic Unit Controls:

1. Control voltage transformer.
2. Unit-mounted thermostat for wall mounted unit and remote low voltage thermostat for recessed ceiling units with the following features.

   a. Heat-off switch.
   b. Fan on-auto switch.
   c. Manual fan speed switch.

H. See Drawings for Capacities and Characteristics.

2.2 ELECTRIC UNIT HEATERS;

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. QMark Electric Heating; a division of Marley Engineered Products. (Basis of Design).
2. Brasch
3. Chromalox.
4. Daikin.
5. Markel Products; a division of TPI Corporation.

B. Description: An assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.

C. Comply with UL 2021.

D. Cabinet: Removable panels for maintenance access to controls.

E. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.

F. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

G. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

H. Electric Resistance Heating Elements: Aluminum finned, copper clad steel sheathed heating element. Fin surface temperature shall not exceed 550 deg F at any point during normal operation.

1. Circuit Protection: One-time fuses in terminal box for over-current protection and limit controls for high-temperature protection of heaters.
2. Wiring Terminations: Stainless-steel or corrosion-resistant material.

I. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

J. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Type: Permanently lubricated.

K. Control Devices:

1. Wall mounted thermostat with on-off switch.

L. See Drawings for Capacities and Characteristics.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for electrical connections to verify actual locations before unit heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install electric heaters to comply with NFPA 90A.

B. Install electric unit heaters level and plumb.

C. Suspend propeller unit heaters from structure with all-thread hanger rods. Hanger rods and attachments to structure are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

D. Install wall mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

E. Install new filters in each cabinet unit heater within two weeks of Substantial Completion.

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

A. Adjust initial temperature set points.

END OF SECTION 238239

SECTION 260500 - GENERAL ELECTRICAL PROVISIONS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements, Division 1 Specifications, apply to this Section.

1.2 REFERENCE TO CONDITIONS OF THE CONTRACT

A. The Conditions of the Contract General, Supplementary and other Conditions and Divisions 1 through 31 and General Requirements, apply to the work specified in Division “26” and “28”. Unless the specifications contain statements which are more definitive or more restrictive than those contained in the Conditions of the Contract, the specifications shall not be interpreted as waiving or overruling any requirements expressed in the Conditions of the Contract.

B. No claim or additional compensation shall be entertained on behalf of or paid on account of failure to be informed of the above conditions and requirements.

C. Should a bidder find discrepancies in or omissions from the drawings or specifications, or should he be in doubt as to their meaning, he should at once notify the Associate who shall send written instructions to bidders. If these are ignored by the Contractor, he shall be responsible for furnishing the proper or workable equipment as necessary.

D. Before submitting a bid, bidders shall be held responsible to have visited the site of work, attend the Pre-Bid Meeting, and fully inform themselves as to existing conditions and limitations, including rules, rates and fringe benefits, travel pay, affiliation fees and transportation expense prevailing in the local labor market, and no allowance shall subsequently be made on behalf of the bidder by reason of any error on his part.

E. Carefully examine the architectural, structural, heating, ventilating and air conditioning, plumbing and any other relevant contract documents. If any discrepancies occur within Contract documents, report such discrepancies to the Associate in writing and obtain written instructions as to the manner in which to proceed. No departures from the contract documents shall be made without prior written approval of the Associate.

F. Obtain any additional reference documents and/or information required for installation prior to installing equipment. Coordinate work with other trades making minor adjustments as required. Wiring or conduit layouts are schematic based and exact locations shall be determined by structural or other restricting conditions.

G. Minor details not usually shown or specified but necessary for proper installation and operation shall be provided in the Contractors estimate, the same as if herein specified or otherwise shown.

H. Coordination with the Utility servicing this facility including following and policies of the utility company shall be included in this bid. Where material and installation is deemed the responsibility of the Contractor by the Utility Company, such work shall be included within his bid.

I. Contractor bid submission shall give written notice to the Architect of record any materials or apparatus believed inadequate, in violation of laws, ordinances, rules, standard installation practices and any necessary item required or work omitted. In the absence of such written notice, it is mutually agreed that the Contractor has included the cost associated of all required item in his proposal and that he will be responsible for the approved satisfactory functioning of the entire system without extra cost compensation.

1.3 WORK INCLUDED

A. Provide and install a complete and operating electrical installation in accordance with these specifications and accompanying contract documents. This shall include required labor, material, apparatus and supervision.

B. Without limiting or restricting the volume of work and solely for convenience, the work to be performed will, in general, comprise the following:

1. Installation of switchboards, distribution panels, exterior conduit and transformer pads.
2. Installation of service entrance equipment into north outfield buildings.
3. Installation of natural gas generator and transfer switch.
4. Installation of power and lighting panelboard(s) and supporting equipment.
5. Installation of feeders and branch circuits including overload and disconnecting means.
6. Installation of transient voltage surge protection and waveform correction devices.
7. Wiring devices, multi-gang back boxes, plates and supporting hardware and/or equipment.
8. Installation of low voltage transformers and concrete equipment pads.
9. Temporary services: construction requirements for lighting and power.
10. Wiring of equipment and final connections of equipment furnished by others.
11. Building grounding and bonding of equipment and electrical distribution system.
12. Installation of building interior/exterior light fixtures, lamps, supports, controls, wiring and concrete bases.
13. Technology infrastructure including conduit, boxes and cable tray.
14. Lightning Protection System.
15. New fire alarm equipment installation testing, and coordination.
16. Required material and labor necessary to complete project scope as indicated within complete specifications, drawings or schedules.

C. Items of labor, material, and equipment not specified in detail or shown within Contract documents, but incidental to or necessary for the complete installation and proper operation of the several branches of work and described herein, or reasonably implied in connection herewith, shall be furnished as if called for in detail by the specifications or Contract documents. This includes electrical work associated with mechanical and plumbing work whether indicated on electrical drawings or not.

D. This contractor is advised to carefully coordinate the delivery of large, awkward, heavy equipment, material or relevant items. Delivery limitations may require modifications, supporting means or structural modifications in order to set equipment or components. This contractor shall be responsible for all calculations, material, labor, equipment,

machinery, deliveries, transportation or safety related equipment required for equipment such as but not limited to: transformers, switchgear, generator, site lighting, disconnects, staging materials, panelboards etc.

E. Contractor shall provide raceways, fittings, supports, feeders, branch circuits, overload/short circuit protection, relays, starters, terminals and related accessories to complete his work including installation and termination of items, equipment or controls furnished by other contractors unless specifically stated otherwise.

F. It is the responsibility of the Contractor to verify proper motor rotation and sizing of motor overload protection is in compliance with NEC and equipment manufacturer.

1.4 WORK NOT INCLUDED

A. The following items of Electrical Construction are not included in this contract:

1. Low voltage wiring of certain systems or devices shall be done by the respective Contractor such as temperature control wiring, interlock wiring and related control devices for HVAC equipment unless noted or otherwise. Raceways shall be provided by the Contractor.
2. Certain motors and equipment shall be provided by others, complete with motor and built-in or separate controllers as covered by such contracts such as packaged HVAC or plumbing equipment. The Contractor shall provide feeders, branch circuits and/or disconnecting means as called for within the Contract documents.

1.5 DEFINITIONS AND ABBREVIATIONS

A. Definitions

1. "Furnish" shall mean supply and deliver to project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.
2. "Install" shall be used to describe operations at project site including unloading, packing, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning, and similar operations, as applicable in each instance.
3. “Installer” shall mean a company or individual specializing in performing work meeting the requirements of their trade with minimum of three (3) years of experience.
4. "Provide" shall mean furnish and install, complete and ready for intended use, as applicable in each instance.
5. "Directed" shall mean as directed by Batavia Local School District or its Representative prior to installation of equipment.
6. "Indicated" shall mean "indicated on Contract Documents".
7. "Shown" shall mean "shown on Contract Documents".
8. "Section" shall mean one of the Specification Sections.
9. "Division" shall mean one of the Specification Divisions.
10. "Article" shall mean one of the numbered paragraphs of the Specification Section.
    "Work" or "Electrical Work" herein includes products, labor, equipment, tools, appliances, transportation and related items, directly or indirectly required to complete the specified and/or indicated electrical installation.
11. "Code" shall mean any and all regulations and requirements of regulatory bodies,

public or private, having jurisdiction over the work involved.

12. "Product" used in Division 26, 27 and 28 means material, equipment, machinery, and/or appliances directly or indirectly required to complete the specified and/or indicated Electrical Work.
13. "Standard Product" shall mean a manufactured product, illustrated and/or described in catalogs or brochures, which are in general distribution prior to the date of issue of construction documents for bidding. Products shall generally be identified by means of a specific catalog number and manufacturer's name.
14. "Wiring" shall mean fittings, conduits, wires, junction boxes, connections to equipment, splices, and other accessories required to complete the work.
15. Abbreviations and Symbols: See lists on drawings.
16. "This Contractor" shall mean the Contractor responsible for Divisions 26, 27 and 28 work.
17. Contract Documents: drawings, specifications, manufacturer’s specification/data sheets, bid forms, addendum, and change orders.
18. Whenever the phrases "approved by the Associate or Owner’s Representative," "approved equivalent," or "equivalent to" appear in these specifications, they shall be interpreted as meaning "as recommended by the Associate and approved by the Authority."

B. Reference to the latest editions of codes and standards shall mean:

Reference	Definition
NEC	National Electrical Code
ASTM	American Society for Testing Materials
NEMA	National Electrical Manufacturers Association
ANSI	American National Standards Institute
FS	Federal Specification, US Government
CS	Commercial Standards issued by US Department of Commerce
NESC	National Electrical Safety Code
NETA	National Electrical Testing Association
ADA	Americans with Disabilities Act
OBC	Ohio Building Code
NFPA	National Fire Protection Association
Owner	Owner / Owner’s Representative

1.6 REGULATIONS

A. Electrical work, equipment, and materials furnished and installed under this contract shall conform to the requirements of the latest edition of the National Electrical Code, the National Fire Protection Association and any other governmental or local authorities having jurisdiction. Pay any fees required for the installation of this Division work. Certificates of approval shall be obtained in duplicate from any department or agency issuing same, and shall be turned over to OWNER or its representative at the completion of the work.

B. Provide any labor, materials, services, apparatus, CAD drawings and documents required to comply with applicable laws, ordinances, rules and regulations, whether or not shown.

C. Obtain certificates of inspection and approval from authorities having jurisdiction and deliver same to OWNER as a prerequisite for final acceptance of the work. Provide record copies of permit applications, permits and other items for which certification are indicated.

1.7 SPECIAL ENGINEERING SERVICES

A. In the instance of complex or specialized electrical systems such as fire alarm, security, telecommunication or similar systems; the installation, final connections and testing of such systems shall be made under the direct supervision of qualified authorized service engineers who shall be in the employ of the respective equipment manufacturer. Provide OWNER with copies of instruction manuals and booklets for each system and piece of equipment installed. Provide any additional instructions over and above that listed above in the care, adjustment and operation of parts of the electrical systems.

B. Pay any and all expenses incurred by these equipment manufacturers' representatives.

1.8 SUBMITTALS

A. Shop drawings, product data, and samples shall be submitted to the Associate for approval. Submit a minimum of (6) sets (or equivalent documentation in PDF format) of shop drawings and related specifications to the Associate in a bound set included with letter of transmittal.

1. Contractor must first review content for project specification compliance prior to submission. Drawings and specifications shall bear the Contractor’s approval stamp indicating specification compliance. Sets received without Contractors approval stamp will not be reviewed.
2. Shop drawings shall be new drawings, and not reproductions or tracings of the Contract Documents. In preparing shop drawings, establish lines and levels for the work specified, and check the drawings to avoid interference with structural features and other work. Immediately call to the attention of the Architect any interference for clarification in writing.
3. Manufacturer's literature and data sheets shall be submitted indicating the necessary installation dimensions, weights, materials, and performance information. Each piece of literature shall be identified with the specific

specification number, paragraph, and equipment schedule identification.

4. Engineer’s review of Manufacturer documents or specifications shall not relieve the contractor from responsibility of errors or omissions in such submittals, schedules, drawings or deviations form contract documents.
5. Layout and detail drawings shall be submitted in the form of legible sepia reproducible and paper prints. Manufacturer's drawings shall be standard drawings. Equipment shop drawings shall show specific data and other special features required for review consideration.
6. Equipment shop drawings (8-1/2 by 11 inch sheets) shall be bound together in sets, in loose leaf binders, and shall be indexed in accordance with Specification Section. Additional shop drawings may be submitted at a later date for insertion therein, and the original submittal shall note which shop drawings shall be submitted later. Marked-up catalogs are not acceptable, and shall be rejected.
7. Materials and equipment shop drawings shall be submitted within 30 calendar days of Contract receipt.
8. Manufacturers' instruction manuals shall be submitted together with shop drawings. Furnish instruction manuals and parts listed for each piece of electrical equipment, on 8-1/2 by 11 inch sheets, or catalogs, suitable for loose leaf side binding, packaged separately, and clearly identified. Instructions shall include information pertaining to installation, operation, and maintenance of equipment as applicable. Each piece of literature shall be clearly identified with the specific job equipment identification. Literature shall be factory printed and not reproduced copies.
9. Any characteristic of any piece of equipment which deviates from the characteristics of the equipment specified shall be hi-lighted and circled in red.

B. Submit manufacturers' data, and/or shop drawings of the following:

1. Distribution panels, branch panelboards, and related equipment.
2. Emergency and safety related equipment.
3. Transformers.
4. Lighting Fixtures with ballast/driver data.
5. Wiring devices, pull boxes, and junction boxes.
6. Lighting controls devices such as switches, contactors, motion, occupancy sensors and relevant control sensors.
7. Surge protection and waveform corrector equipment.
8. Disconnect Switches, Motor Starters, variable frequency drives, and controls supplied by the Contractor.

1.9 OPERATING AND MAINTENANCE INSTRUCTIONS

A. After final tests and adjustments have been completed, furnish the services of qualified personnel to fully instruct the OWNER Maintenance representative in the operation and maintenance procedures for equipment installed. Operation and maintenance instructions for major items of equipment shall be directly supervised by the equipment manufacturer's representative. Supply qualified personnel to operate equipment for sufficient length of time as required to meet governing authorities' operation and performance tests and as required to assure that OWNER representatives are properly qualified to take over operation and maintenance procedures.

1. Notify the Associate, OWNER representatives and equipment manufacturers'

representatives, by letter, as to the time and date of operating and maintenance instruction periods at least one week prior to conducting same.

2. Forward to the Associate the signatures of all present for the instruction periods.

B. Furnish three (3) copies of recommended equipment operation and maintenance procedures manuals as specified herein, assembled and bound together in 8-1/2 by 11 inch three-ring binders. The ring binders shall be submitted to the Associate in accordance with procedures established for shop drawing submittals.

1. The operation and maintenance procedures manuals shall include the following:

a. Project Title
b. Associate’s Name and Address
c. Date Submitted
d. Contractor's Name and Address
e. Index (in alphabetical order, with page numbers)
f. General Description of Each System
g. Parts List, identifying the various parts of equipment for repair and replacement purposes.
h. List of spares recommended for normal service requirements.
i. Operating instructions outlining step-by-step procedures required for system start-up and operation. The instructions shall include the manufacturer's name, model number, service manual, and brief description of each piece of equipment and its basic operating features.
j. Maintenance instructions describing routine maintenance and lubrication procedures and schedules, and simplified diagrams which illustrate the systems as installed.
k. Wiring and control diagrams for each piece of equipment, showing "as installed" conditions.

1.10 SINGULAR NUMBER

A. References made to any item in the singular number shall apply equally to as many identical items that the work may require.

1.11 PROTECTION OF SERVICES

A. Repair, replace and maintain in service any new or existing utilities, facilities or services (underground, overhead, interior or exterior) damaged, broken or otherwise rendered inoperative during the course of construction. The method used in repairing, replacing or maintaining the services shall be approved OWNER and Associate. OWNER reserves the right to make emergency repairs as required to keep equipment in operation without voiding the Contractor’s guarantee bond not relieving the contractor of his responsibilities during bond period.

B. OWNER’s property and the property of other trades shall be scrupulously respected at all times include damage from leaks. This contractor shall provide drop cloths or similar barriers where dust or debris is generated protecting adjacent area.

C. This contractor shall be held responsible for damages caused by his work or through neglect of his workman or subcontractors. Repairing of damages shall be done in accordance by OWNER or its representative. Costs associated with repairs shall be

paid by this contractor.

1.12 PROTECTION OF FLOORS, EQUIPMENT AND PERSONNEL

A. Protect flooring from damage during the construction period. Provide plywood or similar material under equipment or materials stored on floors, and in areas where construction may damage the floor surfaces. Replace floor surfaces (including sealer) damaged during the construction.

B. In addition to the provisions and stipulation of the General Conditions, each contractor and subcontractor of shall provide various types of protection as follows:

1. Protect finish floors from chips and cutting oil by the use of metal drip receiving pan and oil proof floor coverings.
2. Protect equipment and finish surfaces from welding and cutting splatters with baffles and splatter blankets.
3. Protect equipment and finished surfaces from paint droppings, insulation adhesives, grout, fire proofing and other related non-finished material.

C. All equipment shall be stored at the site with openings, bearings, etc., covered to exclude dust, moisture or foreign debris from entering.

D. Construction openings, trip hazards and unsafe conditions created by this contractor shall be scrupulously inspected for personnel safety and protection of property with strict compliance of OSHA work and construction practices.

E. Conduit and excavations required for electric work shall be covered when work is not in progress such as capping conduit openings, cover wall or floor openings with material of adequate strength supporting construction traffic, safety warning tape, warning lights and signs.

1.13 TEMPORARY LIGHT AND POWER SERVICES

A. Refer to the Division 1, General Requirements, of these specifications to determine responsibility for temporary lights, power, water and heat.

B. The Contractor is responsible for all temporary power and lighting requirements throughout construction. The Contractor shall review all associated phasing plans and schedules and provide any and all equipment, either temporary or permanent, required to maintain or provide temporary power and lighting to all areas of this facility, throughout the construction process.

C. In addition to minimal temporary lighting and power needed for construction operations, occupied areas throughout construction shall be provided with temporary power and lighting services that meet or exceed the existing services that currently serve these areas. Power interruptions to such areas shall be kept minimal and be scheduled 48 hours prior to alterations of service.

D. The electrical documents indicate the final arrangement for the power/lighting/communication/ signal/data systems and do not reflect equipment,

devices, etc., needed to provide the required temporary power and lighting services.

E. At the completion of this project, all temporary lighting, temporary receptacles, and temporary wiring shall be removed in their entirety.

F. Waste material generated by this contractor or relating to his work shall be properly disposed of in accordance to local, state and federal guidelines or requirements.

1.14 SUBSTITUTIONS

A. It is the intent of these specifications that wherever a manufacturer or product is specified, and the term "or approved equivalent" is used, the substituted item must conform in respects to the specified item. Consideration shall not be given to claims that the substituted item meets the performance requirements with lesser construction. Performance indicated in schedules, drawings and specifications shall be interpreted as minimum performance.

B. Note that where specific manufacturers' products are indicated in the Contract Documents, the associated systems have been designed on the basis of that product's physical characteristics. Where specific manufacturers' products are indicated in the Contract Documents and other manufacturers' names are listed, the associated systems have been designed on the basis of the first-named manufacturer's product. When products other than those used as the basis of design are provided, additional costs related installation, usage or modifications to the systems and/or structure required by the use of that product shall be paid by this contractor.

C. This Contractor shall be responsible for all costs associated with changes to sizes such as conduit, fuse, starter, wire, supports etc. caused by change of equipment from the basis of design including usage of other named manufactures. Space allocation due to usage of other manufacture shall be the responsible of the Contractor ensuring adequate clearances for maintenance, operation, service, code requirements are met.

D. Equipment of one type shall be the products of one manufacturer; similar items of the same classification shall be identical, including equipment, assemblies, parts and components.

E. Materials furnished shall be new, defect free, used in accordance to its listing and determined safe by a nationally recognized testing organization, such as Underwriters' Laboratories, Inc., or Factory Mutual Engineering Corporation, and materials shall be labeled, certified or listed by such organizations.

F. Where a specific manufacturer is specified and other manufacturers' names are listed as equivalent, the bid shall be based upon the specified or equivalent manufacturers only. Any substitutions shall be submitted to the associate no later than ten (10) days prior to the bid opening. Refer to Article I and the General Conditions of this specification for more information.

G. Final acceptance of substitutions shall be at the discretion of the associate.

1.15 PERFORMANCE OF EQUIPMENT

A. Materials, equipment and appurtenances of any kind, shown on the drawings, hereinafter specified or required for the completion of the work in accordance with the intent of these specifications, shall be completely satisfactory and acceptable in operation, performance and capacity. No approval either written or verbal of any drawings, descriptive data or samples or such material, equipment and/or appurtenance shall relieve the Contractor of his responsibility to turn over the same to OWNER in perfect working order at the completion of the work.

B. Any material, equipment or appurtenances, the operation, capacity or performance of which does not comply with the drawings and/or specification requirements or which is damaged prior to acceptance by OWNER shall be held to be defective material and shall be removed and replaced with proper and acceptable materials, equipment and/or appurtenances or put in proper and acceptable working order, satisfactory to the school district, without additional cost to the Owner.

1.16 WEATHERPROOFING LOCATIONS (WP)

A. Electrical apparatus, such as outlet boxes, switches, thermal switches, manual starters, disconnect switches, combination switches and starters, motor control centers, and motor starters shall be weatherproof gasket type, NEMA Types 4 in the following instances:

1. On surface of exterior face of building, including areas where not under canopies, cast boxes with threaded hubs must be used and under canopies steel boxes with gasket connections to devices.
2. In any areas where specifically noted "WP" or required by the NEC or Electrical Regulations mentioned herein.
3. Within air conditioning enclosures.
4. In underground splice boxes.
5. On building roof.

1.17 CLEANING, PROTECTING AND ADJUSTING

A. Materials shall be stored in a manner that shall maintain an orderly, clean appearance. If stored on-site in open or unprotected areas, equipment and material shall be kept off the ground by means of pallets or racks, and covered with tarpaulins.

B. Equipment and material, if left unprotected and damaged, shall be repainted or otherwise refurbished at the discretion of the Owner. Equipment and material is subject to rejection and replacement if, in the opinion of the Associate or the manufacturer's engineering department, the equipment has deteriorated or been damaged to the extent that its immediate use or performance is questionable, or that its normal life expectancy has been curtailed.

C. During the construction period, protect ductwork, raceways, conduit and equipment from damage and dirt. Properly cap ductwork and conduit.

D. Vacuum cabinets, switch boards, distribution panels, lighting and power panels, etc., after completion of work.

E. Remove recorded construction measurements from equipment, panels, walls or other

defaced surfaces.

1.18 ACCESSIBILITY

A. Coordinate to ensure the adequacy of the size of shafts and chases, and the adequacy of clearances in hung ceilings and other areas required for the proper installation of this work.

B. Locate equipment which must be serviced, operated or maintained in fully accessible positions. Equipment requiring access shall include, but is not necessarily limited to, motors, junction boxes, fire alarm devices, controllers and switchgear.

C. Provide, as required, the exact locations of access doors. Provide access doors in finished construction for installation by others. Locations of access doors in finished construction shall be submitted in sufficient time to be installed in the normal course of the work. Keep conduit and other electrical devices clear of access door openings to allow adequate space to work in or enter the concealed space.

D. Access panels shall not be smaller than 12 inches by 16 inches or as required by authority of jurisdiction and shall be all-steel construction with a No. 16 gauge wall or ceiling frame and a No. 14 gauge panel door with not less than 1/8 inch fireproofing secured to the inside of the door. Doors shall be provided with concealed hinges and be secured with suitable clips and countersunk screws. Outside of access panels shall finish flush with finished wall or ceiling surfaces. Covers shall be factory primed with two (2) coats of primer.

E. Working clearances: Provide at least 3’-0” of clear space in front of all electrical panels and as wide as the equipment with a minimum of 2’-6” wide. Height and width of working spaces shall be in accordance to Article 110.26 of National Electric Code.

1.19 GUARANTEE

A. Guarantee material, equipment and workmanship for a period of one (1) year from date of final acceptance by Associate and Owner’s Representative. Replace defective material and workmanship furnished and installed and other work and equipment damaged thereby.

B. In addition to the one (1) year guarantee, furnish any warranties or guarantees that normally come with specific pieces of equipment that exceed the one (1) year guarantee. These additional warranties shall be given to OWNER for the time period specified.

1.20 COORDINATION

A. The General Contractor shall be in charge of the coordination drawing process and shall be responsible to resolve all conflicts and settle any disputes resulting from the coordination drawing process. Coordinate and furnish in writing to other Primes, including the Associate, any information necessary to permit the work of all contractors

to satisfactorily complete installation of their work with the least possible interference or delay.

B. Each Prime Contractor shall participate in the preparation of coordination drawings. No installation of permanent systems shall proceed until the coordination drawings are approved by the General Contractor. No extra charges shall be allowed for changes required to accommodate installation of system by other contractors.

C. Coordination drawings shall be prepared in Revit 2014 format for each floor level and shall be of a scale not less than 1/4 inch - 1 foot. Coordination drawings shall include equipment, lighting, telecommunication, fire alarm, cable tray and raceway plans, with elevations with dimensions. Coordination drawings shall also include required access points through ceiling panels, access doors, cover plates, etc.

D. Field discrepancies shall be resolved by the field foreman. When discrepancies cannot be resolved, the signed-off coordination drawings shall be re-examined for rights. Any and all discrepancies in construction, phasing, etc., due to the lack of coordination shall be at the sole expense of the associated contractors and in no way will be passed on to OWNER.

E. Devices and appurtenances which are to be installed in finished areas shall be coordinated with the General Contractor and OWNER for final approval as it relates to location, finish, materials, color, and texture.

F. When work is installed without proper coordination, changes to this work deemed necessary by the Associate shall be made to correct conditions without any extra cost to OWNER.

G. Disciplines shall include in coordination: Electric, Telecommunications, HVAC, Mechanical, Plumbing, Fire Protection and Fire Alarm System.

H. Related coordination specification in Division 01.

1.21 PRE-BID SITE VISIT

A. Before submitting a bid, the Bidder is required to visit the site and fully inform themselves concerning all conditions affecting the scope of the work. Any discrepancies between the contract documents and the job site shall be brought to the Contract Officer’s attention before bids are due. Failure to visit the site shall not relieve the Contractor from any responsibility in the performance of this Contract. No extra charges shall be allowed as a result of existing conditions.

1.22 DRAWINGS

A. The Electrical drawings are diagrammatic and indicate the general arrangement of fixtures, equipment, furniture and work included in this contract. Consult the project documents and details for locations and dimensions of such equipment. All dimensions shall be field verified prior to material ordering. Where such items are not dimensioned or properly detailed, contact the Architect for required information.

B. The Contractor shall follow the drawings in laying out work while checking drawings of other trades prior to installation. Maintain NEC required work clearances including overhead electric space requirements. Contact the Architect where clearances are inadequate prior to equipment installation.

C. Where directed by the Architect, the Contractor shall modify layouts as needed to prevent conflict of work with other trades. No additional charges shall be made for coordination. Failure to coordinate with other trades or within project documents shall not relieve the Contractor from his responsibility or necessity of furnishing material or performing his work as required by the contract documents.

PART 2 - PRODUCTS

2.1 MATERIALS AND WORKMANSHIP

A. Equipment shall be so built and installed as to deliver its full rated capacity at the efficiency for which it was designed. Equipment shall meet the detailed requirements indicated, and shall be suitable for the installation shown.

B. Surface mounted electrical equipment shall be installed on 3/4" thick, fire retardant mounting board. Mounting board shall bear UL classified mark indicating ASTM E 84 test compliancy. Backboard material shall have a final applied finish according to manufacturer specifications prior to mounting of electrical equipment. Finishing material may include but not limited to fire retardant coatings. Backboard material shall minimally extend 6” in all directions beyond grouping of electrical equipment. The Contractor may use discretionary expertise to provide fire retardant backboard for individual equipment such as standalone disconnect switches, starters and the like. Where said devices are grouped (starters, disconnects, contactors etc.) installation shall include fire retardant backboard. Fire retardant mounting board installed on perimeter outside walls to be shimmed 1/2" from wall with washers to permit back ventilation.

Approved manufacturers:

1. Hoover Treated Wood Products Inc. - Pyro-Guard
2. D-Blaze[a] Fire Retardant Pressure Treated Wood
3. FlamePRO Fire Retardant Treated Ply wood
4. Approved equal.

C. Where two or more units of the same class of equipment are furnished in same Section of Specifications, provide each from the same manufacturer. Furnish equipment and materials new and free from defects of size, make, type and quality herein specified, or as reviewed.

D. Work shall be installed in a neat and workmanlike manner. Raceway installations shall parallel exterior and interior walls and be level. Vertical runs shall be plumb.

E. Capacities, dimensions, or sizes specified or indicated are minimums, unless otherwise stated. Tolerances used in rating or testing standards specified shall not be allowed in determining capacities of equipment.

F. Materials shall be listed by the Underwriters' Laboratories, Inc. where applicable and shall be manufactured in accordance with applicable standards established by ANSI, NEMA, ASTM, and IEEE.

G. Any products judged not in accordance with the Specifications either before or after installation will be rejected. Costs associated with rejection shall be paid by this contractor.

H. Where products are specified with no reference to a particular manufacturer's product, the product used shall meet or exceed industry construction and testing procedure standards applicable to the product, for life expectancy, performance and safety.

I. Where electrical products are a fabricated assembly, the fabricator shall assume responsibility for correct operation of the entire assembly and of its individual components.

J. Tools: Provide special tools for proper operation and maintenance of the equipment.

K. It’s the responsibility of the Contractor to provide clean electrical equipment which is free from dirt, paint, blemishes or markings. Scratches to equipment or enclosures shall be touched up with factory-color paint matching field color. Acceptance to restoration shall be to the satisfaction of the Architect.

L. Required device or equipment adjustments shall be made by EC before and after equipment is in operation throughout the warranty period.

M. Job site cleanliness and site safety of the removal of electrical generated trash or debris is the responsibility of this contractor. All job site safety rules, regulations and requirements shall be followed and maintained.

2.2 IDENTIFICATION

A. Switchgear, panels, relays, terminal control cabinets, junction boxes, contactors, circuit breakers, safety switches, motor starters, and similar items shall be identified with a single nameplate. Nameplates shall be laminated phenolic with white surface and black core (red surface for emergency and white core). Use 1/16” thick material for plates up to 2” x 4” and 1/8” thick for larger sizes. The lettering shall be condensed gothic with space between the lines equal to the width of the letters.

B. Nameplate shall read as follows:

1. First line shall be 1/2 inch letters stating panel/equipment name.
2. Second line (if applicable) shall be 1/4 inch letters stating the existing panel name in parentheses ( ).
3. Third line shall be 1/4 inch letters stating voltage/phase.
4. Fourth line shall be 1/4 inch letters stating breaker number, panel number, and final room name/room number from which it is fed.
5. Fifth line shall be1/4 inch letters stating function and/or equipment which it controls.

C. Names and numbers shall coincide with those listed within Contract documents unless altered by Owner descriptors.

D. Nameplates shall be secured with screws, a minimum of one on each end.

E. Label receptacle plates with identification showing panel and breaker number from which it is fed. Labels shall be made using the Dymo RinoPro or an equivalent approved system.

F. Label junction boxes and pull boxes, showing circuit numbers contained in the enclosure. Use an approved marking device as noted.

G. Label wire with an identification tag showing panel and breaker number from which it is fed at splices, junctions, and terminations as explained in this specification.

H. Label fire alarm device bases with identification showing device address number assigned by fire alarm system manufacturer. Labels shall be made using the Dymo RinoPro or equivalent system.

I. Branch breakers shall be labeled by Owner provided room numbers and descriptors.

2.3 ANCHOR BOLTS

A. Provide and set in place, at the time of pouring of concrete foundations, necessary anchor bolts as required for the equipment called for under these specifications. Anchor bolts shall be of the hook type, of proper size and length to suit the equipment. Anchor bolts shall be set in pipe sleeves of approximately twice the bolt diameter and one half the embedded length of the bolt. Assume full responsibility for proper emplacement of the bolts.

2.4 INSERTS

A. Provide inserts of an approved metallic type for hangers. Where two or more parallel conduits are installed, continuous inserts may be used. Where required to distribute the load on the inserts, a piece of reinforcing steel of sufficient length shall be passed through the insert.

2.5 SLEEVES

A. Provide sleeves in all roofs, floors, and any fire-rated walls. Each sleeve shall extend through its respective floor, wall or partition and shall be cut flush with each surface unless otherwise required.

B. Sleeves in bearing and masonry walls, floors and partitions shall be standard weight steel pipe finished with smooth edges. For other than masonry partitions, through suspended ceilings, and for concealed vertical piping, sleeves shall be No. 22 USG galvanized iron.

C. Sleeves shall be properly installed and securely cemented in place.

D. Floor sleeves shall extend 1 inch above the finished floor, unless otherwise noted.

Space between floor sleeves and passing conduit shall be caulked with graphite packing and waterproof caulking compound.

E. Where conduits pass through waterproofed floor or walls, design of sleeves shall be such that waterproofing can be flashed into and around the sleeves.

F. Where conduits pass through roofs, sleeves shall be installed and flashed and made watertight by the General Contractor unless otherwise specified or shown within Contract documents.

G. Sleeves through exterior walls below grade shall have the space between conduit and sleeve caulked watertight using an approved method.

2.6 FIREPROOFING

A. Where sleeves, ducts, cable trays, or other penetrations pierce floors or walls having specific fire ratings, the space between the sleeves and passing conduit shall be fireproofed with an approved UL listed fire proofing assembly. Installation method shall be per manufacturer's recommendations and approved by the Associate.

B. Reference Division 7, section “Through-Penetration Firestop System”.

2.7 WIRE GAUGE

A. The sizes of conductors and thickness of metals called for herein or within other Contract documents shall be understood to be American Wire Gauge.

2.8 MISCELLANEOUS METAL AND STRUCTURAL STEEL

A. Scope of Work: Furnish labor, materials, equipment and services necessary for the installation of miscellaneous metal and structural steel work required to complete this contract. Erect structural steel required for the proper support of equipment required under this contract.

B. Supports, brackets, and clamps and other items specified herein shall be installed in strict accordance with the best practices and recognized code.

C. Materials: Structural steel members required under this part shall conform to ASTM Standard Specification A-7. Other materials shall be as specified hereinafter.

D. Priming: steel and iron work shall be primed with Rust-Oleum 769 or approved equivalent. Before priming, metal shall be thoroughly cleaned free from scale, rust and dirt.

E. Anchors: Provide anchors, bolts, screws, dowels and connecting members, and do cutting and fitting necessary to secure the work to adjoining construction. Build in connecting members to masonry, concrete and structural steel as the work progresses.

F. Supports and Brackets: shall be neatly constructed to structural shapes to adequately support the equipment intended. Supports must be approved prior to installation. Attention is directed to the proper rigid support required for conduit. Field conditions shall regulate the type of support required.

G. Reference Division 7, Section “Spray fire-resistive Material” for coordination of hangers an applicable supports.

2.9 VIBRATION ISOLATION MOUNTS

A. Provide vibration isolation mounts for all substations, power centers, transformers or equipment subject vibrations in accordance with this or other applicable sections.

2.10 GRADING, FERTILIZING, AND SEEDING

A. Provide labor, materials, equipment, and services required to strip and store topsoil, replace topsoil, and rough and finish grade and fertilize and seed areas disturbed beyond the work area of the General Contract. Topsoil must be stored where directed on the site.

B. Reference Division 31, “Earthwork” for backfill and compaction requirements.

2.11 MOTORS

A. Motors shall be built in accordance with the latest standards of NEMA and as specified. Motors shall be tested in accordance with ASA C50 and conform thereto with respect to insulation resistance and dielectric strength.

B. Each motor shall be provided with conduit terminal box and adequate starting and protective equipment as specified or required. The capacity shall be sufficient to operate associated driven devices under conditions of operation and load and without overload, and shall be at least the horsepower indicated or specified. Each motor type shall be premium energy efficient and of quiet operation.

C. Motor starting equipment must be selected so that starting currents or transients do not have an adverse effect on lighting or other electrical equipment. This contractor shall provide devices or equipment required to snub or eliminate such electrical disturbances.

D. Motors shall be verified for proper rotation prior to service of equipment.

E. Motors connected to inverter controllers shall comply with the requirements of Division 23 Specification 230513 “Common Motor Requirements For HVAC Equipment” when included in Contract Documents.

F. Motors shall comply with Energy Independence and Security Act of 2007.

1. Motors shall comply with NEMA MG 1 table 12-11 and 12-12 unless noted

otherwise.

G. Motors connected to inverter controllers shall be inverter rated containing shaft mounted grounding protection ring such as AEGIS bearing protection ring.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide information to the General Contractor for any chases or openings required under this Contract. No cutting shall be done which may affect the building structurally or architecturally without the prior approval of the Associate. Damaged construction shall be restored to its original conditions and finished to match the surrounding work. Refer to "Supplementary General Conditions" for the disposition of Cutting and Patching.

B. Grades, elevations, and dimensions shown on the drawings are approximately correct; however, field check and otherwise verify such data at the site before proceeding with work.

C. The Contractor shall be entirely responsible for apparatus, equipment, and appurtenances furnished by him or his subcontractors in connection with the work and special care shall be taken to protect parts thereof in such manner as may be necessary or as may be directed. Protection shall include covers, crating, sheds or other means to prevent dirt, grit, plaster or other foreign substances from entering the working parts of machinery or equipment. Special care shall be taken to keep open ends of pipes closed while in storage and during installation. Where equipment must be stored outside the building, it shall be totally covered and secured with heavy weatherproofing tarps and kept dry at all times. Where equipment has been subjected to moisture, it shall be removed from the site and replaced with new equipment. Protect open excavating until covered over.

D. Due to the schematic nature and small scale of the electrical drawings, it is not possible to indicate exact locations, offsets, fittings, access panels, pull boxes, and miscellaneous parts which may be required to form a complete system. The drawings are generally indicative of the work to be installed. Arrange work accordingly furnishing necessary parts and equipment as may be required to meet the various conditions and to provide a complete circuit from end use device to circuit protective device in panel.

E. Within thirty (30) days after acceptance of bids, submit to the Associate for approval, a complete list of equipment and materials to be furnished under this contract, giving names and addresses of manufacturers and material cut sheets they intend to furnish.

3.2 CLEARANCES

A. Take caution when routing conduit and location of equipment. In many cases, ceiling (plenums) clearance is limited due to ductwork and other mechanical lines, systems and structural steel. The Contractor shall be responsible for routing around mechanical equipment and ducts in order that everything can remain concealed in finished areas.

3.3 CUTTING AND PATCHING

A. Provide cutting and patching necessary to install the work specified herein. Patching shall match adjacent surfaces. Refer to Section 01731, Cutting and Patching, for specific direction.

B. No structural members shall be cut without prior approval of the Associate, and such cutting shall be done in a manner directed by the Associate.

C. Provide ceiling removal and replacement where work above finished ceilings is required. Replace ceiling components damaged in the process.

D. Provide patching where electrical devices are removed from or through walls, ceilings or floors.

3.4 PAINTING

A. Finished painting shall be performed by others except for standard factory finishes.

B. Electrical motor’s, pump casings, and other similar items shall be provided with three coats of machinery enamel at the factory, and shall be carefully cleaned, rubbed down, and oiled after installation.

3.5 LOCATIONS

A. Apply for detailed and specific information regarding the location of equipment as the final location may differ from that indicated on the drawings. Outlets, equipment or wiring improperly placed because of failure to obtain this information shall be relocated and re-installed without additional cost to the Owner. Determine the actual direction of door swings, so that local switches and other controls shall be installed at the lockside of doors, unless otherwise noted. Improperly located switches shall be relocated without additional cost to the Owner.

B. The design shall be subject to such revisions as may be necessary to overcome building obstructions. No changes shall be made in location of outlets or equipment without written consent of the associate.

C. Unless otherwise mentioned or indicated, mounting heights of outlets are shown on the drawings or in the specification. Dimensions given shall be considered to be from center of outlet to finished floor.

D. Coordinate the exact location and elevation of all electrical devices and fixtures with the architectural interior elevation plan and reflective ceiling plan prior to installation.

E. Properly rough in for the electrical conduit and equipment under this contract and modify as required for coordination during the construction period.

3.6 RECORD DRAWINGS

A. During the construction period, maintain in good order a complete set of as-built electrical contract drawings. Record the actual electrical installation as the work progresses. Include changes to the contract and to equipment sizes and types. Keep these drawings available at the site at all times for inspection.

B. Take proper caution against the use of superseded drawings. Check such copies and mark "void." Where drawings have been corrected by memorandum, assume the responsibility for marking all drawings so affected with the changes; such marked drawings shall remain in use until revised drawings are issued.

C. At the conclusion of the work, provide to the Associate a complete set of drawings which indicate precisely how the electrical system, single line, and riser diagram equipment has been installed. Return such reproducible drawings within 30 days to the Associate.

3.7 EQUIPMENT, FOUNDATIONS, SUPPORTS, PIERS AND ATTACHMENTS

A. Provide necessary foundations, supports, pads, bases and piers required for equipment specified in this division; submit drawings in accordance with Shop Drawing Submittal requirements prior to the purchase, fabrication or construction of same.

B. Provide concrete pads for base-mounted transformers and Electric Contractor provided rotating equipment and for other floor mounted electrical equipment. Pads shall be extended 6 inches beyond matching base in all directions with top edge chamfered. Inset 6 inch steel dowel rods into floors to anchor pads.

C. Construction of foundations, supports, pads, bases and piers, where mounted on the floor, shall be of the same materials and same quality of finish as the adjacent and surrounding floor material.

D. Equipment shall be securely attached to the building structure in an approved manner. Attachments shall be of a strong and durable nature and any attachments that are, in the opinion of the Associate, not strong and durable shall be replaced as directed. Reference Division 3 “Concrete”.

3.8 SCAFFOLDING

A. Furnish and erect scaffolding and ladders required in the installation of wiring, raceways, cable tray, equipment and lighting fixtures.

3.9 ENVIRONMENTAL AIR PLENUMS

A. In spaces over suspended ceilings which are used for environmental air handling purposes as defined by Article 300.22C of the National Electric Code, power, data and communications cables must be in conduit or of the type cable rated for air plenum use. This Contractor shall be responsible to clearly define ceiling space used for environmental air purposes, provide material and installations meeting installation environment.

3.10 HAZARDOUS LOCATIONS

A. In hazardous locations as defined by Article 500 of the National Electrical Code, electrical work installed in these areas shall be installed in accordance with the requirements of Article 500 whether specifically called for or not. Fixtures, fittings, and devices shall be installed according to, be rated for area of installation and meet requirements of binding code, including devices, seal offs, etc. Determine such areas as defined by the NEC and NFPA and conform to requirements of the enforcing agencies.

END OF SECTION 260500

SECTION 260510 – APPARATUS COORDINATION, INSPECTION & TESTING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements, Division 1 Specifications, apply to this Section.

1.2 DESCRIPTION

A. The intent of the inspection, testing and check-out work specified herein, or required, is to ensure that electrical workmanship and equipment is installed and performs in accordance with the design specifications, drawings, manufacturer's instructions and applicable codes and requirements. Also, it is intended to provide, ensure, or determine the following.

1. If the equipment or installation has been subjected to damage during shipment or installation.
2. If the equipment is in accordance with the purchase orders and Contract Documents.
3. Provide initial acceptance tests and recorded data that can be used as a bench mark for future routine maintenance and trouble shooting.
4. Ensure a successful start-up with a minimum of last minute interruptions and problems.
5. Determine the suitability of the equipment and systems for energization and placing into operating service.
6. Provide assurance that each system component is not only installed satisfactorily but performs and shall continue to perform its function in the system with reasonable reliability throughout the life of the system.

B. Provide necessary supervision, labor, materials, tools, test instruments or other equipment or services and expenses required to inspect, test, adjust, set, calibrate, functionally and operationally check work and components of the various electrical systems and circuitry throughout the installation. Include the furnishing of sufficient personnel to assist operating forces in any additional checks that may be required for acceptance, start-up, run-in and placing the equipment and systems into continuous service.

C. As specified herein, electrical equipment and systems shall be tested and adjusted in accordance with current NETA testing specifications. It will be acceptable for the testing of low-voltage systems such as fire alarm systems, security and access control systems to be performed by the equipment manufacturer.

D. Contractor provided inspections and tests of the facilities, in accordance with recognized standards, in no way relieves the Contractor of the responsibility for the performance of varied tests, check-outs, and inspections required during the various stages of construction. Nor does it relieve or shift responsibility for the guarantee outlined in this specification. The Contractor must allow for corrective action to resolve failing items while meeting project schedule.

E. The listings and descriptions of the inspections, tests and checks described herein shall not be considered as complete and all-inclusive. Additional normal standard construction (and sometimes repetitive) checks and tests shall be necessary throughout the job, prior to final acceptance by Owner.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS FOR INSPECTION, TESTING AND START-UP

A. Obtain all inspections required by all laws, ordinances, rules, regulations or public authority having jurisdiction and obtain certificates of such inspections and submit same to Associate and Owner. Pay all fees, charges and other expenses in connection therein.

B. When the Associate and Owners Representative makes final inspection of all electrical work, tests will be ordered as deemed necessary. This Contractor shall provide such assistance as required (including manpower and tools) to start and stop the various systems. This Contractor (not Owner or its representatives) is responsible to turn on the systems and demonstrate they are operating properly including any programming or final adjustments.

C. Prepare proposed procedures and schedules for inspections, test, settings and calibrations specified or otherwise required prior to or during the checkout for start-up and acceptance of the electrical components, equipment and systems. This work shall be coordinated and shall be compatible with both the work of other crafts and the project schedule. The above must be organized and submitted with proposed testing and check out forms for the review and approval of the Owner’s representative. The procedures must provide specific instructions for the checking and testing of each component in addition to the system functional checks. Tests and inspections shall also be scheduled as the job progresses and may require repetition in greater detail at a later stage of construction. Procedures submitted shall include job safety rules proposed.

D. Equipment purchased by the Contractor or purchased by Owner for installation shall be inspected and tested to determine its condition. See other applicable sections of the specifications and contract documents for required checks and responsibilities.

E. At any stage of construction and when observed, any electrical equipment or system determined to be damaged, faulty, or requiring repairs shall be reported. Corrective action may require prior approval.

F. Electrical power distribution equipment and systems shall be tested in accordance with the current edition of NETA Standard's acceptance testing specification.

G. Check the continuity of all circuits to ground before they are energized. The phase wires and neutral wires shall be checked for continuity prior to the last connection

made. Feeders shall be meggered for insulation abrasions in accordance to NETA testing specifications.

3.2 TESTS TO BE PERFORMED

A. The following electrical equipment and systems shall be tested in accordance with the current edition of the NETA Acceptance Testing Specifications:

1. Switchgear and switchboard assemblies.
2. Medium and high voltage cable (over 600 volts).
3. Transformers in excess of 32 kVA.
4. Metering and instrumentation.
5. Grounding system.
6. Ground fault systems in switchgear, ground fault breakers and ground fault receptacles.
7. Motors in excess of 0.5 HP and related control systems.
8. Surge arresters.
9. Emergency systems such as egress lighting including transfer to emergency power.
10. Feeders and distribution equipment including panelboards.
11. Panel Load balancing.
12. Insulation resistance, grounding resistance, and ground continuity tests of feeders, branch circuits and equipment.

B. The fire alarm system shall be tested in accordance with NFPA-72.

C. The following low-voltage equipment and systems shall be tested in accordance with the manufacturer's recommendations. As a minimum, each and every device shall be tested for full functionality and interconnectivity.

1. Security systems.
2. Fire alarm systems.
3. Access control systems.

D. Telecommunication systems including voice, data, video and fiber optic cables shall be tested in accordance with the current edition of the NETA Acceptance Testing Specifications.

3.3 DOCUMENTATION OF TEST RESULTS

A. All personnel engaged in performing the above tests shall provide a signed legible letter verifying successful operation of the system(s). Attached to this letter shall be a copy of the document outlined in paragraph 3.1 with a check indicating tests performed by this individual.

B. Any measured test data shall also be attached for future reference by the school district.

END OF SECTION 260510

SECTION 260512 – ELECTRICAL POWERED EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION

A. This section of the specifications describes the principal electrical work related to the installation, connection, and control of electrical powered equipment furnished under other divisions. Should examination of related effort indicate discrepancies or omissions, request clarification prior to bidding, performing or omitting any required work.

B. Examine Contract documents and other divisions of these specifications to ascertain the extent of powered equipment covered by the drawings and specifications and the method by which each item of equipment shall be furnished, delivered to the site, installed, and the amount of electrical work which shall be included with the powered equipment. Verify the voltage and frequency requirements of electrical equipment as it is delivered to the site. If voltage and frequency are not compatible with the building electrical system, immediately inform the Associate in writing. Particular attention is called to the following items:

1. Mechanical equipment
2. Specialized equipment
3. Owner furnished equipment
4. Elevator

C. Definition:

1. Wiring: Contactors, conduit, enclosures, connections, labor and miscellaneous material required to supply power to powered equipment and associated controls for proper operation.

D. Motor Installation and Connections: utility motors such as fans, pumps, etc., are furnished under applicable sections of specifications. Those not provided as an integral part of the mechanical equipment, shall be delivered to this contractor at the point of installation. Receive these motors, handle, store (if required), and provide power wiring, including a phasing rotation check for applicable motors. Connect each motor to a separate branch circuit, feeder and include disconnecting means except where noted. Terminate conduit to motors in final connection with Liquidtight flexible conduit. Equipment frames shall be bonded per National Electrical Code.

E. Control Devices and Wiring: Control devices (such as pressure switches, floats, electrodes, P.E. switches, E.P. switches, relays, thermostats, etc.), prewired in packaged type equipment and/or control panels shall be provided by the appropriate contractor. Provide required interlocking control, time delay relays, control

transformers, break-glass stations, remote pushbuttons required to perform functions indicated within Contract documents including requirements of local authorities.

F. Verify motor rotation for equipment before it is turned over to other Contractors or Owner.

G. Furnishing and installation of control devices, control panels, and control wiring for HVAC equipment shall be provided under Division 23.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Refer to other related sections of Division 23 for applicable materials. Particular attention is called to the following sections:

1. Section 262813, Fuses
2. Section 262913.03 Manual and Magnetic Motor Controllers
3. Division 01 Section “Sustainable Design Requirements – LEED for Schools”.
4. Division 01 Section “General Commissioning Requirements”.
5. Division 01 Section “Construction Waste Management and Disposal”.

PART 3 - EXECUTION

3.1 ELECTRICAL WORK FOR MECHANICAL EQUIPMENT

A. Motors and Motor Controls: Pre-wired packaged type equipment, control devices, control panels and alarm panels for Mechanical Work, shall be furnished and installed under other sections of the specifications and wired under this section of the specifications, except as otherwise noted. Control devices which have piping connections shall be installed under other sections of the specifications. Where wall space is not available, provide suitable primed and painted angle iron framework supports for mounting of starters and controls. Power wiring shall be provided to motors, starters, variable frequency drives, consoles, and each refrigeration machine, electric boilers, and auxiliaries. Perform required adjustments, wiring modifications, in conjunction with any testing and operational system start-up procedures. In general, starters, disconnects, switches and fuses shall be furnished under Division 23 and wired under this division.

B. Responsibility: Electrical work specified in Division 23 as "by the Contractor" is an obligation of this contractor, the same as if specified herein.

1. Electric Heaters (Plumbing or HVAC): electric heaters are furnished under other Sections. Provide power wiring at heaters. Thermostats for heaters furnished under other sections.
2. Control Wiring for HVAC Systems: control wiring of HVAC equipment shall be under Division 23 unless noted otherwise.

END OF SECTION 260512

SECTION 260519 – ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements, Division 1 Specifications, apply to this Section.

B. Related Sections:

1. Division 01 Section “Construction Waste Management and Disposal”.

1.2 DESCRIPTION

A. Provide all wires and cables in accordance with the Contract Documents for service, feeders, branch circuits, lighting, systems, egress, control wiring and telecommunications.

B. This section includes cable requirements for systems below 600 volt insulation.

C. Conductors shall be soft drawn stranded copper having conductivity not less than 98 percent.

D. Aluminum conductors type XHWN #1AWG or greater are permitted only on service conductors or feeders to distribution equipment or panelboards otherwise indicated or directed within Contract Documents. Splicing of distribution or a feeder circuit is prohibited. Aluminum conductors for branch circuits which feeds lighting or receptacles is not allowed.

E. All wiring and cables shall be installed in raceway unless otherwise noted.

F. Conductors shall be insulated for minimum of 600 volts. Motor conductors (T-leads) controlled by variable frequency drives shall have a minimum rating of 1000 volts for voltages over 240v.

G. All conductors shall be U.L. labeled and installed in accordance to the NEC.

H. Insulation types are the type referenced in NEC.

PART 2 - PRODUCTS

2.1 600 VOLT WIRE OR LESS

A. Conductors shall be “UL” approved stranded copper with a minimum insulating rating of 600v.

B. Manufacturers:

1. Southwire Company
2. General Cable Corporation
3. American Insulated Wire Corporation
4. Approved Equal.

C. Type of conductor insulation for general use shall be as follows, subject to limitation listed:

1. Type THW – no restrictions
2. Type THHN/THWN – restrictions as follows:

   a. Do not use for conductors in/under slab.
   b. Do not use in wet locations.

3. Type XHHW – no restrictions.
4. Fixture wiring shall be single conductor, 600 volt, 200˚C, Type SF-2, stranded silicone rubber insulation with overall glass braid.

   a. Wiring routed within ballast trough shall be high ambient wire: single conductor, 600 volt, 125˚C minimum, Type SA stranded silicone rubber insulation with overall glass braid.

5. Fire alarm cable: EC to provide all power and signal circuits for the fire alarm system. Wire and cable requirements must meet NEC and that of fire alarm system Manufacturer. Refer to Specification 28 31 00 for cable types and usage.

2.2 TYPE MC CONDUCTOR CABLE

A. MC conductor cable usage is only approved for connections to ceiling grid mounted light fixtures (from overhead powered junction boxes). MC cable shall be constructed with insulated phase(s), neutral and one full size green conductors. Branch circuit type MC cable (14-6 AWG) shall use copper conductors. All MC conductors shall be type THHN/THWN-2 600v stranded.

B. Manufacturers:

1. AFC Cable System
2. General Cable
3. Alcan Cable
4. Southwire
5. Approved equal

2.3 PLENUM CONDUCTOR CABLE

A. Plenum conductor cable may be used for NEC Class 2 or 3 wiring if conductor cable is UL listed in accordance with UL 910 and UL 1820 and is installed in accordance with the NEC and is acceptable to the Authority having jurisdiction. Insulation types, UL listing, and written acceptance by the local authority shall be submitted for review.

B. Installation of cables shall be installed in a neat and workmanship like manner. Cables shall be supported conforming to the requirements of the latest edition of National Electrical Code and Electronics Industries Association and Telecommunications Industries Association.

2.4 CONNECTORS & LUGS

A. See Specification 262730 “Taps, Splices & Terminations”

2.5 ADJUSTABLE FREQUENCY DRIVES (AFD/VFD)

A. Motor Conductors for voltages greater than 240v and length exceeding 45ft from AFD/VFD:

1. Cable characteristics:

a. As recommended by AFD manufacturer and meet minimum requirements: UL standard 44, 1277, MSHA & TC-ER approved, 600-1000 volt rated, 90˚C, XLPE insulation with copper tape shield with symmetrical grounds. Wire gage sized per NFPA 70-460.6(A).

b. Manufacturer:

1) LAPPUSA Olflex VFD Symmetrical
2) SAB Associated Wire Products (SAB North America)
3) Belden - Large VFD Symmetrical Design
4) Approved equal

2. Bending radius: Contractor shall provide means of maintaining motor conductor minimum bending radius throughout protective raceway, pull boxes and terminations.

2.6 MOTOR TERMINATIONS

A. Motor branch conductors larger than #10 AWG shall be connected to the factory motor leads with compression type connector. Field wiring and factory wiring shall be terminated with individuals crimp type, single indent terminal lugs. Crimp connections shall be sized fro the connecting wires, type and construction. Individual connections shall be joined through bolting with a combination of bolt, nut, flat and locking washer.

B. Conductive motor terminals shall be insulated and sealed with factory engineered motor connection kits. Connection kits shall be rated for voltage, insulation class and dielectric strength. Connection kits shall be rated for 90˚C continuous conductor operation. Motor connection kits shall be equal to type RVC or MCK as manufactured by Raychem Corporation or equal by 3M or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide circuit wiring complete as shown as called for within Contract documents, and as hereinafter specified or required. The minimum size of wire for branch circuits shall be No. 12, except 120 volt circuits over 100 feet in length shall be No. 10; 120 volt circuits over 150 feet in length shall be No. 8. Wiring shall be increased in size if so demanded by wattage of load.

B. Voltage drop calculations shall be performed by the contractor. Conductors sized shall be increased where branch circuit calculations result in a voltage drop greater than 3%.

C. 600 volt wiring shall be color coded. Consistent phase identification of wires from service feeders to branch circuit wires shall be maintained as follows:

1. 120/208 volts - Normal - Phase A..... Black
2. 120/208 volts - Normal - Phase B..... Red
3. 120/208 volts - Normal - Phase C ..... Blue
4. 120/208 volts - Neutral ..... White
5. 120/208 volt - Ground Wire ..... Green
6. 277/480 volt - Phase A ..... Brown
7. 277/480 volt - Phase B ..... Orange
8. 277/480 volt - Phase C ..... Yellow
9. 277/480 volt - Neutral ..... Grey

D. Fire alarm wiring or cable color coding shall be RED or per manufacturer's recommendation.

E. Labeling: Contractor shall identify each termination via a permanent printed type "Brady" wire marker as noted.

F. Do not pull wires into raceways until raceways are permanently in place, thoroughly clean, and termination points are not subject to damage. Usage of pulling lubricants shall be applied sparingly.

G. Do not use uninsulated wire conductors.

H. Provide excess free conductor end length at termination points, adequate to make up splices and terminations, permitting neatly training conductors, and in any case not less than:

1. No. 14 through 10 AWG - 8 inches
2. No. 8 or 6 AWG - 12 inches
3. Larger than No. 6 AWG - 18 inches

I. Support vertical cables as required by Code. Use lock type cable support bushings having internal wedges and retaining collars. Locate support points in readily accessible pull boxes sized to code requirements.

J. Control circuit wiring in cabinets, panels, pull boxes, etc., shall be tied, bundled and held with Thomas & Betts Nylon Self-Locking Ty-Raps, or approved equal.

K. Large equipment pull, junction or terminal boxes shall contain suitable racks to support, arrange, and retain wire and cable in an orderly manner.

L. Equipment conductors smaller than No. 4 AWG, in wireways, gutters, pull boxes, terminations, etc., shall be identified with wire markers. Designate panel and circuit number on each individual marker.

M. Feeder or equipment conductors No. 4 AWG or larger, shall be individually identified with metal, fiber or fireproof linen tags or with wrap around markers. Designate panel circuit number on each individual marker. In addition, designate use of each set of conductors on a common tag or on each individual conductor marker. Tagging shall include panel source and feeder size of equipment supply.

N. Switchboard and distribution panelboards with ratings greater than 10,000 RMS symmetrical amperes shall have supply cables braced in accordance with board manufacturer bracing requirements where such panels are approved for bracing.

1. Wrapping of cables: Wrap line cables together with nominal 3/8-inch nylon rope or rope having a minimum tensile strength of 2000 pounds at 6 inches and 12 inches from the line terminals with minimum of five non-spaced wraps.
2. For electrical equipment that is not clearly marked as to whether or not cable bracing is required, contact the Manufacturer's representative.

O. Where the single pole work is used on branch circuits, circuit wiring shall have a dedicated neutral conductor. Do not gang or share neutrals. The Contract documents are schematic and diagrammatic and indicate the general method of installing circuit wiring and the outlets which are to be supplied.

P. Lighting and convenience outlet circuiting are indicated on the Contract documents separately as single pole work for clarity; however, the Contractor shall provide a minimum of 20 percent spare future capacity in each raceway.

Q. All branch circuits shall have a dedicated neutral conductor. Sharing neutrals is not permitted.

R. The minimum sizes of wire on an installation shall be as follows:

Emergency and Exit Circuits	10 AWG
Lighting and Power Circuits	12 AWG
Signal Circuits - with common or individual leads	14 AWG
Remote Control Leads	As recommended by manufacturer
Low Voltage Light Control, Communication,	Twisted Pair, Shielded or as recommended by manufacturer
Data, and Fire Alarm Systems	Shielded or recommended by manufacturer
Fixtures	14 AWG Min. SF-2 and as required by Underwriters Laboratories and National Electrical Code

S. Install in each empty interior conduit, one nylon measuring fish line for the future installation of wire or cables.

T. Great care shall be exercised in pulling wires into the conduits so as not to injure the insulation. Only UL approved lubricants shall be used to assist in the pulling in of wires with an outer covering or braid.

U. Where switch boxes are used as the termination of the "home runs" in addition to the switch legs, not less than a two-gang box shall be used.

V. The size and general location of the various feeders or branch circuits are approximately shown. However, the contractor shall determine and coordinate the exact location and routing at the site.

W. Seal around conduits penetrating fire-rated elements according to Division 7, Section "Through-Penetration Firestop Systems".

X. Communications, sound, dimming, fire alarm, data and other low voltage wiring shall be of size by the manufacturer of the equipment being served and cable type as required by the National Electrical Code.

Y. Branch circuits to be connected as numbered within Contract documents. Prior to energizing, test cable and wire for continuity of circuitry, and also for short circuits. Correct malfunctions when detected.

Z. In every pull or splice box and all other places where wires and cables may not be readily identified by nameplate on the equipment to which they connect, each circuit shall be identified with a permanent identification tag securely fastened to the conductors.

END OF SECTION 260519

SECTION 260526 – GROUNDING & BONDING FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements and Division 1 Specification Sections, apply to this Section.

B. Related Sections:

1. Division 01 Section “Construction Waste Management and Disposal”.

1.2 QUALITY ASSURANCE

A. NFPA 70 - National Electrical Code

B. UL 467

C. Bare solid copper conductors ASTM B3.

D. Bare stranded copper conductors ASTM B8.

E. Underground distribution components IEEE C2.

1.3 PERFORMANCES

A. Conduit is not an allowable grounding means.

B. Continuous grounding conductor carried throughout the power system.

C. Grounding of voice, video and data systems.

D. Provide grounding of circuits, equipment, conduits and etc. as required by the NEC.

1.4 DESCRIPTION

A. Provide all system equipment and static grounding in accordance with the Contract Documents and in full compliance with the lasted edition of National Electrical Code, and the Authority having jurisdiction. Grounding requirements specified in this section may be supplemented by special requirements of systems described in other sections such as Section 27 10 00 “CABLE”.

B. Ground every device and metal part of the electrical system including all enclosures, fixtures, boxes, feeders and branch circuits over 40 volts shall include a copper grounding conductor sized in accordance with NEC Table 250.122 except not smaller than #12 for power and lighting circuits and #14 for control circuits.

1. All equipment ground conductors shall have green colored insulation.
2. Isolated ground conductors shall have green colored insulation with yellow stripe.
3. Feeders to have alternating, three (3) green and two (2) yellow bands of tape.

C. Maintain continuity of system and equipment grounds throughout the electrical installation unless specifically shown otherwise. Provide ground bushings and jumpers where normal metallic ground paths are interrupted or unreliable.

D. Grounding shall be accomplished by means required by NEC and generally outlined in the subsequent paragraphs.

E. Grounding shall be connected to the water feed service pipe such as water heater and piping systems likely to become energized. Install a separate equipment grounding conductor to each electric water heater or heat-tracing system complying with manufacturer's installation specifications. Bond conductor to heater units, piping, connected equipment and relevant components.

F. All electrical equipment, cabinets, boxes, conduit, metal fixture poles and metal raceways shall be grounded in accordance with the NEC and as specified herein.

G. All connections to apparatus and conduits shall be made with an approved UL type of bolted or compression connector. Connectors shall be securely fastened to the equipment. All contact surfaces shall be thoroughly cleaned and bright before connections are made in order to insure a good metal-to-metal contact.

H. All underground ground cable splicing or connections shall be exothermic welded.

I. Tie all grounding systems together at their origins and as called for by the NEC or authority of jurisdiction.

J. A solid ground shall be provided for the complete conduit system, feeder neutrals, motor frameworks, transformer cases, neutral of 480 volt and 208 volt building services, heating equipment enclosures, telecommunications and other items as required.

1.5 GROUNDING SYSTEM

A. Grounding electrodes shall be installed and interconnected according to NEC Article 250.50.

1. Bond water supply piping system in accordance with NEC Article 250.52
2. Per NEC Article 250.52(A)(3), provide a concrete-encased foundation electrode and bond to other electrodes per NEC.
3. Provide building ground ring with connections to structural steel columns in accordance to NEC Article 250.52(A)(4) at locations as shown within Contract documents. Steel columns shall be connected to the grounding electrode system with bare stranded copper where shown on contract documents or required by NEC or Authority having jurisdiction. Size bonding conductor in accordance to NEC Article 250. Connections to steel columns shall be made above grade using exothermic connection within web of column.

B. Provide insulated copper grounding conductors in conduit for metal water service pipe from building's main service equipment, or grounding bus, to main metal water service entrance. Connect grounding conductors to main metal water service pipes by approved grounding connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

C. Where installed, vertical drops from the lightning protection loops shall be connected at points located on the lightning protection plan(s). Drops shall connect first to a driven ground rod outside building then to ground loop.

D. Individual grounding risers for power, data/communications, security, and fire alarm closets shall be of wire type and sized as required by manufacturer or as specified elsewhere in specifications. Telecommunication bus bar shall be provided by this contractor and installed per BiCSi and EIA/TIA standards.

E. Where any ground conductor required protection from physical damage, route conductor through a non-ferrous conduit or a steel conduit that's bonded at both ends.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Ground conductors shall be of size indicated or required by code.

B. Ground rods shall be copper-clad steel, 3/4 inch diameter and 10 feet long.

C. Connectors shall be as manufactured by Burndy, O.Z. Gedney, or Erico.

D. Exothermic welding shall be Erico, Burndy, or O.Z. Gedney.

E. Accessible connections shall be made with multiple bolt silicon bronze connectors specifically designed and approved for the connection to be made.

F. Lighting fixtures shall be grounded by the use of a manufacture-supplied ground lug or pigtail or by the use of manufacture approved ground connection.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The neutral wire for the electrical system shall not be used to ground miscellaneous conduits.

B. Ground wires required by the National Electrical Code shall be installed.

C. The resistance between the grounding system and absolute earth shall not exceed values as specified and shall be measured in the presence of the Owner's representative.

D. The equipment grounding terminal bars of the normal and emergency electrical system panel boards shall be bonded together with an insulated continuous copper bonding jumper not smaller than No. 6 copper or otherwise shown within Contract documents.

E. Steel columns shall be bonded per NEC requirements.

F. Electrically continuous metal raceway system shall not be used as the primary grounding or bonding conductor. A separate continuous grounding conductor shall be carried throughout the raceway system.

3.2 EQUIPMENT GROUNDING

A. Conduit system shall be electrically continuous. All locknuts shall cut through enameled or painted surfaces on enclosures. Where enclosures and non-current carrying metals are isolated from the conduit system, use bonding jumpers with approved clamps. Where reducing washers are used and where concentric or eccentric knockouts are not completely removed, bonding bushings shall be required. Conduit crossing building expansion joints shall have provision for maintaining ground continuity.

B. Cable shielding, metallic conduits, wireways, cable boxes, electrical equipment housings and all noncurrent carrying metallic parts shall be grounded. Run a separate ground wire to all equipment.

C. All conduit stub-ups shall be grounded and where multiple stub-ups are made within an equipment enclosure, such as a switchboard, conduits shall be equipped with grounding bushings and bonded together and to the enclosure ground bus.

D. Provide bonding devices, fittings or jumpers at expansion fitting, isolation sections or wherever continuity of ground is broken.

E. Install all grounding conductors with sufficient slack, to avoid breaking due to settlement or movement of conductors or attached points. Installation of bonding straps or jumpers shall be provided for vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

F. Motors shall be grounded by means of a grounding conductor located in the same raceway with the motor feeder connected to a grounding bushing at the motor terminal box and the ground bus from source of power or to the incoming conduit grounding bushing of an individually mounted motor starter.

G. Where flexible medal conduit is used for all or part of a conduit run, except lighting branch circuits, a grounding conductor shall be provided in the conduit and connected to grounding bushings at each end of the run.

H. Usage of steel core Liquid-Tight conduit shall have an exterior spiral wrapped green THHN bonding conductor terminating to external type grounding fittings using a minimum green #10 copper conductor.

I. Under no circumstances shall a neutral conductor or neutral bar in an enclosure be used for grounding purposes.

3.3 FEEDER GROUNDING

A. Run a separate insulated ground for feeders.

B. Size grounds in accordance with the NEC or as noted within Contract documents whichever is more stringent.

3.4 FIELD QUALITY CONTROL

A. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.

B. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two (2) full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 8l.

C. Provide to Architect of record plan drawings locating each ground rod and ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

   1. Equipment Rated 500 kVA and Less: 10 ohms.
   2. Equipment Rated 500 to 1000 kVA: 5 ohms.
   3. Equipment Rated More Than 1000 kVA: 3 ohms.
   4. Substations and Pad-Mounted Switching Equipment: 5 ohms

D. Excessive Ground Resistance: If resistance to ground exceeds specified values, suitable and approved methods to reduce ground resistance shall be provided by this contractor.

END OF SECTION 260526

SECTION 260529 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements and Division 1 Specification Sections, apply to this Section.

B. Related Sections:

1. Division 01 Section “Construction Waste Management and Disposal”.
2. Division 7, section “Spray Fire-resistive Material” for coordination of all hangers or applicable supports.

1.2 DESCRIPTION

A. Provide products to suspend, attach, support and otherwise retain in location, electrical work.

1. The specified requirements herein include support and hardware information of a general nature. Where additional requirements are stated elsewhere in the specification related to specific products and conditions, such additional requirements shall supersede these general specifications.

B. Approvals: Obtain approval before cutting, drilling, or welding to, structural members. Where cutting, drilling, or welding is permitted, this work, as required for product support, is a part of product installation electrical work.

C. Welding: Use certified welders for welded installation. Steel in weld area shall be cleaned before and after welding operations, and refinished after welding.

1. Do not weld raceway pipe straps to structure.

2. Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.3 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 MATERIALS

A. Use expansion shield anchors or toggle bolts of the following manufacturers:

1. Phillips Drill Company, Inc. "Red Head Self Drilling"
2. Rawl Products Company "Saber Tooth"
3. McCulloch Industries "Kwik Bolt"

B. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Cooper B-Line, Inc.; a division of Cooper Industries.
   b. Thomas & Betts Corporation.
   c. Unistrut; Tyco International, Ltd.
2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
5. Channel Dimensions: Selected for applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Cooper B-Line, Inc.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head

5) MKT Fastening, LLC.

3. Mechanical Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4

inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.

6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Division 09 Section "High-Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 INSTALLATION

A. Provide common support trapezes for parallel raceways.

B. Use manufactured preformed U-Channel system having accessory connecting and clamping devices available where parallel raceways are to be supported. Load channel system not to exceed manufacturer's recommendation.

C. Fabricate supports for transformers, panel boards, cable tray, lighting fixtures, cabinets, pull and junction loads, and similar electrical products from preformed U-Channel systems. Load on channel system not to exceed manufacturer's recommendations.

D. Support panelboards, disconnect switches, telecommunications, equipment, security, fire alarm panels, grounding bars and all other wall mount electrical equipment via ¾” primed and fire treated plywood. Electrical equipment shall be mounted on said plywood in computer, telecommunication or electric rooms unless noted otherwise.

E. Use preformed U-Channel concrete inserts preset into forms to secure hangers suspended from slabs.

F. Use concrete expansion shield anchors or preformed U-Channel cast-in-place concrete inserts for attaching electrical products to concrete walls.

G. Support loads from stud anchors or concrete inserts at not to exceed manufacturer's live loading recommendations.

H. Do not use powder-charge driven fasteners. This includes anchors which are driven into place by any device which produces and impact force by use of compressed air, gas or any other propellant.

I. Do not drill holes or install driven fasteners in concrete at less than 12 inches from prestressed steel.

J. Do not use nylon or similar concrete inserts without prior approval, except for supporting 1 inch or smaller individual runs of conduit or tubing.

K. Use toggle bolts to attach supports for electrical products to hollow masonry walls. Do not attach products weighing more than 50 pounds to hollow masonry walls, without prior approval.

END OF SECTION 260529

SECTION 260533 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements, Division 1 Specifications, apply to this Section.

B. Related Sections:

1. Division 01 Section “Construction Waste Management and Disposal”.

1.2 DESCRIPTION

A. Provide concealed or surface mount raceway as required to complete work indicated on the Contract Documents. Installed raceways shall be plumb and level. Raceways and backboxes shall be provided for Technology, Fire Alarm, Security and Other Trades in non-residential spaces.

1. Raceways and backboxes shall be “RED” in color for all fire alarm related wiring.
2. Raceways and backboxes shall be “YELLOW” in color for all emergency circuits derived from emergency panelboards as noted within Contract documents.

B. All wiring shall be in conduit unless otherwise noted. Conduit shall be concealed in finished areas and may be exposed in unfinished areas such as mechanical and electrical areas. Conduit runs shall be continuous from outlet to outlet, fitting, pull or junction box, to cabinet or panel; and shall be mechanically secured electrically continuous.

C. Minimum conduit size is 1/2”. Where required, maximum lengths of 3 feet of ½” flexible conduit may be used for connecting instruments, sensors or associated control components.

D. Provide outlet boxes in the raceway systems wherever required for pulling wires and cables, making connections, mounting devices, lighting fixtures, controls or connecting miscellaneous equipment. Boxes installed shall be level and flushed mounted within wall cavities/partitions for wall mount devices as noted on plans.

E. Certain backboxes for the fire alarm systems shall be supplied by the respective equipment suppliers. Any boxes required for the respective systems and not furnished by the respective equipment suppliers shall be furnished and installed. It is this Contractor's responsibility to determine what boxes are and are not furnished by the respective equipment suppliers.

F. EC to provide all backboxes for Mechanical, HVAC and Plumbing equipment power and/or control devices.

G. Provide plaster rings as required in gypsum board partitions.

H. Coordinate box sizes with other equipment supplier as required.

I. All boxes associated with plastic conduits shall be PVC boxes with cast aluminum covers, complying with NEMA OS2.

J. Unless otherwise noted, backboxes for telecommunication, technology and security devices shall have extra deep capacity with a minimum size of 4”x4”.

1.3 GENERAL

A. Wherever the terms "conduit" or "raceway" appear hereinafter it shall be understood to mean any one, or combination of, the following type:

1. Rigid Metal Conduit / Intermediate Metal Conduit - RMC ANSI C80.1, IMC ANSI C 80.6
2. Electrical Metallic Tubing - ANSI C 80.3
3. Flexible Metallic Conduit
4. Square Steel Raceway Duct
5. Liquid Tight Flexible Conduit with External Wrap Ground Wire - UL 360
6. Surface Mounted Raceway
7. Metal Duct Wireway
8. Intermediate Steel Conduit
9. PVC Coated Rigid Metal Conduit
10. Rigid Non-Metallic Conduit (PVC)

B. The contractor shall precisely record location of all feeders on legible submitted “As Built” plans at end of project.

C. Conduits shall not be supported by wire ties. All components including backboxes, pull boxes, panels and the like shall be independently supported from raceway.

D. Backboxes shall be suitably sized for device mounting, splicing and contain required volume for entering conductors.

E. Cuts made to metallic supports, equipment or field made conduit threads shall be sprayed with "cold-galvanize" or equivalent rust protection prior to assembly. Contractor shall not leave untreated metal exposed to weather.

1.4 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. Maintain required safe working clearances and required dedicated equipment space as defined by the latest edition of National Electrical Code.
2. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
3. To provide for ease of disconnecting the equipment with minimum interference to other installations.
4. To allow right of way for piping and conduit installed at required slope.
5. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

C. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping.

E. Coordinate backbox requirements for technology and telecommunication devices as specified in Division 27.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Rigid Metal Conduit / Intermediate Metal Conduit

1. Smooth surfaced heavy/thin wall mild steel tube, of uniform thickness and temper, reamed and machine threaded at each end and protected inside and out with galvanizing, sherardizing, or equivalent process. Rigid Metal Conduit shall comply with Article 344 of NEC and Intermediate Metal Conduit shall comply with Article 342 of NEC.
2. Non permitted usage:
   a. Hazardous or corrosive environments.

B. Electrical Metallic Tubing (EMT)

1. Smooth surface, thin wall, mild steel tube, of uniform thickness and temper, galvanized or sherardized on the outside, and enameled on the interior. EMT shall comply with Article 358 of NEC.

2. Non permitted usage:
   a. Poured concrete.
   b. Exposed to weather.
   c. Underground.
   d. Exposed in mechanical or similar equipment rooms below 8ft from finish floor.
   e. Hazardous or corrosive atmosphere.

C. Flexible Metallic Conduit

1. Interlocking single strip, steel construction, galvanized inside and out, after fabrication. Conduit shall comply with Article 348 of NEC.
2. Allowed usage:
   a. Connection to lighting fixtures not over 3 feet in length.
   b. Narrow movable partitions where other raceways are not practical, when approved by Owner’s representative.

D. Steel Square Raceway Duct

1. Square raceway duct shall be 4 x 4 inch minimum or sized as shown on plan. Duct shall be primed and finished gray baked enamel. Duct shall conform to Federal Specifications and have a hinged access cover on one side. Properly support from building. Complete with all necessary fittings.

E. Liquid Tight Flexible Conduit With Exterior Spiral Wound Ground Wire

1. Raceway with a circular cross-section having an outer liquid tight, non-metallic, sunlight-resistant jacket over an inner flexible metal core. Conduit shall comply with Article 350 of NEC.

2. Allowed usage:
    a. Connection to motors, controllers or panels located on dynamic equipment and transformers. All motor connections shall be water and dust tight with grounding lug fittings approved for wet location usage. Maximum length: 3 feet.

F. Surface Mounted Raceway (SMR)
1. Surface mounted raceways shall be used only where indicated within Contract documents with sizes required by the National Electrical Code. Raceways shall be totally enclosed and shall be complete with sectional barriers, connectors, fittings, bridges, couplings, conduit adapters, clips, hangers, transition fittings and required device plates for a complete installation.
2. Surface mounted raceways shall be of one manufacture with finish and construction type as noted.
3. Any unused openings to be closed by the Contractor with blank faceplates.
4. Raceways shall be installed in a neat and symmetrical manner. Feeds to raceways shall be concealed in walls, unless prohibited by wall construction. Installation shall comply with Article 378 of NEC.

G. Metal Duct Wireways
1. Wireways shall be used only where indicated with usage for mounting groups of switches and/or starters. Wireways shall be the standard manufactured product of a company regularly producing wireway and shall not be a local/remote shop-assembled/fabricated unit.
2. Wireways shall be of screw or hinged-cover types, UL listed, and of sizes indicated or otherwise required by the NEC. Finish shall be light-gray enamel over rust inhibitor.
3. Wireways installed in interior spaces shall be NEMA 12 or 3R if installed in an exterior environment.
4. Wireways shall be routed, provided with all necessary components and sized by the Contractor to accommodate all cables and wires per NEC.

H. Intermediate Steel Conduit
1. Smooth surface, intermediate wall, mild steel tube, of uniform thickness and temper, threaded at each end, and protected inside and out with galvanizing or equivalent process. Conduit shall comply with Article 342 of NEC.
2. Non permitted usage:
    a. Hazardous or corrosive environments.

I. Rigid Non-Metallic Conduit (PVC)
1. Rigid non-metallic conduit shall be designed for installation below ground and with or without concrete encasement. Rigid non-metallic conduit shall comply with Article 352 of the NEC.
2. Limited usage:
    a. In or under concrete slabs on grade.
    b. Exterior use when encased in 3 inch concrete except as noted in project electrical details.

J. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

K. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

L. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).

b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

M. Outlet boxes specified herein refer generally to cast or pressed steel boxes of less than 50 cubic inch internal volume per gang. Refer to "Junction and Pull Boxes" for larger box specifications.

N. Outlet boxes where exposed to water or weather shall be approved for this use and shall be made of cast iron.

O. All exterior outlet boxes shall be watertight and dust tight with hinged gasketed covers similar to Thomas & Betts “WTD” Series, Crouse-Hinds or TayMac for two (2) GFCI outlets with integral lock and shall be cast aluminum and threaded for rigid conduit similar to Thomas & Betts “LT” Series. There must be a gasket between the enclosure and the mounting surface and between the hinge cover and the mounting base plate. Enclosure shall be marked “UL listed” and “Suitable for wet locations while in use”.

2.2 ACCEPTABLE MANUFACTURERS

A. Rigid Metal Conduit: O-Z/Gedney, Wheatland Tube, Allied Tube and Conduit.

B. Intermediate Steel Conduit:, O-Z/Gedney, Wheatland Tube, Allied Tube and Conduit.

C. Electrical Metallic Tubing: O-Z/Gedney, Wheatland Tube, Allied Tube and Conduit. Steel compression type only, concrete tight with non-insulated throat.

D. Flexible Metallic Conduit: ACME, International, Electri-Flex

E. Flexible Conduit, Liquid Tight: Anaconda "Sealtight," National Electric, Coleman Cable and Wire Company.

F. Steel Square Raceway Duct: Square D, Hoffman Engineering Company, Cooper B-Line.

G. Surface Mounted Raceway: Wiremold v700 series or dual channel non-metallic 5400 series, “white” (unless noted otherwise within Contract Documents), Siemen or Panduit Corp.

H. Wireways: Hoffman, Hammond Manufacturing, Panduit or approved equal.

I. PVC coated Rigid Metal Conduit: Occidental Coating Company, Robroy Industries, Perma-Cote, or equal.

J. Rigid Non-Metallic Conduit (PVC): Allied, Cantex, Prime Conduit

K. Pressed Galvanized Sheet Steel Boxes: Appleton Electric, Bowers Manufacturing Company, Steel City, or equal.

L. Cast Iron Boxes: Crouse Hinds, Appleton, Thomas & Betts, or equal.

M. Outlet boxes manufactured to provide mounting for special devices are specified with the product affected.

N. Outlet boxes for nonmetallic conduit: Carlon Electric Sciences, Inc, Cantex, Wiremold, or approved equal.

O. PVC coated outlet boxes: Occidental Coating Company, Robroy Industries, Calbond, or equal.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, non-corrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 USE

A. The following shall be used as a minimum guideline for the installation of raceways:

1. In metal stud and masonry walls:
   a. Electrical Metallic Tubing (EMT).
   b. Intermediate Steel Conduit (IMC).
   c. Rigid Metal Conduit.
2. Above plaster, drywall, lay-in and furred ceilings:
   a. Electrical Metallic Tubing (EMT).
   b. Intermediate Steel Conduit (IMC).
   c. Rigid Metal Conduit.
3. Where exposed in dry locations:
   a. Electrical Metallic Tubing (EMT).
   b. Intermediate Steel Conduit (IMC).
   c. Rigid Metal Conduit.
4. Where exposed in dry locations of storage rooms, mechanical equipment rooms, electrical equipment rooms, etc.
   a. Intermediate Steel Conduit (IMC).
   b. Rigid Metal Conduit.
5. Feeders and service entrances encased in concrete:
   a. Rigid Metal Conduit.

b. Rigid Non-Metallic Conduit (PVC).
c. Rigid Poly-Vinyl Chloride (PVC) Coated Steel Conduit.

6. Branch circuits in direct contact with earth.

   a. Rigid Metal Conduit.
   b. Rigid Non-Metallic Conduit (PVC).
   c. Rigid Poly-Vinyl Chloride (PVC) Coated Steel Conduit.

7. Where installed in non-conditioned type areas such as parking garages, transformer vaults, loading docks, etc.:

   a. Rigid Metal Conduit. (RSC).
   b. Rigid Poly-Vinyl Chloride (PVC) Coated Steel Conduit.

8. All interior feeders in excess of 600 volts:

   a. Rigid Metal Conduit (RSC).

9. In short lengths (not to exceed 3'-0") for final connections to equipment subject to vibration:

   a. Flexible Metallic Conduit.
   b. Liquidtight Flexible Metallic Conduit (Sealtight).

10. In locations where structural or existing conditions prevent the use of rigid conduit, intermediate metallic conduit or electrical metallic conduit. (In cases where flexible conduit is used, prior written approval of the Owner’s representative shall be required):

    a. Flexible Metallic Conduit.

11. Where exposed to weather on rooftops, sides of buildings, etc.:

    a. Rigid Metal Conduit (RSC).
    b. Rigid Non-Metallic Conduit (PVC).
    c. Rigid Poly-Vinyl Chloride (PVC) Coated Steel Conduit.

12. In short lengths for final connections (not to exceed 3'-0") to equipment subject to vibration and exposed to oil or moisture.

    a. Liquidtight Flexible Metallic Conduit (Sealtight).

13. For connections (not to exceed 3'-0") to kitchen equipment, lab equipment, etc.

    a. Liquidtight Flexible Metallic Conduit (Sealtight).

14. Branch circuits in direct contact with earth and under roadways.

    a. Rigid Metal Conduit encased in concrete.
    b. Rigid Non-Metallic Conduit encased in concrete.
    c. Rigid Polyvinyl Chloride (PVC) coated steel conduit encased on concrete.

15. Use 3/4 inch minimum trade size conduit unless otherwise noted or specified. In any case, use conduit of sufficient cross section to prevent insulation damage by abrasion and deformation during pulling.

16. Use rigid non-metallic conduit from SPD to building system ground.

3.2 INSTALLATION

A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

B. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

C. The actual runs and locations of conduit, lines, and equipment shall be determined on the site and shall be installed to meet the various conditions at the building. Any changes necessary to conceal conduit or clear existing pipes, equipment or construction shall be made.

D. Do not reduce conduit sizes where indicated as larger than required by Code for conductors indicated to be installed. Electric design may have over-sized raceway to permit future added conductors.

E. Raceways shall be installed plumb, level, parallel or right angles to nearby surfaces or structural steel following surface contours as much as possible. Use insulating bushing to protect conductors when joining raceways with fittings designed and approved for that purpose. Joints hall be made wrench tight.

F. Support individual conduit 1 inch and smaller by securing with one-hole malleable iron or pressed steel type straps. Use screws and inserts on concrete or masonry construction, approved clamps or clips on steel construction, or other approved means.

G. Attach conduit larger than 1 inch to framing members, using approved split ring pipe hangers or 2-hole malleable iron or pressed steel straps.

H. Use 3/8 inch minimum hanger rod for 2 inch and smaller individual conduit support and 1/2 inch rod for larger individual conduit support. Use preset concrete inserts to support hanger rods. Where inserts are required after placement of concrete, use expansion shield type anchors.

I. Do not use perforated plumbers tape to support conduit.

J. Use beam clamps of steel, cadmium-plated or galvanized for attachment to beams and columns.

K. Do not employ running threads for conduits.

L. Cut ends square, ream and shoulder in fittings.

M. Provide conduit expansion fittings at building expansion joints, where necessary to compensate for thermal expansion and contraction or where continuous conduit runs exceeds distances as recommended by manufacturer. Metal raceways shall remain electrically continuous by means of approved bonding jumpers where expansion fittings are used.

N. Install conduit and tubing in a manner which shall not trap moisture due to coupling leakage or condensation. Make conduit joints in earth, concrete, masonry, or exposed on exterior, gas tight.

O. Conduit shall be supported at intervals of not more than 10 feet or as otherwise required by National Electrical Code. Flexible steel conduit shall be supported at intervals of not more than 3 feet. No conduit or outlet boxes shall be attached to ductwork, piping, or mechanical equipment, unless specifically approved. Support 1-1/4 inch and smaller size within 18 inches of outlets, and 1-1/4 inch or larger sizes within 36 inches of terminations. Do not support conduit from ceiling suspension systems, except that short lengths of flexible conduit for lighting fixture connections may be so supported.

P. Use cast metal boxes and cast metal fittings for right angle direction changes and for tee, or cross-connections for exposed conduit except where pressed steel boxes are permitted by this Specification. Use factory elbows or field bends only when approved to fit job conditions.

Q. Do not install bends visibly deformed from true circular cross-section. Make field bends with conduit hand or power bender. Minimum bending radius for power, lighting, and the fire alarm shall be as required by Code.

R. Minimum bending radius for telephone and data shall be:

1. Not less than 10 times diameter for conduit 2-1/2 inches and larger.
2. Not less than 20 times diameter for conduit 2 inches and smaller.

S. Clearance from all mechanical piping including steam, gas, refrigeration, hot water, chilled water, etc., shall not be less than 6 inches and 4” from cross piping.

T. Conduits to motors in Mechanical Equipment Rooms shall run exposed.

U. Exposed conduits shall be plumb, level, parallel with or at right angles to building line, beams, or ceilings. Symmetrical bends or metal boxes shall be placed at changes in direction or taps. Positively no conduit shall be run exposed on the exterior face of building unless otherwise pre-approved by the Architect.

V. Conduit terminals at boxes, cabinets, and in general to wiring enclosures, shall be rigidly secured with double locknuts and bushings or approved fittings. Conduits shall be screwed in and shall engage at least five threads in hub where conduit boxes with threaded hubs are used. Insulating bushings shall be used for conduits 1-1/4 inch or larger, and for conductors larger than 10 AWG, and in cases where wiring is subject to vibration.

W. Provide independent support for conduit rising from floor for motor connection if over 24 inches above floor. Do not support to a motor or ductwork which may transmit vibration.

X. Close ends and openings against entry of construction debris, until access is required for installation of conductors or pull wires.

Y. Do not install across ventilation openings or other foreign systems in electrical clearance areas as specified in NEC Article 110.26.

Z. All wiring, unless otherwise noted, shall be installed in rigid metal conduit, intermediate metal conduit or EMT as outlined in this specification and subject to the restriction of the NEC. Minimum size raceways shall be 1/2 inch unless otherwise noted or specified. In any case, use conduit of sufficient cross section to prevent insulation damage by abrasion and deformation during pulling.

AA. All surface and flush mounted panelboards shall have a minimum of six (6) 1” diameter conduits stubbed to nearest accessible ceiling location.

BB. Empty conduit runs shall have heavy nylon, polypropylene or monofilament pull cord with not less than 200 lbs. tensile strength. Leave at least 12” of slack at each end of pull cord tied to end of each raceway.

CC. Field bend non-metallic conduit in accordance with the manufacturer’s recommendations using heater and bending devices designed and approved for the purpose. The use of torches or other flame-type devices shall not be permitted. Use internal bending plugs on 2 inch conduit and larger to prevent crimping.

DD. To make joint in non-metallic conduit, use Solvent Cement as recommended by the conduit manufacturer. Be sure conduit ends are clean, dry, and cut at the right angle to the centerline of the conduit. Apply coat of Solvent Cement the length of the socket to be attached. Push conduit firmly into fitting while rotating conduit slightly about one-quarter turn to spread cement evenly. Allow joint to set before proceeding.

EE. Vertical conduits through floor slabs shall be through sleeves sealed with DOW “RTV” or “Chase Foam”. Sleeves shall extend 1” above the finished floor. Multiples of conduit risers may be run through floor openings with concrete or metal curbs of 4 inches in height and closed with insulated fire proofing steel plates. Seal water and moisture tight all conduits entering from outside the building to a conditioned space.

3.3 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors (2 inches) above finished floor level.

G. Size pipe sleeves to provide (1/4-inch) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants.

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work. Roof mounted equipment shall have conduit routed to the equipment within the equipment curb where possible. If a roof penetration must be made, it shall be installed with a pipe seal flashing kit designed for the purpose.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using [steel] [cast-iron] pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.4 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.5 UNDERGROUND WORK

A. Underground work shall include excavating, concrete envelopes, raceways, cables, and backfilling required under this Contract unless noted otherwise. The Contractor shall be responsible for clearing new and/or existing underground service lines such as gas, water service, sanitary and storm water piping. Excavation shall be as set forth under “Special Conditions/Requirements.” Excavations shall be properly barricaded and protected to protect persons from injury. Follow rules of authorities having jurisdiction for safety standards. Excavation shall be on an unclassified basis.

B. Trench excavations shall be made open to proper alignment and grade. Trenches shall be of sufficient width to provide free working space on each side of the raceway structure for concrete envelope forms if required. In earth excavation, the trench shall be carried to a point 6 inches below the bottom of the structure envelope. Raceway structures shall not be allowed to rest directly upon rock, but shall be cushioned by a 6 inch layer of selected crushed stone or gravel. The on-site Owner's representative shall govern the number of points at which the Contractor shall be permitted to work and the length of continuous open trench.

C. Raceways shall be firmly supported above the trench bed and separated from each other by means of approved spacers installed at intervals not exceeding 5 feet.

D. Raceway banks shall be encased in minimum of 3000 PSI concrete envelope not less than 3 inches thick all around the outside limits of the raceway group. In all instances, the concrete shall be not less than 3 inches between any surfaces of a raceway. Underground structures shall be so installed that the top of the enclosing concrete envelope shall not be less than 30 inches below finish grade or otherwise required by code or local AHJ's. Exiting of raceways from concrete slab shall be made with rigid galvanized steel elbows.

E. Concrete envelopes shall be reinforced at points where they cross fill or loose soil, foreign piping, or under vehicular roadways. Reinforcing shall be of size and extent indicated within Contract documents and shall extend 6 feet beyond each limit of fill, roadway, and/or foreign pipe. Where excavation for building purposes is below required grade for duct and manholes, and fill is to be placed under another contract, the Contractor shall be responsible for determination of satisfactory bearing conditions, and construct in accordance with preceding requirements.

F. Excavations shall be backfilled to finished grades. Backfill shall consist of screened excavated materials approved for backfilling consisting of earth, loam, sandy material, soft shale, or other approved materials, free from large clods of earth or stone. Backfill shall be brought up on approximately 6 inch layers and compacted. Any trenches improperly backfilled or where settlement occurs shall be reopened to the depth required for proper compaction, then refilled and compacted. Refer to Division 3 "Concrete" and Division 31, "Earthwork" for backfill and compaction requirements.

G. Open trenches under roadways or paved areas shall be backfilled as specified above, except that the entire depth of trench shall be backfilled in 6 inch layers, each layer moistened and compacted to a density at least equal to that of the surrounding earth and in such manner as to permit rolling and compaction of the filled trench together with the adjoining earth to provide the required bearing value so that paving of the area can proceed immediately after backfilling is completed.

H. Identification for conduits for medium voltage feeders.

1. Provide self adhesive or painted sign reading "HIGH VOLTAGE" red on white, size ½ height of conduit diameter.

2. Signs shall be provided at 20 foot intervals on accessible conduits and on armored cable in cable trays.

3.6 OUTLET BOXES

A. Do not install boxes smaller than permitted by National Electrical Code. Where no outlet box size is indicated or specified, install a box of not less than 4 inches square by 1 1/2 inches deep dimensions. In dry locations, use pressed galvanized steel boxes, with drilled and tapped ears, and manufacturer's pre punched knockouts. In wet locations, for exposed interior locations below 4 feet above floor, and where poured into exterior concrete, use cast metal boxes with threaded hubs.

B. Provide pressed steel outlet boxes with tile ring where installed in brick, tile, marble, and similar material and in masonry block walls. Equip with plaster rings where plaster or drywall finish is indicated. Select rings of proper depth to place front of ring even with the plane of the finish surface. Select style of ring to match device and finish plates to be installed. Boxes shall be installed plumb, level and flush with wall surface.

C. Close unused openings in pressed steel boxes with knockout closure and in cast boxes with threaded plugs.

D. Gaskets for cast metal boxes may be omitted where installed in dry locations.

E. Use concrete type boxes where required to clear and not displace reinforcement.

F. Use multiple gang boxes for grouping devices at one location. Provide barriers between different systems and between adjacent devices when the voltage between adjacent exposed live parts exceeds 300 volts to ground.

G. Support ceiling outlet boxes flush with the ceiling plane. Use approved bar hanger or other approved means to provide adequate support for lighting fixtures or other products attached to ceiling outlet boxes. Equipment boxes with fixture studs where required by the lighting fixtures to be installed. Support boxes in suspended ceiling systems from main runner channels, or joists or other structural members. Do not support from the ceiling suspension system support wires or tile support tees or similar light weight ceiling components, unless the components are designed and approved for this purpose.

H. Provide outlet boxes used as junction boxes with blank device plates if installed flush, and with blank galvanized covers if installed on the surface. Use raised covers on surface boxes in finished areas. Flat plates may be used on surface boxes in machine rooms, electrical rooms, and similar unfinished areas.

I. Provide outlet boxes with bushed cover plates where used for systems requiring an exposed cable connection from the box.

J. Locate outlet boxes so that they shall be readily accessible. Boxes over suspended ceiling systems are considered readily accessible if the ceiling tile removal permits ready access to such boxes.

K. Use PVC coated junction boxes in conjunction with PVC coated Rigid Metal Conduit and fittings.

L. Individual circuits are shown on plans for clarity. Branch circuit “home runs” maybe grouped together (unless noted otherwise) and extended to panels as shown.

3.7 FLOOR BOXES

A. Provide box with protective removable concrete cover. Pour and trowel concrete so cover is flush with concrete. Remove cover after concrete is set and adjust box flush with final floor surface. Where installed in “other” floor types box shall be fully supported and secured with final assembly matching surface of finish floor. Installation of floor box must conform to manufacturer’s specifications and shall be flush with final floor finish. Box type and configured service ports as specified in Section 262726 “Wiring Devices”.

3.8 PROTECTION

A. Provide final protection and maintain conditions that ensure coating, finishes and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacture.

B. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacture.

END OF SECTION 260533

SECTION 260534 – JUNCTION & PULL BOXES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements and Division 1 Specification Sections, apply to this Section.

B. Related Sections:

1. Division 01 Section “Construction Waste Management and Disposal”.

1.2 DESCRIPTION

A. Provide junction and pull boxes in accordance with Contract Documents. Wherever possible, use outlet boxes for junction and pull boxes Fuses in equipment shall be furnished by the respective contractor supplying the device and installed under this Division.

B. Provide cabinets in accordance with the Contract Documents. Cabinets for same type of use shall be the product of a single manufacturer. Do not install surface mounted cabinets in finished areas, unless indicated. Where conflicting data is indicated, verify mounting requirements prior to ordering cabinets.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Sheet Steel Junction and Pull Boxes: Hoffman, Hammond Mfg, Steel City or approved equal.

B. Cast Iron Junction and Pull Boxes: O.Z. Electric Manufacturing Company, Crouse Hinds Company, Hubbell, or equal.

C. Rigid Nonmetallic Junction and Pull Boxes: Carlon Electric Sciences, Inc. Hubbell, Cantex Industries or equal.

D. Underground Junction Boxes: Quazite Incorporated, Oldcastle, J&R Concrete, or approved equal.

1. Junction or hand-hole boxes shall be “Tier-15” rated and installed to withstand all loads likely to be imposed meeting the requirements of 2011 NEC, ANSI/SCTE 77-2002 and UL. Underground box shall be NEMA 4 constructed of non-corrosive polymer concrete and reinforced by a heavy weave fiberglass. Cover shall be gasketed and recessed cover bolts shall be stainless steel. Cover shall be flush with sidewalk, landscaping or surrounding surface. Cover logo shall say reflect contents such as “COMMUNICATION”, “ELECTRIC” or as noted within Contract documents. Box shall be ribbed externally and internally for rigidity, shall be able to be drilled to accept mounting brackets without impairing strength.

Cover and box shall be ultraviolet protected. Conduits shall enter bottom of lower unit using a long-sweeping ell fitting.

E. Cabinets: Products of the following manufacturers are acceptable. Other products shall be approved as equal.

1. Cabinets for General Use: Hoffman Engineering Company, Hammond Manufacturing, McMaster-Carr, or equal.

2. Cabinets for systems and/or products, use cabinets furnished by manufacturer with system or product. Where system or product cabinets do not comply with these specifications, submit cabinet shop drawings, indicating deviations, and obtain approval for their use.

2.2 MATERIALS

A. Fabricate sheet metal junction and pull boxes of galvanized, Code gauge, sheet steel. Include angle iron framing where required for rigidity. Boxes shall not deflect or deform when covers are removed after conduit and conductors are installed, and any deflection occurring shall not prevent the easy installation and removal of cover attachment screws.

B. Size junction and pull boxes to not less than minimum National Electrical Code requirements. Increase size above Code requirements where necessary to provide space for pulling, racking, or splicing enclosed conductors, or where specified or indicated dimensions exceed Code requirements.

C. Metal junction and pull boxes exposed to weather shall be listed for use such as (and not installed in or below grade) raintight, weatherproof or waterproof. Boxes shall contain gaskets with removable covers. Use boxes constructed to meet NEMA 3R requirements or otherwise noted or required by code. Equivalent gasket boxes or boxes of similar design permanently rendered weatherproof. Raintight or weatherproof boxes shall use threaded watertight hubs for top or side entry and may use knockout for bottom entry only. For exterior pull boxes, use a minimum of 14 gauge galvanized sheet steel. Apply galvanizing by the hot dip process after fabrication.

D. Surface sheet metal junction and pull boxes with covers aligning with the sides of the box and equip flush boxes with covers extending 3/4 inch all around the perimeter of the back box. Provide sufficient cover attachment screws to ensure that box covers contact the surface of the box for the entire perimeter of the enclosure. Use brass or stainless steel screws to attach covers to boxes.

E. Use brass screws only to attach junction and pull box covers to interior floor boxes or boxes located where moisture may be present.

F. Do not use single covers for junction and pull boxes having cover length or width dimension exceeding 3 feet so specified, indicated, or approved. Sectionalize covers that exceed 3 feet in either dimension into two or more sections.

G. Provide barrier between pull boxes for cables of different voltage and to separate cables connected to the emergency and normal power.

H. Provide split or hinged covers on junction/pull boxes when the cover exceeds eight (8) square feet in area.

I. This contractor shall paint all fire alarm system junction boxes, pull boxes and covers in red paint in accordance to Ohio Building Code.

J. Indoor Cabinets:

1. Construct of cold rolled quality steel, with metal gauges and construction methods conforming to National Electrical Code requirements, and Underwriters' Laboratory standards.
2. Finish doors, trims, and back boxes for surface mounted cabinets in finished areas, by applying a rust resistant treatment, prime coat, and a final coat of manufacturer's standard enamel or lacquer finish. Galvanize all other sheet metal components of cabinets, excepting non ferrous metal parts, or steel parts provided with cadmium plating or equivalent protective plating.
3. Equip doors with concealed or semi concealed hinges and with flush or semi flush spring catch type flush cylinder locks. Key cabinet doors of similar use alike, and provide two keys with each lock.
4. Set cabinet doors flush into cabinet trim. Equip trim with adjustable clamps or other approved means to fasten trim to cabinets. Fastening method shall permit adjustment for aligning the trim of flush cabinets to a plumb position. Trim for flush cabinets shall extend not less than 3/4 inch beyond the perimeter of the back box.
5. Do not use factory furnished knockouts with surface back boxes. Punch or drill required openings during installation. Equip flush back boxes with manufacturer's standard pattern of knockouts.

K. Outdoor Cabinets:

1. Cabinets shall be constructed of 12 gauge, Type 304 stainless steel, reinforced as necessary in large sizes.
2. Cabinet shall have gaskets, etc., required to meet NEMA Type 4 and UL 508 requirements.
3. Cabinets shall be of size indicated within Contract documents meeting minimum code requirements plus 25 percent growth.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate interior junction and pull boxes in machine rooms, equipment rooms, storage rooms, electrical rooms, and similar utility spaces, unless otherwise indicated or approved. Fasten plates to boxes with countersunk flat head screws. Provide plates with 3/4 inch trim all around.

B. Do not exceed the equivalent of three 90deg bends between general wiring pull and junction boxes, and reduce to not more than the equivalent of two 90deg bends where telephone or other multi conductor cable shall be installed.

C. Install junction boxes and pull boxes in a manner to insure that equipment ground continuity is maintained.

D. Junction and pull boxes shall be accessible.

E. Boxes shall be installed every 100 feet in major feeders.

F. Underground junction boxes shall be installed according to manufacturer's instructions.

G. Support all junction/pull boxes with 1/2 inch all-thread rod from floor above or joists or structural members. If mounted tight to floor above, use approved anchors. Tie wire used to support, suspend, or secure junction/pull boxes is not acceptable.

H. Cabinets:

1. Set cabinets at heights indicated or specified. In the absence of such information, set cabinets at not to exceed 6 feet 6 inches from finished floor to top of cabinet.
2. Level and align the tops of cabinets in sight of each other at a uniform height.
3. Install cabinets (and other enclosure products) plumb with building construction. Install flush enclosures so that the trim shall rest against the surrounding surface metal around the entire perimeter of the enclosure.
4. Fastenings shall be made by means of not smaller than 3/16 inch diameter bolts, expansion bolts, or toggle bolts; not smaller than No. 9 x 1 inch wood screws. Fastenings, where exposed to weather or moisture, shall be galvanized. Not less than four fastenings shall be used to secure each cabinet. Do not use nails, or wooden fiber inserts in masonry.
5. On masonry or concrete walls, columns or flooring, fastenings shall be made by means of lead expansion shields not smaller than shield size 3/8 inch diameter by 5/8 inch long for use with No.10 24 round head machine screws. Machine screws shall be not less than 1-1/4 inches long for installation on ceiling and not less than 1 inch long elsewhere.
6. Holes for lead expansion shields shall be carefully and accurately drilled, using sharp drills to a depth which shall afford the maximum practical engagement of threads (depth equal to screw length not less than 1 1/4 inches past plaster into solid concrete). Installation shall develop full strength of screws.

END OF SECTION 260534

SECTION 260535 – RACEWAY & FITTINGS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements, Division 1 Specifications, apply to this Section.

B. Related Sections:

1. Division 01 Section “Construction Waste Management and Disposal”.

1.2 DESCRIPTION

A. Provide all raceway fittings, supports and back boxes required to complete work indicated on the Contract Documents.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Subject to general requirements and use as specified in Section 260533 “Raceway and Boxes”.

B. For fittings of specialized type, use the products as scheduled for each type under "Manufacturers," or approved equal.

2.2 MANUFACTURERS

A. General Use Fittings: Steel City, Thomas & Betts, O.Z. Electric Manufacturing Co., Carlon, Sealing Fittings: Appleton Electric, Crouse-Hinds.

B. Liquid-Tight Flexible Conduit Fittings: Thomas & Betts, Appleton Electric, Steel City.

C. Expansion Fittings: O.Z. Type "DX" or approved equal of Appleton, Thomas & Betts, Crouse Hinds.

D. Cast Metal Straight, Tee, Cross, and Fittings: Crouse-Hinds, Appleton Electric, Killark.

E. Rigid Nonmetallic Conduit Fitting: Carlon Electrical Sciences, Inc. Cantex Industries, Hubbell.

F. PVC coated fittings: Occidental Coating Company, Robroy Industries, Ocal (Thomas & Betts) or equal.

PART 3 - EXECUTION

3.1 USE

A. Use threaded fittings for rigid and intermediate metal conduit.

B. Compression or drive-on watertight fittings shall be used for metallic tubing. Fittings with set screws for trade size smaller than 2 inch is not approved for use.

C. Fittings for flexible conduit as approved by the enforcing Code official.

D. Use fittings made of the same material and corrosion resistance as the raceway except:

1. Malleable iron and steel are interchangeable.
2. Die cast fittings may be used for flexible steel conduit, and for factory manufactured offsets.
3. Use insulated bushings for conduit trade sizes.
4. Use steel insulated throat connectors for electrical metallic tubing.

E. Use steel fittings that are galvanized, cadmium-plated, or have other approved protective coating.

F. Use double locknuts for terminating rigid conduit at sheet metal enclosures and equipment conduit ends with bushings.

G. Provide expansion fittings on every raceway larger than 1-1/2 inches, and use a 2 foot piece of seal tight on all conduit routings 1-1/2 inches and smaller where it crosses any building expansion joints. Expansion fittings shall be provided for conduit thermal expansion or contraction in accordance to tables specified in NEC. Verify exact location of building expansion joints prior to installation of raceway with project Architect.

H. Where an expansion fitting is used, conduit bonding shall be continuous by means of a flexible braided copper bonding strap with ground clamps. Bonding strap and clamps shall be provided for grounding continuity as required by NEC. Strap shall be of sufficient length to allow full expansion. Manufacturer Crouse-Hinds XJ or XJG-EMT or approved equal.

I. Use PVC coated fittings for rigid PVC coated steel conduit.

J. Provide moisture barrier fittings for conduit routing entering conditioned spaces from non-conditioned spaces. This contractor shall fill fitting with an approved material preventing circulation and formations of moisture in the conduit system.

K. Where conduit is subject to collection of condensation or moisture, provide a low point combination breather/drain such as Crouse-Hinds ECD or equal.

END OF SECTION 260535

SECTION 260553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Sections, apply to this Section.

B. Related Sections:

1. Division 01 Section “Construction Waste Management and Disposal”.

1.2 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Schedule of Nomenclature: An index of electrical equipment and system components used in identification signs and labels.

C. Samples: For each type of label and sign to illustrate color, lettering style and graphic features of identification products.

1.3 ALQUALITY ASSURANCE

A. Comply with ANSI C2.

B. Comply with NFPA 70.

C. Comply with ANSI A13.1 and NFPA 70 for color-coding.

PART 2 - PRODUCTS

2.1 RACEWAY AND CABLE LABELS

A. Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

1. Color: Black letters on orange field.
2. Legend: Indicates voltage.

B. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl with legend over-laminated with a clear, weather- and chemical-resistant coating.

C. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1inch to 2 inches wide.

D. Provide conduit labels for voltages greater than 115 volts. Labels to indicate voltage and shall be pre-tension acrylic/vinyl construction coiled to completely encircle conduit diameters through five inches or pre-molded to conform to the circumference of six inch conduits.

2.2 NAMEPLATES AND SIGNS

A. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.

B. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.

C. Fasteners for Nameplates and Signs: Self-tapping, stainless steel screws of No. 10/32, stainless steel machine screws with nuts and flat and lock washers.

2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16 inch.
2. Tensile Strength: 50 lb. minimum
3. Temperature Range: Minus 40 to plus 185° F.
4. Color: According to color-coding.
5. Paint: Formulated for the type of surface and intended use.

a. Primer for Galvanized Metal: Single-component acrylic vehicle formulated for galvanized surfaces.
b. Primer for Concrete Masonry Units: Heavy-duty resin block filler.
c. Primer for Concrete: Clear, alkali-resistant, binder-type sealer.
d. Enamel: Silicone-alkyd or alkyd urethane as recommended by primer manufacturer.

B. Provide arc flash hazard label on equipment per the National Electrical Code including NFPA 70E.

C. Provide documentation and compliance to satisfy NEC Article 240.87.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Lettering, Colors and Graphics: Coordinate names, abbreviations, colors and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout project.

C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before applying.

E. Color Banding Raceways and Exposed Cables: Band exposed and accessible raceways of the systems listed below:

1. Bands: Colored adhesive tape. Make each color band 2 inches wide, completely encircling conduit and place adjacent bands of two-color markings in contact, side by side.
2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50 feet maximum intervals in straight runs, and at 25 feet maximum intervals in congested areas.
3. Apply the following colors to the systems listed below:

    a. Fire Alarm System: Red
    b. Fire Suppression Supervisory and Control System: Red and yellow
    c. Mechanical and Electrical Supervisory System: Green and blue
    d. Telecommunication System: Green and yellow.

F. Caution Labels for Indoor Boxes and Enclosures for Power and Lighting: Install pressure-sensitive, self-adhesive labels identifying system voltage with black letters on orange background. Install on exterior of door or cover.

G. Circuit Identification Labels Installed internally backside of wall plates within finished areas, external within unfinished areas unless noted otherwise.

1. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.

    a. Exposed Outlet Boxes: Pressure-sensitive, self-adhesive plastic label on wiring device cover.
    b. Concealed Boxes: Plasticized card stock tags.

H. Color Coding of Secondary Phase Conductors: Use the following colors for feeder and branch circuit phase conductors.

1. 208/120-V Conductors:

    a. Phase A: Black
    b. Phase B: Red
    c. Phase C: Blue
    d. Neutral: White
    e. Ground: Green

2. 480/277-V Conductors:

    a. Phase A: Brown
    b. Phase B: Orange
    c. Phase C: Yellow
    d. Neutral: Gray
    e. Ground: Green

I. Factory-apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG.

1. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6” from terminal points and in boxes where splices or taps are made. Apply last two (2) turns of tape with no tension to prevent possible unwinding. Use 1 inch wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.

J. Power-Circuit Identification: Metal tags or aluminum wrap- around marker bands for cables, feeders and power circuits in vaults, pull and junction boxes, manholes and switchboard rooms.

1. Legend: 1/4” steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
2. Tag Fasteners: Nylon cable ties.
3. Band Fasteners: Integral ears.

K. Apply identification to conductors as follows:

1. Conductors to be extended in the Future: Indicate source and circuit numbers.
2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number and phase. Use color-coding to identify circuits’ voltage and phase.
3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding or cable marking tape.

L. Apply warning, caution and instruction signs as follows:

1. Warnings, Cautions and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8” high lettering for emergency instructions on power transfer and other emergency operations.

M. Fire alarm junction boxes: All fire alarm system junction boxes and cover plates shall be painted red.

N. Service Equipment:

1. Plaque: Provide directory plaque in accordance to NFPA 70-225.37 where building has more than one service.
2. Disconnecting Means: Each service disconnect means shall be permanently identified meeting the requirements of NFPA 70-230.70(B).

O. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes distribution, branch, lighting, communication, signal and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2” high lettering on 1-1/2” high label; where two (2) lines of text are required, use labels 2” high. Use black lettering on white field. Apply labels for each unit of the following categories of equipment using mechanical fasteners.

1. Panelboards, electrical cabinets and enclosures
2. Access doors and panels for concealed electrical items

3. Electrical switchgear and switchboards
4. Emergency system boxes and enclosures
5. Automatic transfer switches
6. Lighting control panels
7. Motor-control centers
8. Disconnect switches
9. Enclosed circuit breakers
10. Motor starters
11. Push-button stations
12. Contactors
13. Remote-controlled switches
14. Dimmers
15. Control devices
16. Transformers
17. Fire alarm master station or control panel
18. Variable frequency drives
19. Manual motor starting switches
20. Manual operation switches
21. Dedicated circuits

P. Panelboard Schedules:

1. Panelboard schedules shall be revised reflecting final alterations, additions and load balancing. Schedules shall include identification of service loads, wattage and/or HP, pole quantity, amperage and shall be type written. Compliance shall be in accordance to NEC article 408.4.

END OF SECTION 260553

SECTION 260923 – LIGHTING CONTROL DEVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Reference specification Division 26 Section 262726 “Wiring Devices”.

1.2 SUMMARY

A. This Section includes the following lighting control devices:

1. Time switches.
2. Photoelectric switches.
3. Indoor occupancy/vacancy sensors.
4. Emergency shunt relays.
5. Interior low voltage lighting controls.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

C. US: Ultrasonic.

D. DT: Dual technology PIR & US

1.4 SUBMITTALS

A. Product Data Sheet: Submit data sheet(s) for each type of lighting control, sensors, required relays and controllers.

B. Shop Drawings: Provide installation plan drawing with layouts and details for each room or area having lighting controls. Each drawing shall include location of controls, light fixtures, sensors and other required equipment. Include bill of material identifying products used with cross-reference to product data sheets. Wiring schematics shall be included for each type of control scheme.

C. Operation and Maintenance Data: Provide for each product used within project shall have operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS (Selected Types Where Applicable)

2.1 TIME SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Area Lighting Research, Inc.; Tyco Electronics
2. Intermatic, Inc
3. Leviton Mfg. Company Inc
4. TORK. Plate, Inc.
5. Hubbell Automation
6. Watt Stopper

B. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.

1. Contact Configuration: DPDT
2. Contact Rating: 30A ballast load, 120/240-V AC
3. Program: 2 on-off set points on a 24-hour schedule.
4. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
5. Astronomic Time: All channels.
6. Battery Backup: For schedules and time clock.

C. Electromechanical-Dial Time Switches: Type complying with UL 917.

1. Contact Configuration: DPDT
2. Contact Rating: 20-A ballast load, 120/227V AC.
3. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
4. Astronomic time dial.
5. Eight-Day Program: Uniquely programmable for each weekday and holidays.
6. Skip-a-day mode.
7. Wound-spring reserve carryover mechanism to keep time during power failures, minimum of 8 hours.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Area Lighting Research, Inc
2. Intermatic, Inc
3. Lithonia Lighting
4. TORK
5. Hubbell Automation
6. Watt Stopper

B. Description: Solid state, with DPST dry contacts rated for 1800-VA tungsten to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range.
2. Time Delay: 15-second minimum, to prevent false operation.
3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.

C. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.3 INDOOR OCCUPANCY/VACANCY SENSORS

A. It's the responsibility of the Contractor to ensure that sensors meet or exceed the specifications included herein. Sensors and their subcomponents shall operate as intended and under load conditions as shown within Contract documents.

1. Building Codes: All units shall comply with applicable, local building codes.
2. All sensors shall be FCC compliant where applicable.
3. Manufacturer shall 100% test all equipment prior to shipment. Sample testing is not acceptable.
4. UL listed having standard warranty of 5 years.
5. This contractor shall provide low voltage communication cable (type per manufacturer specification) from low voltage sensor to remote power pack or fixture per installation details. Cable shall be rated for plenum use.
6. Controls shall be recessed to limit tampering and provide user adjustable settings for time delay and sensitivity.
7. All office & classroom area will require occupancy sensor relay for connection to the HVAC. Refer to Lighting & mechanical drawings.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lutron
2. Watt Stopper
3. Sensor Switch
4. Hubbell Building Automation – Basis of Design
5. Cooper Controls

C. Submittals:

1. Bill of Materials: Complete list of all parts needed to fully install selected occupancy sensors.
   a. Product Data: Submit product data, including catalog cut sheets for specified products.
   b. Shop and Wiring Drawings: Submit shop drawings detailing all mechanical and electrical equipment including one-line diagrams, wire counts, coverage patterns, and physical dimensions of each item.
2. Documentation & Commissioning

a. Field terminations shall be identified indicating wire originations. Point-to-point wiring diagram shall be provided and shall include “As-Built” conditions. Submit in duplicates to Owner and Project Architect.
b. EC shall provide System Manufacturer on-site configuration and programming of lighting system. EC to provide training of Owners representative.

3. Unless otherwise noted within contract documents, the Contractor shall provide wall occupancy switches with the minimum features:
   a. Dual sensor technology
   b. Single circuit
   c. Automatic and Manual operation
   d. Shall meet other requirements of project documents.
4. The Contractor, as part of the work of this section, shall coordinate, receive, mount, connect, and place into operation all occupancy related equipment. The Contractor shall furnish all conduit, wire, connectors, hardware, and other incidental items necessary for properly functioning lighting control and occupancy sensors as described herein and shown within contract documents. The Contractor shall maintain performance criteria stated by manufacturer without defects, damage, or failure.

D. Ceiling Vacancy Sensors
1. Shall use microprocessor for motion signal analysis and internal, adaptive self-adjustment. Shall automatically adapt to changing room conditions.
2. Shall identify, record and learn a room’s normal occupancy cycles to automatically adjust the sensitivity threshold.
3. Shall save learned and adjusted settings in non-volatile memory that retains all settings during power outages.
4. Shall accept Class 2 wiring.
5. Shall mount on the ceiling.
6. Shall provide a concealed bypass switch to force on lighting.
7. Shall save learned and adjusted settings in non-volatile memory that retains all settings during power outages.
8. Shall be equipped with tamper resistant cover.
9. All controls shall be accessible from front of unit.
10. Rugged, plastic housing shall be available in white.
11. Shall incorporate a real-time motion indicator LED, which is visible from the front of unit.
12. Provide white ceiling mount occupancy sensors with accessories and required components as specified within Contract documents by one manufacturer. All color choices shall be confirmed with Architect.
    a. Dual Sensor
       1) Shall incorporate Doppler shift ultrasonic and passive infrared motion detection technologies.
       2) Shall be available in 360º coverage patterns. Infrared lenses shall have a 360º field of view.
       3) Sensor shall have two modes of operation:

a) Multi-technology mode: where the sensors send infrared signal to the microprocessor, which makes the decision to turn on lighting based on the level of the signal.
b) Single technology mode: where the user chooses technology that will turn on lighting.

4) Shall have mask inserts for PIR rejection to prevent false tripping.

b. Single Sensor - Ultrasonic

1) Shall utilize Doppler shift ultrasonic detection technology.

c. Single Sensor – PIR

1) Shall utilize passive infrared motion detection.
2) Shall automatically adapt to changing background PIR levels.
3) Infrared lenses shall have 360º field of view.
4) Shall have mask inserts for PIR rejection to prevent false tripping.

13. Wall Switch Sensors

a. Provide a white wall mount occupancy switch by one manufacturer. All color choices shall be confirmed with Architect prior to ordering.

1) Hubbell – LightHAWK - Basis of Design
2) Sensor Switch
3) LC&D
4) Watt Stopper
5) Lutron

b. Wall switch sensors shall recess into single-gang switch box and fit a standard GFI opening.
c. Wall switch sensors shall have optional features for photocell/daylight override, vandal resistant lens, and low temperature/high humidity operation.
d. Wall switch sensors shall be available in four standard colors (Ivory, White, Light Almond, Black)
e. Wall switch sensors are based on Light Hawk model sensors.

14. Line-Low Voltage Power Pack

a. Shall be compatible with incandescent, magnetic or electronic low voltage, and magnetic or electronic fluorescent, LED, as well as motor loads.
b. Relay function shall not require more than 5-ma control current to operate.
c. Shall be installed inside a standard 4” x 4” junction box.
d. Ratings:

1) 20A lighting load @ 120vAC, 20A lighting load @ 277vAC
2) HVAC Relay – SPDT 500ma@24VDC three-wire isolated. Ratings: 0.5A, 125VAC; 1A, 30VD

15. Wall Switch Dimming Sensors

a. Provide a white wall mounted occupancy switch by one manufacturer. All color choices shall be confirmed with Architect prior to ordering.

1) Hubbell – LightHAWK2 – Basis of Design
2) Sensor Switch

3) LC & D
4) Watt Stopper
5) Lutron

b. Wall switch sensors shall recess into single-gang switch box and fit a standard GFI opening.
c. Wall switch sensors shall have optional features for photocell/daylight override, vandal resistant lens, and low temperature/high humidity operation.
d. Wall switch sensors shall be available in four standard colors (Ivory, White, Light Almond, Black)
e. Wall switch dimming sensors are based on Light hawk model sensors.

16. The Contractor, as part of the work of this section, shall coordinate, receive, mount, connect, and place into operation all occupancy related equipment. The Contractor shall furnish all conduit, wire, connectors, hardware, and other incidental items necessary for properly functioning lighting control and occupancy sensors as described herein and shown within contract documents. The Contractor shall maintain performance criteria stated by manufacturer without defects, damage, or failure.

2.4 EMERGENCY SHUNT RELAY (Where Applicable)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lighting Control and Design, Inc., Lutron, Wattstopper, LC&D or approved equal.

B. Description: Lighting Control and Design Model GR 2001 E/S emergency shunt trip relay wired in parallel with light switch to shunt on manually controlled emergency lighting during a power outage. Relay shall be ETL listed for use on emergency lighting systems, UL 924. Coil rating as noted within Contract documents.

2.6 INTERIOR LOW VOLTAGE LIGHTING CONTROLS

A. System Description

1. The lighting control system as specified herein shall be comprised of stand-alone devices as indicated. Refer to lighting control diagram drawing for additional information.
2. Control devices shall include but not be limited to room controllers, wall switch stations, occupancy/vacancy sensors, daylight sensors, user interfaces, network interfaces, and related input/output devices.
3. The contractor shall provide all related conduit, wire, boxes, and mounting hardware to provide a complete and functional installation.

B. Manufacturers; Subject to compliance with requirements, provide products by one of the following:
1. Hubbell Building Automation – basis of Design
2. Creston
3. Watt Stopper

4. Sensor Switch
5. Cooper Controls

C. Quality Assurance

1. Factory Assembly: All system components shall arrive at the job site completely pre-wired and ready for installation, requiring only the connection of lighting circuits and network terminations. All connections shall be made to clearly and permanently labeled termination points. Systems that require field assembly shall not be acceptable.
2. Component Testing: All system components and assemblies shall be individually tested prior to assembly. Once assembled, all finished products shall be tested for proper operation of all control functions per specifications prior to shipment.
3. NEC Compliance: All system components shall comply with all applicable sections of the National Electrical Code (NEC) as required.
4. NEMA Compliance: All system components shall comply with all applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.
5. UL Approval: All applicable equipment shall be tested to and listed under UL standard 508 and shall bare labels to indicate compliance. Lighting control relays shall be tested to UL standard 508 for both safety and endurance. System listed other ETL or other UL sections shall provide documentation proving compliance with UL standard 508.
6. FCC Emissions: All applicable equipment shall comply with FCC emissions standards specified in Part 15, sub-part j for commercial and residential applications and shall bear labels indicating compliance testing. Equipment the does not meet these standards shall not be acceptable.
7. Title 24: All applicable system components and the system as a whole shall be certified as complying with Title 24 requirements.

D. Submittals

1. Submit a line-by-line comparison that describes the differences between each specifications requirement and the equipment / systems being proposed. Comparison shall include a complete listing of how the proposed equipment / systems differ from that specified with regard to size, quantity, quality, method of control, features and functions, control software functions and installation requirements.
2. Prior to fabrication and shipment of lighting control components, the manufacturer shall provide submittal documentation for approval under the general provisions of these specifications.
3. The submittal documentation shall include Class 2 control wire type and routing requirements necessary to match the proposed lighting control components.
4. Submittal documentation shall include a list of components to be supplied, panel schedules, wiring diagrams, detail drawings, and catalog submittal sheets demonstrating compliance with the specified requirements.
5. Provide as part of the submittal package a system riser drawing of sufficient detail to indicate relative placement of major system components and the required connections between each.
6. It shall be the responsibility of the contractor to verify all control wire requirements with the lighting controls manufacturer prior to rough in.

E. Project Conditions
1. The contractor shall not install lighting control system components in spaces where the ambient temperature cannot be maintained between 0 degrees to 40 degrees C (32 degrees to 104 degrees F) with a maximum humidity of 90%, non condensing.
2. All stored and installed lighting control components shall be adequately protected from dust and dirt.

F. Warranty
1. The lighting control manufacturer shall warrant the system to be free from manufacturing defects for a period of 5 years from shipment.
2. The warranty shall include replacement parts deemed necessary to restore the system to normal operation.
3. The manufacturer shall provide telephone technical support and remote diagnostics where applicable during normal business hours excluding manufacturer holidays.
4. Upon request, the manufacturer shall make available for purchase service contract option(s) which include on-site technician visits for service and repair.

G. Products
1. Manufacturers
a. The basis for design is the *NX* Distributed Lighting Control System from Hubbell Building Automation.
b. All proposed substitutions (clearly delineated as such) must be submitted in writing for approval a minimum of 10 working days prior to the bid date and must be made available to all bidders.
c. By using pre-approved substitutions, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring.
d. Provide complete shop drawings with deviations to the engineer for review and approval prior to rough-in.
2. General
a. Provide lighting control system hardware that is designed, tested, manufactured, and warranted by a single manufacturer.
b. System components shall be UL listed under the UL916 Energy Management Equipment standard.
3. Digital Room Controller
a. As indicated and where shown on the plans, install Hubbell Building Automation NXRC series Room Controller(s) to control the quantity of lighting and plug loads required.
b. Where indicated, the room controller shall provide 0 - 10 volt dimming capability for the required number of dimmable lighting loads.
c. The room controller shall integrate the functionality of connected control components including wall switch stations, occupancy sensors and daylight sensors to provide the required sequence of operation for the space.
d. Room controllers and associated room control components shall operate in a totally stand alone mode and not require the use of a network, software, computer or server for local control functions.
e. Mechanical:

1) The room controller housing shall measure 5.75" X 3.85" X 1.3" and be constructed of GSM UL rated 94 HB plastic approved for use in a return air plenum.
2) The housing and shall include an integral 1/2" chase nipple for external mounting to standard junction box knockout.
3) Four RJ45 Smart Port connectors shall be accessible on the side of the enclosure for connection of room control devices.
4) Two recessed push buttons and associated LED indicators shall be accessible on the top of the enclosure to provide override, status, set-up and testing functions.

f. Electrical:
1) The room controller shall have a single power feed and shall be capable of operation at voltages between 120 and 347 volts AC, 50/60 Hz.
2) One or two output relays (model specific) shall provide a total combined power switching capacity of 20 amps per unit.
3) Where indicated provide one or two independent 0 - 10 volt dimming channels (model specific) for full range dimming control of fixtures equipped with compatible dimmable ballast or driver.
4) Each dimming output shall have a current sinking capacity of at least 30 mA.
5) The room controller shall be capable of supplying 250 mA of Class 2 auxiliary DC power for use by wall switch stations, occupancy sensors, and daylight sensors connected to the room controller's four RJ45 Smart Port connectors.
6) Where indicated, room controllers shall be equipped with power monitoring circuitry capable of measuring and reporting the total connected load for each room controller.

g. Functional:
1) Provide an integral pushbutton and LED indicator for each load for status and to allow operation of the relays and dimmers for testing and verification without requiring other control devices to be connected.
2) The room controller shall have a default operation providing an automatic logical sequence of operation for each load as the room control devices are plugged into the Smart Port connectors.
3) Default operation for occupancy sensors shall be automatic on, automatic off for all loads.
4) Upon connection of a switch, the operation shall automatically change to manual on, automatic off (vacancy) mode for all loads.
5) Provide capability to convert each load independently to automatic on or vacancy mode using only the integral push buttons and LED indicators on the room controller.
6) When in vacancy mode, provide a 30 second grace period after an off during which automatic on shall be temporarily enabled.
7) It shall be possible to connect up to eight (8) room controllers together using Cat5 patch cables to provide configurations up to 16 switched and dimmed loads operating as a single zone.
8) Provide the following set up and configuration functions without the need for additional devices or software:
a) Assign/reassign relays for control by wall switch station buttons

b) Configure relays for occupancy or vacancy operation
c) Assign/reassign dimmers to raise/lower switches
d) Assign dimming channels for response to daylight sensor control
e) Auto calibrate default daylight sensor sequence of operation
f) Save preset scenes

g) Provide NXBTR Bluetooth® radio module with built in time clock function and smart phone app shall allow wireless setup and configuration of the room controller and connected devices through a user-supplied IOS or Android smart phone or tablet. The application shall provide as a minimum:

h) Configure wall switch button types. At a minimum, button types shall include toggle on/off with pilot, preset, on only and off only
i) Configure up to six zones of daylight harvesting per room with independent set points and time delays
j) Include or exclude loads from occupancy sensor control
k) Configure up to 16 load groups per room
l) Configure up to 16 preset scenes per room with independent fade times
m) Set independent power up conditions for relays and dimmers
n) Set independent occupied and unoccupied conditions for each relay and dimmer
o) Adjust dimmer high and low trim points
p) Manually control loads allowing use of the phone or tablet as a personal control for the room

(The Bluetooth® word mark and logos are registered trademarks owned by Bluetooth SIG, Inc. and any use of such marks by Hubbell Building Automation is under license. Other trademarks and trade names are those of their respective owners.)

H. Low Voltage Switch Stations

1. Low voltage digital wall switch stations shall be of the programmable type using standard Cat5 cabling for connection to system smart port.
2. Stations shall have one to six buttons and provide lighting control functions as called out and shown on the plans.
3. All switches shall be single gang and be of the generic decorator style allowing easy ganging and use of a wide array of standard wall switch plate options.
4. Provide two RJ-45 ports per switch to allow for daisy chain connection of up to eight switches to each smart port.
5. Switch station color shall be white, ivory, light almond, grey, or black as indicated.

I. Occupancy Sensors

1. Occupancy sensors shall be ceiling or wall mounted and use dual technology (ultrasonic and passive infrared), ultrasonic and/or passive infrared (model specific) sensing technology as indicated.
2. Sensors shall be Class 2 and connect to any room controller smart port using a wiring adaptor and standard Cat5 patch cable.

3. Occupancy sensors shall be self adaptive and not require manual calibration after installation. Digital circuitry and logic shall automatically make adjustments to the sensitivity and time delay based on learned occupancy patterns and the environment in which the sensor is installed.
4. Sensors using both ultrasonic and passive infrared (dual technology) shall operate such that detection by both technologies is required to initiate occupancy and continued detection by either technology will maintain occupancy.
5. Up to four occupancy sensors may be connected to one room controller.

J. Daylight Sensors

1. The *NX* daylight sensor shall provide ambient light level information to the room controller allowing daylight responsive lighting control.
2. The system shall operate in an open loop sequence of operation reducing the amount of electric light as the quantity of daylight entering the room increases. It shall be possible to configure up to six daylight zones in a room. Each zone shall be programmable to proportionally respond to the light level provided by the daylight sensor.
3. The daylight sensor shall be mounted and positioned to provide an unobstructed view of the windows per the manufacturer's directions.

K. Emergency Lighting Interface

1. Where emergency lighting is to be controlled by the lighting control system, provide UL924 listed load control relays as necessary to insure that emergency lights are automatically turned full on upon loss of normal power to the area.

L. Installation

1. Install all equipment in accordance with manufacturer’s installation instructions.
2. The lighting controls shall be installed in accordance with specific guidelines and submittal documents provided by the lighting control manufacturer.
3. Where variations from the general specifications or drawings exist, the contractor shall request a clarification prior to rough in or installation.
4. The contractor shall verify all wire type and routing requirements with the lighting controls manufacturer prior to installation. Not part of this section are requirements for work including, but not limited to, raceways, electrical boxes, junction boxes, circuit protection, wiring, and fittings required for installation of the lighting control equipment.

M. Startup and Programming

1. The system manufacturer shall provide a factory authorized field engineer to the project site after installation has been completed and prior to system energization for the purpose of testing and adjustment of the system. Factory field engineer shall test and verify all system functions and ensure proper operation of the system components in accordance with the specifications and on-site conditions. The installing contractor shall notify the system manufacturer in writing that the system is completely wired and ready to be energized and tested 2 weeks prior to scheduling a field engineer for start-up of the system. Should the field engineer arrive on the job site and find the installation incomplete, the installing contractor

shall pay the cost of any future visits by the field engineer required to complete the system start-up.

2. During the start-up procedure, the factory field engineer shall provide programming assistance and guidance to the building operating personnel in order to program the systems for initial operation.
3. Allow for up to 4 hours of on-site training on the use and maintenance of the lighting control system to be scheduled at the completion of startup and programming of the system.

N. Technical Support

1. The lighting controls manufacturer shall provide reasonable access to factory direct telephone technical support during normal business hours.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 95 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions. Provide back boxes, mounting brackets, guards, trims plates or other required finishes to provide a complete and functional unit.

The locations and quantities of sensors indicated within Contract drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The contractor shall provide additional sensors if required to properly and completely cover the intended area while meeting 95 percent coverage. It is this contractor’s responsibility to arrange a pre-purchase/installation meeting with the manufacturer’s factory authorized representative, at the owner’s facility, to verify placement of sensors and installation criteria.

3.2 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Wire & Cables." Minimum conduit size shall be 3/4 inch.

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Cable type, pair quantity or sizing of conductors according to lighting control manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

E. It is this contractor’s responsibility to insure exposed cables are properly bundled, supported, protected and rated (plenum) for area of installation.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices which fail tests and inspections are considered defective work and shall be replaced at no cost to the project.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training." Provide no less than (3) three complete set of operation and maintenance manuals at time of training.

END OF SECTION 260923

SECTION 260943 EXTERIOR WIRELESS NETWORK LIGHTING CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements, Division 1 Specifications, apply to this Section.

1.2 SUMMARY AND KEY SYSTEM DIFFERENTIATORS

A. The lighting control system specified herein shall provide a wireless, distributed, secure, self-healing peer to peer mesh network of controlled luminaires with optional motion sensors for outdoor lighting applications.

B. The system shall provide a marked-up site map with all fixture locations, and fixtures shall be labeled (on box and fixture) with corresponding location/type for easy installation.

C. The system shall be capable of turning luminaires on/off (where supported by the luminaire) as well as full range dimming.

D. The system shall be capable of operating luminaires completely independently, without the need for external control equipment (routers, servers, access points, etc.). The controlled luminaires shall have an internal Real Time Clock (RTC) to support independent operation. The RTC shall be backed with a solid state battery, providing backup power for at least four days with AC power disconnected.

E. If required, the controlled luminaires can be shipped pre-commissioned from the factory.

F. The system shall communicate wirelessly utilizing long range 2.4GHz ISM radio band (16 channels) and be capable of supporting distances up to 300’. Systems which use other frequencies shall provide documentation insuring range and performances equal to that of the specified system.

G. All system components shall be completely contained inside of the luminaire.

H. The controlled luminaires shall support multiple schedules including weekday and special date (e.g. Holiday) schedules.

I. The controlled luminaires shall be able to perform lumen maintenance.

J. The controlled luminaires shall support an optional integrated Passive Infrared (PIR) motion sensor (where available). Each sensor shall be capable of controlling its host fixture, satellite luminaires within its group, up to four motion zones or the entire network.

K. The system shall be supplied with a Graphical User Interface (GUI) and USB bridge node to wirelessly interface with and configure the luminaires.

L. Device firmware shall be updateable from the GUI and USB bridge node. Firmware updates shall not require a serial or patch cable. Owner to receive (2) USB bridge node devices.

M. For security purposes, the system shall not be capable of Internet connectivity or remote access. The system shall support AES-128 encryption for wireless communications.

N. System shall not require a third-party 24/7 manned network operations center for systems monitoring.

O. System shall not require an annual service contract or licensing fees.

P. The system shall provide a 5-year warranty for all components.

1.3 DEFINITIONS

A. AES-128 – Advanced Encryption Standard 128 bit encryption key

B. FCC – Federal Communications Commission

C. HCS – Hubbell Control Solutions

D. HLI – Hubbell Lighting Incorporated

E. IC – Industry Canada

F. ISM Band – Industrial, Scientific and Medical radio frequency band

G. NEC – National Electrical Code

H. NEMA – National Electrical Manufacturer Association

I. RF – Radio Frequency

J. RTC – Real Time Clock

1.4 SUBMITTALS

A. Manufacturer shall provide submittal drawings and data for approval prior to beginning manufacture of equipment in printed and/or electronic formats.

B. Submittal package shall include, but not be limited to, the following. Submittals that do not contain all the information listed below will not be considered for approval.

1. Bill of Materials: Provide as part of the submittal package a detailed itemized listing of all proposed equipment, including quantities and capacities for all major system components.

2. Product Data Sheets: Provide as part of the submittal package detailed product data sheets for all major system components.

3. Shop Drawings: Submittal shall include shop drawings that accurately represent the system or systems specified herein. Shop drawings shall include the name of the project, quantity and physical dimensions of all major system components, wire sizes and counts for all required connections between system components.

4. Factory Pre-commissioning and/or Onsite Commissioning Worksheets – must be completed prior to factory pre-commissioning or onsite commissioning start-up.

5. Specifications Compliance: Submit a line-by-line comparison that describes the differences between each specifications requirement and the equipment / systems being proposed. Comparison shall include a complete listing of how the proposed equipment / systems differ from that specified with regard to size, quantity, quality, method of control, features and functions, control software functions and installation requirements.

1.5 QUALITY ASSURANCE

A. Factory Assembly: All devices shall be factory assembled and tested. All system components shall arrive at the job site complete and ready for installation, requiring only the connection of lighting circuits and wireless update of date and time to the network.

B. Component Testing: All system components and assemblies shall be individually tested prior to assembly. Once assembled, all finished products shall be tested for proper operation of all control functions per specifications prior to shipment.

C. NEC Compliance: All system components shall comply with all applicable sections of the National Electrical Code (NEC) as required.

D. NEMA Compliance: All system components shall comply with all applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.

E. FCC Emissions: All applicable equipment shall comply with FCC emissions standards specified in Part 15, sub-part C for commercial and residential applications and shall bear labels indicating compliance testing. Equipment that does not meet these standards shall not be acceptable.

F. All applicable products must be ETL or UL Listed or certified by a Nationally Recognized Testing Laboratory.

G. Manufacturer must have a minimum of ten [10] years of experience manufacturing lighting controls.

1.6 COORDINATION

1.7 WARRANTY

A. All devices in the lighting control system shall have a 5-year manufacturer's warranty.

B. Warranty period shall begin after the completion of the installation and the system's start-up and training, the point at which the system owner receives beneficial use of the control system or 1 year after shipment from the manufacturer, whichever occurs first.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer:

1. Hubbell Control Solutions

a. System: SiteSync™ Lighting Control

B. Substitutions:

1. All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by the design professional a minimum of 10 working days prior to the bid date and must be made available to all bidders. Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.

2. By using pre-approved substitutions, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices and wiring. The contractor shall provide complete engineered shop drawings (including power and control wiring) with deviations from the original design highlighted in an alternate color to the engineer for review and approval prior to rough-in.

2.2 SYSTEM REQUIREMENTS

A. System shall consist of wireless, distributed and intelligent luminaires consisting of but not limited to ON/OFF (where available) and 0-10VDC full range dimming capabilities, and optional integrated motion sensors.

B. Device Firmware and radio firmware shall be upgradable over the air via a USB bridge node.

C. System shall use a flood mesh algorithm wherein each repeater broadcasts each packet received (with safeguards against repeating a message more than once). Selection of repeaters shall be done via a system configuration file.

D. System shall be self healing. System shall be capable to bypass a failed node without compromising message delivery.

E. Controlled luminaires shall be able to maintain accurate date and time using an internal Real Time Clock (RTC). RTC shall be backed with a solid state battery, providing backup power for at least four days with AC power disconnected.

F. System architecture shall facilitate data transmission between each wireless luminaire over the 2.4GHz ISM Radio Frequency (RF) band with an unobstructed RF range of 300ft between each controlled luminaire.

G. System architecture shall support the ability to configure controlled luminaires as wireless repeating nodes or non-repeating nodes. This setting shall be part of the luminaire pre-commissioning if the manufacturer is supplied with an appropriate site map.

H. System shall be capable of securing all wireless messages. When transmitting over the air, each controlled luminaire can be configured to use the strong and secure AES-128 (Advanced Encryption Standard) security cipher to encrypt and decrypt messages.

I. System shall be capable of being accessed from a computer running the Windows® Operating System, the SiteSync GUI client application and the SiteSync USB bridge node.

J. System shall have an intuitive and easy to use Graphical User Interface (GUI) to configure, control and schedule individual luminaires or groups of luminaires.

K. System shall support factory pre-commissioning. If programming is required on site, the system shall remain fully functional during the programming process. Lighting control systems that must be taken “OFF LINE” for programming are not acceptable. All programming changes shall take effect immediately as they are programmed.

L. System shall belong to the customer and the SiteSync client application can be installed on the customer’s own computers.

2.3 WIRELESS CONTROLLED LUMINAIRES

A. Controlled Luminaires shall be fully programmable and capable of storing and autonomously execute commands and schedules. The operating scenarios described below shall reside within each addressable intelligent controlled luminaire even in case of power outage. Systems which rely on the operator to develop these scenarios using a programming language will not be allowed.

B. Standard on all controlled luminaires:

1. Unique network address

2. Radio Script Version Status

3. Radio Channel #
4. Encryption Key
5. Repeater Setting
6. Catalog #
7. Group #
8. Name (Optional)
9. Type (Optional)
10. Pole # (Optional)
11. Description 1 (Optional)
12. Description 2 (Optional)
13. Short ID
14. Schedules (6) – Includes Weekday and Special Date Schedules
15. Lumen Maintenance Setting
16. Motion Sensor Settings
17. Manual Control
18. Diagnostics Information

C. System shall provide repeat capabilities to extend the range beyond normal radio range.

D. Distributed Control

1. Each addressable intelligent luminaire and sensor-modules shall be capable of autonomous automatic operation. Operating scenarios discussed above shall not depend on the operation of a central panel or computer.

E. Controlled luminaires shall be FCC Certified and IC Certified.

2.4 SITESYNC SOFTWARE

A. Graphical User Interface (GUI)

1. Data shall be entered through a simple Graphical User Interface independently of the language of the operating system. The operating system shall be Windows 7 or more recent.

B. Schedules

1. Up to six (6) schedules may be assigned to controlled luminaires.
2. Each schedule shall allow up to eight (8) events per day.
3. Applicable period for individual schedules shall be user-defined, may be specific to the day of week, and shall include the concept of holidays, and special event periods.
4. Schedules may be individually specified for up to twenty-four (24) specific calendar dates, overriding the normally scheduled weekday schedule.
5. Daylight savings time changes (if applicable to the locale) shall be automatic.
6. Dimming events within each schedule may be defined in terms of a definite time (i.e. clock time), or astronomical time (relative to sunrise and sunset). Definite and astronomical times may be combined within the same schedule – the software shall automatically detect any conflict and provide a warning.
7. Sunrise and sunset times shall be based on the site location, and shall be programmed at the factory as part of the luminaire pre-commissioning. Each luminaire shall recalculate sunrise and sunset times on a daily basis and adjust schedules accordingly.

C. Lumen Maintenance

1. Lumen Maintenance settings shall be available to disable or enable lumen maintenance functionality.

D. Motion Sensor Settings

1. Enable Individual Motion Sensing
2. Enable as a Master Sensor for Own Group
3. Configurable cycle duration (mins)
4. Enable as a Master Sensor for up to four (4) Motion Zones
5. Enable as a Master Sensor for Entire Network
6. Restrict motion detection to specific time intervals
7. Configurable High Brightness Level
8. Luminaires responding as satellites can be configured to use either the controlling master’s settings, or their own, for cycle duration and high brightness level.

E. Manual Control

1. Slider control for dimming level %
2. Numerical input for brightness %
3. Increase light level
4. Decrease light level
5. Flash/Wink luminaire
6. Reboot luminaire

F. Diagnostics

7. Downloadable diagnostic data
    a. Network address
    b. Brightness %
    c. Time
    d. Date
    e. Current DST status
    f. DST setting
    g. Clock status
    h. Mode
    i. RTC battery charging status
    j. PCB temperature (where available)
    k. Operating hours
    l. Highest recorded temperature (where available)
    m. Highest temp time/date (where available)
    n. Dim Schedule
    o. Scheduled Events #1 - #8
    p. Thermal Protection Limit %
    q. Global Dimming Factor %

r. Executed Brightness %

s. Link Quality %

t. Dimming Voltage

u. Voltage Ckt 1 and Ckt 2 (where available)

v. Drive Current (A) (where available)

w. Power (W) (where available)

x. Energy Used (kWh) (where available, not certified as Utility Grade)

y. Time of Last Boot

z. Time of Last Time Set

aa. Repeater Setting

bb. Group (Live)

cc. Motion Sensor State

dd. Motion Config ID

ee. Individual Motion Sensor Setting

ff. Remote Motion Sensor Setting

gg. Motion Sensor Master for Network

hh. Motion Sensor Master for Group

ii. Motion Sensor Master for Motion Zones

jj. Software Script Version (Live)

kk. Radio Channel (Live)

ll. Encryption Key (Live)

2.5 MOTION SENSORS

A. Motion Sensors shall provide automatic switching of lighting load(s) within an area/zone based on the presence of human activity.

B. Motion Sensors shall not require any manual adjustment at the time of installation or during operation.

C. Motion Sensors shall utilize passive infrared to detect motion.

D. Motion Sensors with passive infrared technology shall monitor background temperature levels and automatically make corresponding adjustments.

E. Motion Sensors shall be capable of controlling its host fixture, satellite luminaires within its group, up to four motion zones or the entire network, or any combination thereof.

F. Motion Sensors shall have a configurable timeout delay that can be set via the GUI. Motion sensors that require manual time delay knobs or DIP switch settings for field adjustment are not acceptable.

G. Motion Sensors shall be end or surface mounted (depending on model).

PART 3 - EXECUTION

3.1 INSTALLATION

A. All equipment shall be installed in accordance with manufacturer's installation instructions and in compliance with all applicable local and national codes and requirements.

B. Provide complete installation of system in accordance with Contract Documents.

C. Provide documentation on the commissioning of the system including by not limited to the following:

1. Sequence of operations
2. Device settings
3. Load parameters
4. Schedules

3.2 ON-SITE FACTORY COMMISSIONING

A. Upon completion of the installation, the system shall be commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system.

B. The electrical contractor shall provide both the manufacturer and the electrical engineer with ten working days written notice of the system startup and adjustment date.

C. Upon completion of the system commissioning, the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.

END OF SECTION 260943

SECTION 262200 LOW-VOLTAGE TRANSFORMER

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SCOPE

A. Dry type energy efficient transformers shall be provided in the distribution system. Transformers shall have kVA and voltage ratings as indicated on the Contract Documents. Transformers shall exceed the efficiency requirements of DOE 2016, and performance of these units on this project per this specification shall be guaranteed by the manufacturer.

B. Distribution transformers for non-linear three-phase loads shall have a minimum K-7 rating. Where indicated on drawings, they shall be harmonic mitigating type.

1.3 REFERENCES

A. NFPA 70 - National Electrical Code (Edition Adopted by OBC)

B. NEMA ST20-2014 - Dry-Type Transformers for General Applications

C. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment

D. DOE Test Method for Measuring the Energy Consumption of Distribution Transformers under Appendix A to Subpart K of 10 CFR part 431.

E. US Department of Energy, 10 CFR Part 431, 2016. Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule.

F. IEEE C57.110-2008 – IEEE Recommended Practice for establishing transformer capability when feeding non-sinusoidal load currents.

G. ISO 14001:2004 – International Standards Organization - Environmental Management System UL 1561 - Dry-Type General Purpose and Power Transformers.

H. ISO 17025 – International Standards Organization - General requirements for the competence of testing and calibration laboratories.

I. UL 1561 - Dry-Type General Purpose and Power Transformers.

1.4 SUBMITTALS FOR REVIEW

A. Product Data: Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, transformer inrush ratings, tap configurations, insulation system type, rated temperature rise, and performance under linear and nonlinear load.

B. Test Reports: Indicate loss data, efficiency at 25, 50, 75, and 100% rated load, and sound level.

1.5 SUBMITTALS FOR INFORMATION

A. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

B. Documentation from manufacturer stating that all performance requirements shall be met for every transformer on this project.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section shall have a minimum of ten (10) years of experience.

B. Manufactured in a certified ISO 9001, 14001, and 17025 facility.

1.7 REGULATORY REQUIREMENTS

A. Installation to conform to requirements of NFPA 70 and all local codes and standards.

B. Products: Listed and classified by Underwriters Laboratories, Inc. or Authority Having Jurisdiction, as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components enclosure, and finish.

PART 2 - PRODUCTS

2.1 BASIC REQUIREMENTS

A. Sound levels must be 3db below NEMA ST-20-2014 standard levels according to kVA size.

1. Provide audible sound level test report for each transformer reference IEEE C57.1291, NEMA –ST-20-2014.

B. All insulating materials are to exceed NEMA ST20-2014 standards and be rated for 220 deg.C UL recognized insulation system.

C. Transformers shall be configured with maximum winding temperature rise of 130degC.

D. Transformer impedance shall between 3.8-6.0 (%Z).

E. Transformer shall have the following minimum full capacity taps: two (2) 2-1/2% taps above and four (4) 2-1/2% taps below normal rated primary voltage.

F. Neutral: Neutrals sized to accept 200% rated neutral conductors.

G. Transformers shall be low loss type that exceeds DOE 2016 efficiency legislation.

H. Efficiency at linear load shall comply and exceed the minimum requirements with the following when tested per U.S. DOE 10 C.F.R Part 431, Nonlinear load efficiency shall be under K-7 profile.

Three Phase Efficiencies and Losses for K-RATED			
KVA Size	Maximum No Load Watt Losses	%Efficiency at 35% load; Linear	%Efficiency at 35% load; K7 nonlinear
15	34	98.24	97.89
30	57	98.54	98.23
45	80	98.71	98.40
75	115	98.84	98.60
112.5	160	98.97	98.74
150	205	99.03	98.83
225	285	99.13	98.94
300	355	99.20	99.02
500	515	99.28	99.14

I. Enclosure:

1. The transformer shall be protected by a ventilated heavy gauge metal enclosure with ventilating openings. The enclosure shall be degreased, cleaned, primed and finished with baked enamel coating.
2. The transformer core and coil shall be mounted on vibration isolator pads.

J. Basic Impulse Level shall be 10 kV.

K. Enclosure: Type 2: Indoor Ventilated Drip Proof; Vermin Resistant. Provide lifting eyes and brackets. Provide NEMA 3R for installations subject to overhead moisture or installed in suitable environment.

L. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

M. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

N. Transformer shall be suitable for floor mounting unless noted otherwise. Where floor mounted a 4” height fiber reinforced concrete pad extending minimum of 3” inches beyond transformer dimensions and extending beyond meeting manufacturers required ventilation clearances. Whichever dimension is greater.

O. Isolate core and coil from enclosure using vibration-absorbing mounts.

P. Transformer coils shall be copper or aluminum windings of the continuous wound construction type and shall be impregnated with non-hygroscopic, thermosetting varnish.

Q. Harmonic Mitigating: (Where called for with Project Documents)

1. Shall supply phase shift of 0°/30°, 15°/45°, or 0°/20°/40°, or otherwise noted on contract documents. Minimum K-13 rating.
2. Have an impedance range of 3.8%-6% with a minimum reactance of 2% to aid in reduction of neutral currents.
3. Have a temperature rise of 115°C.
4. Have a Zero sequence reactance below 0.3% to minimize added distortion due to 3rd harmonic.
5. Dual Electrostatic shielding to be provided. The attenuation of line noise and transients shall equal or exceed the following limits:

   a. Common Mode: 1.5kHZ to 10kHZ - 90Db
6. Linear load Efficiency shall comply and exceed the minimum requirements with the following when tested per U.S. DOE 10 C.F.R Part 431 procedures. Nonlinear load Efficiency shall be under K-13 profile:

Three Phase Efficiencies and Losses for Harmonic Mitigating			
KVA Size	Maximum No Load Watt Losses	%Efficiency at 35% load; Linear	%Efficiency: K-13 @ 50% nonlinear load
15	55	98.28	97.89
30	80	98.50	98.23
45	110	98.66	98.40
75	150	98.82	98.60
112.5	215	98.92	98.74
150	260	98.99	98.83
225	365	99.09	98.94
300	440	99.15	99.02
500	715	99.25	99.14

2.2 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one (1) of the manufacturers specified per models listed or as recommended by manufacturer representative per given application:

1. PQI – Power Quality International (Design Base)
2. PowerSmiths
3. Eaton Electric
4. Square D, Schneider Electric
5. General Electric
6. Siemens

2.3 PROJECT REQUIREMENTS

A. Primary Voltage: 480 volts unless noted otherwise.

B. Secondary Voltage: 208/120 volts 4 wire unless noted otherwise.

C. Phasing: 3-phase and/or single phase unless noted otherwise.

D. Provide transformer equipment pad for each floor mounted unit as specified within contract documents.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Transformers shall be securely mounted level and plumb, from the building structure or walls with mass at locations shown on Contract documents. Use a neoprene compressive material at points of mounting to cut vibration noises. Sizing of vibration isolators in accordance with actual weight of installed unit. In general, transformers shall be located, set, mounted and connected in such a manner to keep noise levels within the surrounding ambient noise levels.

B. Provide structural steel angle knee bracing platform to mount transformers on walls or provide angles welded to building structural steel members with rods dropping to angle or channel steel platform necessary to support transformers hung above ceiling. Furnish prime coats of paint on steel. Transformer steel supports shall be designed to adequately carry the load imposed and in no case shall supports be anchored to building steel where imposed loads shall endanger building structural system. Verify structural integrity of area where transformers are to be located. Locate transformers in area to assure adequate air circulation around unit. Coordinate hung transformer weight with General Contractor for approval.

C. Unit shall be mounted on free standing rubber vibration isolators sized in accordance with actual weight of unit installed.

D. Use flexible conduit, 24" minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

E. A minimum of 3" space shall be allowed around all ventilation openings or in accordance with manufacturer's recommendations.

F. Provide grounding bonding and required lugs.

G. Accessories: All related items required for connection and final installation shall be provided by this contractor including lugs, wire, crimps, lifting apparatus, tape, shields etc.

H. Mounting location must remain accessible for inspections, replacement and general service.

3.2 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.2.

3.3 ADJUSTING

A. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION 262200

SECTION 262416 SWITCHBOARDS AND PANELBOARDS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Service - Switchboards.
2. Distribution panelboards.
3. Lighting and appliance branch-circuit panelboards.
4. Load centers.
5. Surge protective devices on panelboards.

B. Provide electric services with capacity and voltage requirements per contract documents. Coordinate all service requirements with the local utility including available fault currents, locations and installation of equipment.

C. Interrupting Capacities: Panel boards to have interrupting capacity capable of handling fault current which is available at the point in the circuit where the panel is installed.

D. Interrupting ratings are listed within Contract documents. These capacities are based on feeder sizes and panel locations shown within Contract documents. If changes are made, these ratings must be adjusted by the Electrical Contractor.

E. Source Limitations: Obtain switchboards, panelboards, overcurrent protective devices, components and accessories through one source from a single manufacturer.

F. Provide arc flash hazard label on equipment per the National Electrical Code including NFPA 70E.

G. Provide documentation and compliance to satisfy NEC Article 240.87.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. RFI: Radio-frequency interference.

D. RMS: Root mean square.

E. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of panelboard, overcurrent protective device, surge protection device, accessories, and components indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
   a. Enclosure types and details for types other than NEMA 250, Type 1.
   b. Bus configuration, current, and voltage ratings.
   c. Short-circuit current rating of panelboards and overcurrent protective devices.
   d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
2. Wiring Diagrams: Power, signal, and control wiring.

C. Panelboard Schedules: For installation in panelboards.

D. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device.
3. Selective coordination and series rating charts.

1.5 QUALITY ASSURANCE

A. If an independent testing agency is required, see Division 01 Section "Quality Requirements" for general testing and inspecting agency qualification requirements. If additional control is needed, use one of first two paragraphs below to specify 29 CFR 1910.7 or other more specific criteria (e.g., NETA). 29 CFR 1910.7 defines a nationally recognized testing laboratory as it applies to testing and inspecting for safety, and lists, labels, or accepts equipment and materials that meet certain OSHA criteria.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

C. Product Options: Project documents indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

C. Interruption of Existing Electric Service (Where Applicable): Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner’s representative no fewer than 2 days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without written permission by all affected parties.

1.7 COORDINATION

A. Coordinate layout and installation of panelboards and components with other potential construction interferences such as wall penetrations, supports, including electrical and other types of wall mounted equipment, raceways, piping, and other miscellaneous encumbrances. Electrical Contractor shall maintain NEC workspace clearance requirements.

B. Coordinate size and location of Electric Contractor provided concrete bases with Utility Provider and various equipment manufacturers. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Electrical Contractor shall coordinate with local utilities and general contractor in preparation of and installation of all underground electric including manholes, handholes and raceways associated with: electric services, telecommunications, fire alarm monitoring points, site lighting and feeders or branch circuits.

1.8 EXTRA MATERIALS

A. Provide panelboard nameplate per “Electrical Identification” specification 26-05-53.

B. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: (6) six spares for each type of panelboard lock.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Switchgear, Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
   a. Cutler-Hammer
   b. Square D (basis of design)
   c. General Electric
   d. Siemens

2.2 SHORT-CIRCUIT RATING

A. UL label indicating series-connected rating with integral or remote upstream overcurrent protective devices. Include size and type of upstream device allowable, branch devices allowable, and UL series-connected short-circuit rating.

B. Equipment shall be fully rated to interrupt symmetrical short-circuit current available at terminals.

2.3 GROUND FAULT PROTECTION

A. The ground fault and overload trip mechanisms shall be of the static type with adjustable, long-time, short-time, and instantaneous both in time and current setting. Ground fault protective circuitry hall be provided in accordance with NEC requirements. Adjustment shall be provided by this contractor.

B. Provide ground fault protection for service per Contract Documents.

2.4 SERVICES

A. The electric services to the facility will be provided by the Electrical Contractor at 208Y/120 volts 3-phase 4-wire.

B. Electric Contractor shall provide all necessary primary and secondary trenching, pole riser raceways, all underground raceways, pulling man-holes, transformer pad with cabling vault, transformer grounding, backfill, assembly, service-lateral, secondary terminations including at transformer lugs, labor and material all in accordance with Utility Company and NEC requirements and associated standards.

C. Final pad dimensions and construction must comply with local Utility.

D. All trenching shall be free from projecting rocks or other foreign matter. Dimensions trenches shall meet requirements of electric details shown on Contract Documents and/or that of the Utility Company which ever is more stringent. Rock free trench backfill material shall be compacted in 8 inch lifts. Include trench warning tape per NFPA 70-300.5(3).

E. Grounding of transformer shall be incompliance with National Electrical Code and meet installation requirements of the Utility Company.

F. Meter socket must have provisions for Utility Company lock. Material supplied shall have a minimum 65,000 AIC rating or as otherwise shown on Contract documents. Exterior enclosures shall be NEMA 3R unless noted otherwise in Contract documents.

1. EC shall provide NEMA type terminal lugs sized for service conductors. In addition, EC to route an underground 2” schedule 40 PVC conduit from transformer secondary section to pipe mounted meter socket mounted no more than 66” above finished grade according to Utility installation requirements. Length of 2” underground metering conduit shall not exceed 25 feet in total length. EC shall also provide a 1” underground schedule 40 PVC conduit from the meter socket to the building interior for a phone cable.

G. Secondary underground conduit shall be schedule 40 PVC sized as shown within Contract documents.

2.5 CONDUIT

A. Conduit joints shall be sealed with waterproof joint compound. Schedule 40 PVC conduit shall transition to rigid galvanized steel conduit prior to exiting final grade. All conduit bends shall be factory made large radius elbows. Conduits shall be cleaned and free from internal debris prior to assembly. Full bore conduit opening shall be continuous in length and maintained at all times. All foreign matter must be removed from raceways. Provide a pull cord in each conduit.

2.6 SWITCHBOARDS

A. Provide a dead front type, completely metal enclosed, self supporting structure independent of wall supports. Switchboard shall consist of the required number of vertical sections bolted together to form one rigid switchboard incorporating switching and protective devices of the number, ratings and type noted herein or shown within Contract documents with necessary interconnections. Switchboard construction shall be of the universal frame type using die formed members bolted and braced through the exclusive use of self tapping bolts which shall not loosen during shipment. Ventilation openings shall be provided where required. Covers shall be secured by self tapping screws. Properly anchor to floor.

B. Service Equipment Label: Switchboard shall be UL labeled for use as service equipment.

C. The bus shall be tin plated copper of sufficient size to limit the temperature rise to 55degC based on UL tests, and adequately braced and supported to withstand mechanical forces exerted during short circuit conditions when directly connected to a

power source having the indicated available short circuit current. Connections shall be tightly bolted.

D. A ground bus and lug shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard.

E. Switchboard shall be provided with adequate lifting means and shall be capable of being rolled or moved into installation position and bolted directly to the floor without the use of floor sills.

F. A B C type bus arrangement, left to right, top to bottom, and front to rear, as viewed from the front, shall be used throughout.

G. Record drawings shall be furnished providing the following information: switchboard voltage/current rating; overall outline dimensions including available conduit space; switching and protective device ampere ratings; and one line diagram.

H. Adequate conduit space shall be provided to meet NEC requirements.

I. Each switching and protective device shall be provided with visible means of ON OFF identification. Terminals shall be solderless type suitable for copper or aluminum cable of sizes indicated.

J. Exterior and interior steel surfaces of switchboards shall be properly cleaned and finished with two baked enamel over rust inhibiting phosphatized coatings. Two toned gray shall be ANSI 61 and ANSI 49.

K. Switchboard shall be of construction by Square D Type QED-2 Series or an approved manufacturer, 3 phase, 4 wire, voltage as specified within Contract documents, in which:

1. Service Equipment Label: UL labeled for use as service equipment.
2. All sections of switchboard shall be uniform 24” in depth.
3. Switchboard MSB at the facility shall have a 36 inch wide bottom fed main service incoming lug section (on the right side viewed from the front),
4. Switchboard MSB at the facility shall have a 36 inch wide bottom fed main service incoming lug and main breaker section with metering and ERMS switch and a 42 inch wide distribution section coordinating with under slab conduit stub-ups, . Main Overcurrent Protective Devices: 100% rated circuit breaker or as called for within contract documents.
5. Construction shall allow maintenance of incoming line terminations, main device connections and main bus bolted connections to be performed without rear access.
6. The feeder or branch devices shall be removable from the front and shall be panel mounted with the necessary device line and load connections front accessible.
7. The main horizontal bus bars shall be mounted on glass polyester insulators with all three phases arranged in the same vertical plane. The main bus shall have ampacities and bracing for maximum short circuit values. Main bus splices shall be supplied between adjacent distribution sections.
8. Vertical sections shall be completely factory assembled, wired and tested before delivery and shall bear UL labels where qualified. Design shall meet NEC and

NEMA standards as well as OSHA requirements. Individual vertical sections shall be designed for bolting together at installation site.

9. All interconnecting wires for connecting of vertical sections shall be field installed.

2.7 DISTRIBUTION PANELBOARDS

A. Distribution panelboards shall be of construction by Square D Type ILINE or an approved manufacturer, 3 phase, 4 wire, voltage as specified within Contract documents.

B. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.

C. Doors: Secured with tumbler lock; keyed alike.

D. Main Overcurrent Protective Devices: 100% rated circuit breaker or as called for within contract documents.

E. Branch Overcurrent Protective Devices:

1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
2. For Circuit-Breaker Frame Sizes Larger Than 125 A: plug-in circuit breakers as furnished by panelboard manufacturer.

2.8 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Lighting and appliance panelboards shall be 3 phase, 4 wire, unless called out otherwise in the Contract documents. Provide voltage and branch circuit quantity as specified within Contract Documents.

B. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

C. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

D. Available Manufacturers:

1. Square D Type “NF” or “NQ” (Basis of Design)
2. Cutler-Hammer
3. General Electric
4. Siemens

2.9 PANELBOARD ACCESSORIES

A. Accessories: Provide all required accessories required for a complete assembly and as noted but not limited to the following: lug kits, ground and neutral bars, filler plates, breakers, shunt trip devices, breaker handle attachments, circuit ID strips, completed directory card etc.

2.10 SURGE SUPPRESSION

A. See Specification Section 264310 for SPD requirements.

2.11 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: UL 489, with interrupting capacity to meet available fault currents.

1. Provide overload protection for each device or circuit deriving from panels according to plans or schedules. Where a specific circuit has not been assigned to a device or equipment, a properly sized circuit for load served shall be provided at no additional cost to the project.
2. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit breaker frame sizes 250 A and larger.
3. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
4. Electronic trip-unit circuit breakers shall contain:
   a. UL listed as field replaceable, 100% rated.
   b. Upgradable without special adjustments
   c. To be true RMS current sensing
   d. Field-replaceable rating plug.
   e. Advance relay protection (voltage under/over, phase loss, current imbalance, etc.)
   f. Field-adjustable settings:
      1) Instantaneous trip
      2) Long- and short-time pickup levels.
      3) Long- and short-time time adjustments.
      4) Neutral protection
      5) Ground-fault pickup level, time delay, and I2t response.
5. Switchgear main breaker trip unit shall be Square D Micrologic 6.0P or approved equal.
6. Main switchgear circuit breakers 125 amp and larger shall be electronic trip-unit circuit breakers (see item #4 above).
7. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
8. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
9. Shunt Trip: Panels in areas where shown on plans shall be equipped with breakers featuring shunt trip coils operating at 120vAC. Coil shall be energized from separate circuit, set to trip at 75 percent of rated voltage unless specified elsewhere or subject to code compliance.
10. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.

11. Auxiliary Contacts: One SPDT switch with "a" contacts mimic circuit-breaker contacts.

12. Multipole units enclosed in a single housing or factory-assembled to operate as a single unit.

B. Branch Breakers

1. Branch circuit portions of each panel board shall comprise the required and indicated number of interchangeable bolt on non combustible thermal magnetic circuit breaker sections; single or multiple pole, rated not less than 20 amperes, 125 volts and higher as noted. Breakers are required to provide I.C. sym. amp as shown on the panel schedule(s).
2. Circuit breakers shall be readily removable from the front of panel board without disturbing adjacent units. They shall have quick make and quick break toggle mechanisms, non fusible contacts, with inverse time, short circuit characteristics. Breakers shall trip free on overload. They shall indicate clearly whether they are in the open, tripped or closed position. Multipolar units shall have thermal element in each pole and shall have a single handle. Closely grouped circuit breakers and thermal tripping devices mounted in a common cabinet shall be derated when necessary in accordance with NEMA standard recommended practices for high ambient temperatures.
3. Circuit breakers protecting circuits supplying receptacles, signaling devices, clocks, special equipment and other similar circuits not requiring switch control shall be equipped with an approved breaker locking device as called for within Contract documents.
4. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
5. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity. Provide 30-mA trip sensitivity for electric heating equipment conforming to the NEC.
6. Breakers in panelboards used for switching of circuits shall be rated for switching duty.
7. Breakers loads which include high intensity discharge (HID) lighting systems, such as mercury vapor, metal halide or high-pressure sodium shall be HID rated.
8. Lighting applications or other applications where high inrush current exceeds standard tripping conditions, high-magnetic circuit breakers shall be used. Consult branch breaker manufacturer for applications requiring such.
9. Neutral sharing for multiphase panelboards is not an approved wiring method. All branch circuits shall be wired with a dedicated neutral sized in accordance with the NEC.

2.12 REQUIRED ACCESSORY COMPONENTS AND FEATURES

A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Customer Metering (Main and Branches)

1. Provide a separate customer metering compartment with front hinged door containing a solid state monitoring system.

2. The customer metering device shall have the following features:
    a. All startup parameters shall be stored in nonvolatile memory and retained in the event of a control power interruption.
    b. The meter shall provide the following, true RMS metered quantities:
        1) Current, per phase and neutral.
        2) Current demand – maximum per phase and neutral.
    c. Voltage, per phase (L-L, L-N).
    d. Power, per phase, 3 phase total (kW, kVA, kVAR).
    e. Power factor, 3 phase total.
    f. Power demand,(kWd) present and peak.
    g. Power demand, (kVARd, kVAd) present and peak.
    h. Real energy (kWh).
    i. Energy, IN and OUT (kWh, kVARh, kVAh).
    j. Minimum/maximum readings, currents, voltages, frequency, power factor, and total harmonic distortion.
3. Power demand calculation capabilities.
4. Minimum and maximum value collection with the following recorded attributes:
    a. Date/time of minimum/maximum values.
    b. Minimum/maximum value.
    c. Phase of recorded minimum/maximum (for multi-phase quantities).
    d. All minimum/maximum values shall be available via communications and display.
5. Accuracy of the meter shall comply with ANSI C12.20 Class 0.5 and IEC 60687 Class 0.5 including:
    a. Accurate to 0.25% of reading plus 0.025% of full scale for power and energy.
    b. Voltage and current shall be accurate to 0.075% of reading plus 0.025% of full scale.
    c. Power factor metering shall be accurate to ± 0.002 from 0.5 leading and to 0.5 lagging.
    d. Frequency metering shall be accurate ± 0.01 Hz at 45-67 Hz.
6. Meter shall provide steady state waveform captures of voltage and current channels which shall be stored in non-volatile memory.
7. Meter shall be supplied with one digital input and one digital solid state output.
8. Meter shall have logging capability for alarms, waveform, and three separate custom data logs.
9. Meter shall have capability for user definable alarm conditions.
10. Meter shall have output relay control.
11. Meter shall be field upgradeable to enhance functionality. Upgrades shall not require disassembly or changing of integrated circuit chips and it shall not be necessary to de-energize the circuit or equipment to perform the upgrade.
12. Communicate externally via Ethernet TCP/IP and Modbus (DDC) protocols. Coordinate communication package with DDC system installer.
13. Meter shall be equipped with a back lit LCD display and shall be anti-glare and scratch resistant. The display shall have the following capabilities:
    a. Provide viewing of four values on the screen simultaneously.

b. Provide viewing of a summary screen.
c. Provide local access for metered quantities.
d. Provide for reset of electrical parameters.
e. Provide for setup for system requirements.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1. Mounting shall be plumb and rigid without distortion of box.

B. Surface mounted electrical equipment shall be installed on 3/4" thick, fire retardant mounting board. Mounting board shall bear UL classified mark indicating ASTM E 84 test compliancy. Backboard material shall have a final applied finish according to manufacturer specifications prior to mounting of electrical equipment. Finishing material may include but not limited to fire retardant coatings. Backboard material shall minimally extend 6” in all directions beyond grouping of electrical equipment. The Electrical Contractor may use discretionary expertise to provide fire retardant backboard for individual equipment such as standalone disconnect switches, starters and the like. Where said devices are grouped (starters, disconnects, contactors etc.) installation shall include fire retardant backboard. Fire retardant mounting board installed on perimeter outside walls to be shimmed 1/2" from wall with washers to permit back ventilation.

1. Approved manufacturer: Hoover Treated Wood Products Inc. - Pyro-Guard
2. Approved equal.

C. Mount top of panelboard cabinets 72 inches above finished floor, unless otherwise indicated.

D. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

E. Install overcurrent protective devices and controllers.

1. Set field-adjustable switches and circuit-breaker trip ranges.

F. Install filler plates in unused spaces.

G. Stub four 1-inch empty conduits from lighting/receptacle panelboards into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

H. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables.

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records. Submit all branch circuit changes to the engineer.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.5 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 262416

SECTION 262653 - ELECTRIC VEHICLE CHARGING EQUIPMENT - LEVEL 2

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes EV charging equipment that provides Level 2 EV charging.

1.3 DEFINITIONS

A. EV: Electric vehicle.

B. EV Cable: The off-board cable containing the conductor(s) to connect the EV power controller to the EV that provides both power and communications during energy transfer.

C. EV Capable: Parking spaces that include nearby termination of raceway (conduit) to a power source with sufficient electrical panel capacity designed for simultaneous charging of electric vehicles in all planned EV parking spaces. Provide conduit, box and wiring system for future charging station installation by owner.

D. EV Charger or EV Charging Equipment: See "EVSE".

E. EV Connector: A conductive device that, when electrically coupled to an EV inlet, establishes an electrical connection to the EV for the purpose of power transfer and information exchange. This device is part of the EV coupler.

F. EV Coupler: A mating EV inlet and connector set.

G. EV Inlet: The device in the vehicle into which the EV connector is inserted, and a conductive connection is made for the transfer of power and communication. This device is part of the EV coupler.

H. EV Make Ready: Parking spaces that include nearby termination of raceway (conduit) <u>and electrical wiring pulled</u> to a power source with sufficient electrical panel capacity for simultaneous charging of electric vehicles in all EV parking spaces.

I. EVSE: Electric Vehicle Supply Equipment. It includes the EV charging equipment and conductors, including the ungrounded, grounded, and equipment grounding conductors and EV cables, attachment plugs, and all other fittings, devices, power outlets, or

apparatus installed specifically for transferring energy between the premise wiring and the EV. There will be (2) dual charging station devices installed to serve 4 EV spaces under this contract. Preparation for (8) future devices and 16 EV spaces will be made available for future installation of devices. Panel EV, conduit, boxes and wiring will be installed under this project.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site, with City of Hagerstown Maryland Department of environment & sustainability representative, project owner's representative and contractor.

1.5 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for EV charging equipment.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Sustainable Design Submittals:

1. Plan showing location and number of EV charging units, and distance from building.
2. Plan showing "reasonable accessibility" to EV charging units.
3. Plan showing location and number of EV charging units, charging levels and connectors, and ability of EV charging units to participate in a demand-response or time-of-use pricing program, as well as a power load management system that allows for an increased number of charging stations than would otherwise be feasible without power load management.

C. Shop Drawings: For EV charging equipment.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of mounting assemblies for EV charging equipment.
4. Include diagrams for power, signal, and control wiring.
5. Include verification of wireless communications service at each location of EV charging equipment.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Area plans and details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members to which equipment will be attached.
2. Electrical service.
3. Communications service, including wireless communications equipment.
4. Items penetrating finished floors and ceilings.

B. Qualification Data: For Installer, factory-authorized service representative.

C. Field quality-control reports.

D. Sample Warranty: For manufacturer's warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For EV charging equipment to include in operation and maintenance manuals.

B. Software and Firmware Operational Documentation:

1. Online training and help documentation.
2. Station activation sticker.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

C. Comply with UL 2231-1. UL 2231-2, UL 2594, and NEC Article 625.

D. Comply with SAE J1772.

E. Comply with FCC Part 15 Class A.

1.9 FIELD CONDITIONS

A. Wireless Survey: Complete wireless survey to determine if wireless provider signals meet or exceed manufacturer's recommended minimum values.

B. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not exceeding minus 22 to plus 122 deg F.

2. Altitude: Not exceeding 6600 feet.

C. Rate Equipment for non-operation under the following conditions:

1. Ambient Temperature: Not exceeding minus 40 to plus 140 deg F.
2. Altitude: Not exceeding 6600 feet.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components of EV charging units that fail(s) in materials or workmanship within specified warranty period.

1. Extended Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Provide ChargePoint CT4000 family of electric vehicle charging stations for commercial applications.

B. Source Limitations: Obtain EV charging equipment from single manufacturer.

1. ChargePoint Basis Of Design
2. Schneider Electric
3. General Electric
4. Approved Equal.

2.2 EV CHARGING EQUIPMENT DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Comply with NFPA 70.

C. ADA compliant.

D. Metering: +/- 2 percent from 2 percent to full scale of output (30 A).

E. EV Charging Equipment Mounting: Wall mount.

F. Enclosures:

1. Rated for environmental conditions at installed location.

a. Indoor Locations: NEMA 250, Type 3R.
b. Aluminum and UV-resistant plastic.
c. Paint and Anodized.
d. Charging components protected by security screws.
e. Charging connectors in locking holsters.
f. Meter, modem, and CPU, tamper resistant.

G. EV Cable and Connectors:

1. SAE J1772 connector.
2. Two connectors with locking holster.
3. 23-foot cable with cable management system.

H. Status Indicators:

1. LEDs to indicate power, vehicle charging, charging complete, system status, faults, and service, as well as authorization.

I. Display Screen:

1. VGA-resolution, daylight-viewable LCD screen with UV protection. Daylight readable and fingerprint resistant.
2. Displays power, charging, charging complete, remote control, system status, faults, payment and pricing details, and service.

J. Networking:

1. WAN Communications: Cellular GSM/GPRS and CDMA.
2. LAN Communications: 2.4 GHz Wi-Fi 802.11b/g/n.
3. Capable of remote configuration, diagnostics and reporting.
4. Capable of remote software updates (future proof).

K. Payment System:

1. RFID (ISO 15693, ISO 14443), NFC, Contactless credit card reader.
2. PCI (Payment Card Industry) compliant.
3. Capable of remote control and authorization including mobile phone application or toll free phone number.

L. Charging Network: Compatible with the ChargePoint EV charging network.

1. Multiple units shall independently connect to charging network.
2. Individual units shall be capable of indicating station status and availability providing or connecting user to customer support and remote control.

2.3 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

B. Surge Withstand: 6 kV at 3000 A.

C. Integral GFCI.

D. Auto-GFCI fault retry.

E. Input Power:

1. Two 40A, 208Vac, 60 Hz, single phase circuits per charger.
2. Dual circuits do not need to be interlocked.

F. EV Charging Levels:

1. Dual vehicle: AC Level 2 at up to 7.2 kW (CT4000) per vehicle circuit.

2.4 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for EV charging equipment electrical conduit to verify actual locations of conduit connections before equipment installation.

C. Examine walls, floors, and pavement for suitable conditions where EV charging equipment will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 413. Install per manufacturer’s instructions.

B. Wall Mounting:

1. Install EV charging equipment so that its receptacles or holders are not less than 4 feet above finished floor.

2. Mount EV charging equipment to steel slotted supports 1-1/4 inches in depth. Orient steel slotted supports vertically.
3. Ensure that EV charging equipment is plumb and rigid without distortion of box.
4. Secure EV charging equipment according to manufacturer's written instructions.

C. Wiring Method: Conceal conductors and cables in walls, and floors where possible.

D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

E. Circuit Breakers: Comply with Section 262816 "Enclosed Switches and Circuit Breakers."

F. Secure covers to enclosure.

3.3 CONNECTIONS

A. Connect wiring according to Low-Voltage Electrical Power Conductors and Cables.

B. Comply with grounding requirements in Grounding and Bonding for Electrical Systems.

C. Comply with requirements for installation of conduit in Raceways and Boxes for Electrical Systems. Drawings indicate general arrangement of conduit, fittings, and specialties.

D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections with the assistance of a factory-authorized service representative.

C. Tests and Inspections:

1. For each unit of EV charging equipment, perform the following tests and inspections:

a. Unit self-test.
b. Operation test with EV.
c. Network communications test.

D. EV charging equipment will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ONGOING MANAGEMENT SERVICES

A. Engage a station manufacturer that offers a service to manage the administration and policies of the electric vehicle charging stations on an ongoing basis.

3.8 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for the duration of an active ChargePoint Network Service Plan.

B. Upgrade Service: At Substantial Completion, remotely update software to latest version. Install and program software upgrades that become available while an active ChargePoint Network Service Plan is maintained. Upgrading software shall include operating system and new or revised licenses for using software.

END OF SECTION 262653

SECTION 262713 – ELECTRICITY METERING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

A. This Section includes equipment for utility company's electricity metering.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Describe electrical characteristics, features, and operating sequences, both automatic and manual. Include the following:

1. Electricity-metering equipment.

B. Shop Drawings for Electricity-Metering Equipment:

1. Dimensioned plans and sections or elevation layouts.
2. Wiring Diagrams: Power, signal, and control wiring specific to this Project. Identify terminals and wiring designations and color codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 COORDINATION

A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:

1. Comply with requirements of utilities providing electrical power and communication services.
2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

1. Manufactures:

   a. Cutler-Hammer; Eaton Corporation.
   b. General Electric Company; Electrical Distribution & Control Div.
   c. Square D; Schneider Electric

2. Housing: NEMA 250, Type 3R enclosure
3. Minimum Short-Circuit Rating: 65,000 amperes symmetrical at rated voltage.

B. Current-Transformer Cabinets: Comply with requirements of local utility company.

C. Meter Sockets: Comply with requirements of local utility company.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

B. Install equipment for utility company metering. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required.

END OF SECTION 262713

SECTION 262726 – WIRING DEVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements, Division 1 Specifications, apply to this Section.

1.2 DESCRIPTION

A. This section covers power-related devices such as receptacles, switches, and plug strips.

B. Devices listed in this section may or may not be used on this project. Specifications for devices not included in the Contract Documents are included in case they are needed during construction phase.

1.3 LOCATION OF DEVICES

A. The approximate schematic location of devices is given within Contract documents. The exact location shall be determined at the building as the work progresses. Refer to Architectural plans for any special details, elevations, and reflective ceiling plan. Verify door swings at job site. In no case shall switches be located behind door swings. Any switch so located shall be changed. Field verify equipment location and adjust locations to avoid inaccessibility. Relocate inaccessible outlets.

B. This contractor shall be responsible for installations of wiring devices meeting ADA requirements where applicable.

C. Unless otherwise indicated or otherwise decided at the site or required to meet ADA requirements, outlet boxes in walls shall be located with centerline at elevation above the finished floor as noted below:

D. Fire Alarm Telephone ..... 4 feet 9 inches (unless directed by AHJ)
Fire Alarm Notification ..... 6 feet 8 inches or 6 inches below ceiling in low ceiling areas
Fire Alarm Pull Stations ..... 3 feet 6 inches (to activation handle)
Fire Alarm Speaker ..... Ceiling mounted or 8 feet or 6 inches below ceiling in low-ceiling (wall mounted) areas
Fire Alarm Annunciator ..... 5 feet 2 inches (unless directed by AHJ)
Fire Alarm Control Panel ..... 6 feet (to top of panel)
Wall Switch Outlets ..... 4 feet 0 inches
Convenience Outlets (general) ..... 1 foot 6 inches
Convenience Outlets (mechanical areas) ..... 4 foot 0 inches
Counter Outlets ..... 8 inches above countertop
Desk Telephone Outlets ..... 1 foot 6 inches
Wall Telephone Outlets ..... 4 feet 9 inches
Telephone Outlets above Counter ..... 8 inches above countertop
Thermostat ..... 4 feet 4 inches

Public Telephone Outlets ..... Coordinate with telephone company
Plug In Strip ..... To be determined at the site
Exterior and Interior Wall Brackets..... To be determined at the site

1. **The Architect and Owner's representative reserve the right to change the location of any outlet, before it has been installed.**

1.4 DESCRIPTION

A. Wiring Device Requirements

1. Use the products of a single manufacturer for each type of wiring device.
2. Receptacles for general equipment or Owner's-Furnished Equipment: match cord-plug configurations.
3. Use the products of a single manufacturer of all wiring and device plates. Obtain prior approval for any variations from this requirement, except that plate variations are allowed for the following devices:

a. Where the selected plate manufacturer does not manufacture a suitable finish plate.
b. For heavy-duty receptacles rated at more than 30 amperes.
c. Where the raceway system enclosure employs a non-standard finish plate.
d. Where non-standard plates are specified or indicated.

1.5 QUALITY ASSURANCE

A. High Capacity Floor Boxes: Underwriter's Laboratory Listed
B. Duplex Receptacles and Integral GFCA Receptacles: Underwriter's Laboratory 498, NEMA WD 1
C. Tamper-Resistant Duplex Receptacles: NEMA WD 1, UL 498
D. Wall Switches: NEMA WD 1, UL 20
E. Wall Switch Occupany Sensors: Underwriter's Laboratory
F. Dimmer Switches: UL 1472
G. Poke Through Assemblies: Underwriter's Laboratory

PART 2 - PRODUCTS

2.1 MATERIALS

A. Representative general purpose wiring devices and device plates as listed herein are intended to indicate type, function, and quality of the products. Provide the products as specified.

1. Industrial/Institutional construction type:

a. Receptacles, toggle and snap switches: Hubbell, Pass & Seymour, Leviton, Cooper Wiring Devices
b. Lighting Control; Dimmers & Occupancy Sensors: Hubbell, Leviton, Wattstopper, Lithonia, Cooper Wiring Devices
c. Time Switches: Intermatic Inc., Tork, MH Rhodes
d. Exterior/Cast: Crouse-Hinds, Appleton, Hubbell, Cooper Wiring Devices

2. Hospital Grade:

a. Extra heavy duty tamper-resistant duplex receptacles complying with NEC Article 517. Manufacturer as named above.

2.2 STANDARDS

A. Straight-Blade-Type Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G and UL 498.

B. GFCI Receptacles: Straight blade, non-feed-through type, with integral NEMA WD 6, complying with UL 498 and UL 943-2003. Design units for installation in a 2-3/4” deep outlet box without an adapter.

C. Pendant Cord/Connector devices shall have matching, locking-type plug and receptacle body connector, NEMA WD 6, Configurations L5-20P and L5-20R, Heavy-Duty grade.

1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

D. Single- and Double-Pole Switches: Comply with DSCC W-C896F and UL 20.

E. Wiring device color unless specifically noted within contract documents. All color choices shall be confirmed with Architect:

1. White within finished areas
2. Ivory mounted in surface mounted raceways
3. Black within equipment rooms (electrical, mechanical, technology closets)
4. Red fed from emergency/standby power circuits
5. Yellow for exterior weather resistant duplex receptacles

2.3 SWITCHES

A. General:

1. Device (general use) color: White within finished areas, White for lighting controls within finished areas, Ivory mounted in surface mounted raceways or black within unfinished areas. All color choices shall be confirmed with Architect.
2. Switches mounted vertically shall have the "ON" position at the top and horizontal-mounted switches shall have the "ON" position at the left. Unless otherwise indicated switches shall be mounted in the vertical position.
3. Tumbler switches shall be the AC heavy-duty, specification grade, 120/277 volts, flush toggle type switch rated at 20 amperes, Underwriters' approved and meeting NEMA Standard WD-1 1965 and Federal Specifications W-S-896d (Type III). The operating mechanism shall be totally enclosed in a high-heat, non-inflammable, non-hygroscopic molded compound case with terminal screws located on the side of the switch. Operating handles shall be made of high heat phenolic compound. Switches shall have wide plaster ears.
4. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switch and audible frequency and EMI/RFI filters. Architectural grade, preset slide control, plate kit, AC dimmer with minimal wattage (after derating) and specified

voltage for intended load. Contractor provided dimmer shall be compatible with fluorescent ballast manufacturer.

a. 120v Hubbell AS-103, AS-153, AS-203 (White) P&S, Leviton
b. 277v Pass & Seymor 93271, 93472, 93673, 93874 (White) – Magnetic, Hubbell, P&S
c. 277v Leviton MNX20-7L, MNX30-7L (White) – Electronic, Hubbell, P&S.

B. Occupancy Sensors:

1. See specification 260923 “Lighting and Control Devices”.

C. Manufacturers:

1. Single pole toggle switch, 20 ampere, 120-277 volt, institutional grade, Hubbell Catalog No. HBL1221, Pass & Seymour, Cooper Wiring Devices or Leviton equal.
2. Keyed single pole toggle switch, 20 ampere, 120-277 volt, industrial-institutional grade, Hubbell Catalog No. HBL1557L, Pass & Seymour, Cooper Wiring Devices or Leviton equal.
3. Three-way toggle switch, 20 ampere, 120-277 volt, institutional grade, Hubbell Catalog No. HBL1223, Pass & Seymour, Cooper Wiring Devices or Leviton equal.
4. Four-way toggle switch, 20 ampere, 120-277 volt, institutional grade, Hubbell Catalog No. HBL1224, Pass & Seymour, Cooper Wiring Devices or Leviton equal.
5. Double pole toggle switch, 20 ampere, 120-277 volt, institutional grade, Hubbell Catalog No. HBL1222, Pass & Seymour, Cooper Wiring Devices or Leviton equal.
6. Single pole key lock switch, 20 ampere, 120-277 volt, institutional grade, Hubbell Catalog No. HBL1221-L, Pass & Seymour, Cooper Wiring Devices or Leviton equal.
7. Single pole toggle switch with pilot light on with load off, 20 ampere, 120 volt, institutional grade, Hubbell Catalog No. HBL1221-PL, Pass & Seymour, Cooper Wiring Devices or Leviton equal.
8. Three-way toggle switch with pilot light on with load off, 20 ampere, 120-277 volt, institutional grade, Hubbell Catalog No. HBL1223-IL, Pass & Seymour, Cooper Wiring Devices or Leviton equal.
9. Momentary contact switch, 3-position, 2-circuit, center off, 20 ampere, 120-277 volts, institutional grade, Hubbell Catalog No. HBL1557, Pass & Seymour, Cooper Wiring Devices or Leviton equal.
10. Maintained contact switch, 3-posistion, 2-circuit, center off, 20 ampere, 120-277 volts, institutional grade, Hubbell Catalog No. HBL1385, Pass & Seymour, Cooper Wiring Devices or Leviton equal.
11. Fan switches — coordinate with fan supplier (switch is normally provided by fan supplier; if not, provide single-pole switch listed above or provide manual motor starter per specification 262913 where motor overload protection is not provided).

C. Miscellaneous Switch Appurtenances:

1. Weatherproof cover - Hubbell 1795
2. Locking cover - Hubbell 96061
3. Pass & Seymour, Leviton equal.

2.4 CONVENIENCE RECEPTACLES

A. Receptacles for convenience outlets shall be duplex self-aligning grounding type rated for 20 amperes at 125 volts. Contacts shall be made of heavy spring copper or bronze so designed as to securely grip both sides of each receptacle blade and shall be enclosed in high heat, non-inflammable, non-hygroscopic molded compound case, provided with wide plaster ears. Each terminal shall be provided with two (2) binding screws located on the side of the receptacle. Hubbell Catalog No, IG5362GY, Pass & Seymour, Cooper Wiring Devices or Leviton equal.

B. Where noted within Contract documents, tamper-resistant convenience outlets shall be rated for 20 amperes at 125 volts with integral shutter or reciprocating contact system meeting minimum requirements as noted above. Nylon face shall visually identify unit as tamper resistant; Hubbell Catalog No, HBL8300SGGYA, Pass & Seymour, Cooper Wiring Devices or Leviton equal.

C. Where noted within Contract Documents, extra heavy duty, tamper-resistant hospital grade convenience receptacles shall be rated for 20 amperes at 125v. Receptacle construction shall be in compliance with UL-498. Manufacturers as named within Contract Documents.

D. Manufacturers:

1. Generator fed receptacle (derived from “E” or “S” type panels), 20 ampere, 125 volt, 2 pole, 3 wire grounding type, NEMA 5-20R, red in color and connected to the normal/emergency/standby system; Hubbell Catalog No. HBL5362R, Pass & Seymour, Cooper Wiring Devices or Leviton equal. The stainless steel cover plate shall have the word "Generator" engraved at the top with red filled lettering.
2. Ground fault interrupter type duplex receptacle, 20 ampere, 125 volt, 2 pole, 3 wire grounding type, NEMA 5-20R; Hubbell Catalog No. GFR5352-__ST, Pass & Seymour, Cooper Wiring Devices or Leviton equal.
3. Safety type duplex receptacle, 20 ampere, 125 volt, 2 pole, 3 wire grounding type, NEMA 5-20R. Pass & Seymour Catalog No. SG-62
4. Duplex receptacles fed from computer panelboards shall be of color white, 20 ampere, 125 volt, 2 pole, 3 wire grounding type, NEMA 5-20R, Hubbell Catalog No. 5362OW (white), Pass & Seymour, Cooper Wiring Devices or Leviton equal.
5. Single receptacle, 20 ampere, 125 volt, 2 pole, 3 wire grounding type, NEMA 5-20R ("EWC" denotes electric water cooler-coordinate mounting height with the equipment supplier); Hubbell Catalog No. 5361-BK, Pass & Seymour, Cooper Wiring Devices or Leviton equal.
6. Exterior duplex receptacles shall be yellow in color weather resistant type. Leviton WBR20-Y, Pass & Seymour or Hubbell equal.

E. Appurtenances:

1. Weatherproof covers - use Hubbell WP26 or WPSF26, Pass & Seymour Catalog No. WPH8 or Bryant Catalog No. 4510D for GFI-WP locations; or Hubbell 5205WO or 5206WO, Pass & Seymour Catalog No. WPH26 for non-GFI-WP locations. Leviton equal.

2.5 PROTECTED RECEPTACLES

A. Receptacles shall be ground fault and/or arc-fault protected in accordance to Articles 210.8 and 210.12 of 2011 National Electric Code.

2.6 SPECIAL PURPOSE RECEPTACLES

A. Special purpose receptacle, size and type as called for within Contract documents. (Each receptacle shall be provided with one matching plug for installation on the associated piece of equipment.)

B. 30 ampere, 125 volt, 1 phase, 2 pole, 3 wire grounding type, single receptacle, with black face, NEMA 5-30R. Hubbell Catalog No. 9308. (Plug-Catalog No. 9309), Pass & Seymour, Cooper Wiring Devices or Leviton equal.

C. 20 ampere, 250 volt, 1 phase, 2 pole, 3 wire grounding type, single receptacle, with brown face, NEMA 6-20R. Hubbell Catalog No. 5461. (Plug-Catalog No., 5466-CA), Pass & Seymour, Cooper Wiring Devices or Leviton equal.

D. 30 ampere, 250 volt, 1 phase, 2 pole, 3 wire grounding type, single receptacle, with black face, NEMA 6-30R. Hubbell Catalog No. 9330. (Plug-Catalog No. 9331), Pass & Seymour, Cooper Wiring Devices or Leviton equal.

E. 50 ampere, 250 volt, 1 phase, 2 pole, 3 wire ground type, single receptacle, with black face, NEMA 6-50R. Hubbell Catalog No. 9650. (Plug-Catalog No. 9650-ANP), Pass & Seymour, Cooper Wiring Devices or Leviton equal.

F. 50 ampere, 125/250 volt, 1 phase, 3 pole, 4 wire grounding type, single receptacle with black face NEMA 14-50R. Hubbell Catalog no. 9450-FR. (Plug Catalog No. 9452-ANP), Pass & Seymour, Cooper Wiring Devices or Leviton equal.

G. 20 ampere, 250 volt, 1 phase, 2 pole, 3 wire grounding type, single twist, single twist-lock receptacle, with black face, NEMA L6-20R. Hubbell Catalog No. 2320. (Plug-Catalog No. 2321-CA), Pass & Seymour, Cooper Wiring Devices or Leviton equal.

H. 30 ampere, 250 volt, 1 phase, 2 pole, 3 wire grounding type, single twist-lock receptacle, with black face, NEMA L6-30R. Hubbell Catalog No. 2620. (Plug-Catalog No. 2621-CA), Pass & Seymour, Cooper Wiring Devices or Leviton equal.

I. 50 ampere, 125/250 volt, 1 phase, 3 pole, 4 wire grounding type, single twist-lock receptacle, with black face, NEMA L6-50R. Hubbell Catalog No. CS6369. Hubbell Catalog No. 6365, Pass & Seymour, Cooper Wiring Devices or Leviton equal.

J. 30 ampere, 125/250 volt, 1 phase, 3 pole, 4 wire grounding type, single twist-lock receptacle, with black face, NEMA L14-30R. Hubbell Catalog No. 2710. (Plug-Catalog No. 2711-CA), Pass & Seymour, Cooper Wiring Devices or Leviton equal.

K. 50 ampere, 125/250 volt, 1 phase, 3 pole, 4 wire grounding type, single receptacle with black face NEMA 14-50R. Hubbell Catalog No. 9450-FR. (Plug Catalog No. 9452-ANP), Pass & Seymour, Cooper Wiring Devices or Leviton equal.

L. 20 ampere, 250 volt, 3 phase, 3 pole, 4 wire grounding type, single twist-lock receptacle, with black face, NEMA L15-20R. Hubbell Catalog No. 2420. (Plug-Catalog No. 2421), Pass & Seymour, Cooper Wiring Devices or Leviton equal.

2.7 COVER PLATES

A. Unless otherwise specified, switch, receptacles, special purpose outlets, wall mount telephone, and other device plates shall be Bureau of Standards No. 302-18.8 brushed or satin stainless steel with beveled edges so as to lie flat against the wall. Where more than one (1) switch or receptacle occurs at one point, use a single multi-gang plate.

B. Zinc-coated plates may be used in unfinished spaces.

C. Plates shall be set true and plumb and shall fit tight against finished wall surfaces and outlet boxes.

1. Manufacturers: Hubbell 97000 Series, Pass & Seymour, Cooper Wiring Devices or Leviton equal.

2.8 FLOOR BOXES

A. Floor boxes are flush floor mounted of type noted at locations shown on plans or otherwise scheduled.

B. Floor boxes shall be of proper type as called for and sized as required by the NEC and shall be secured firmly in place and set true and flush with the final finished floor surface.

C. Floor boxes shall be fully fitted with required number of receptacles, modular communication connectors (phone, data, video, audio etc), separators, partitions, plates, sub plates, trim rings, metal covers and other necessary items required for a complete assembly. Other specifications requirements by particular manufacturer.

1. Characteristics: Complete factory assembled unit consisting of floor fittings, cover assembly, application plates and suitable for both on or above grade applications. Assembled unit having a UL listed 514A and 514C for scrub water requirements. Final cover plate shall match final floor finish or as noted on architectural documents. Where required, assembly shall have UL listing for use in fire rated floors. Floor boxes are rated and acceptable for use in environmental air handling spaces per NEC article 300.22(C). Separate raceways and sections for power and communications with minimum power size of 3/4" and 1” for communications.
2. Sub-plate: Provide a complete fully fitted plate meeting minimum requirements as shown within Contract documents. Furnished sub-plate shall include receptacles, data, video, audio or furniture feeds as required.

D. Manufacturer:

1. Hubbell : S1CFB cast box, S1CFCBRS or S1TFCBRS brass cover, S1SP4X4 or other sub-plate configuration to meet project requirements.
2. Hubbell: B2437 or B4214 cast box, brass screw cover plate for tile or terrazzo floors such as but not limited to: S3625, S2825 or S3425.
3. Manufacture and model as called for within Contract Documents. Include required plates, sections, faceplates, terminations including specified construction.

4. Approved equal from Leviton or Pass & Seymor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Devices shall be flush mounted unless otherwise noted. Properly align level and plumb devices including plates. Plates shall fit flat against wall and tight against device surface without straining or buckling the plate.

B. Devices to be recessed mounted flush and level in CMU (Concrete Masonry Unit) walls in all areas except mechanical and electrical rooms. Devices shall be installed in a neat and workmanlike manner. Holes for device boxes shall be saw-cut and uniform. Cuts shall be plumb and level, with minimal space around perimeter of boxes that will require grout. Boxes shall be grouted in place.

C. Tighten electrical connectors and terminals according to manufacturer’s published torque-tightening values. If manufacturer’s torque values are not indicated, use those specified in UL 486A and UL 486B.

D. Code sized (#12 minimum) bonding jumper shall connect grounded outlet box to receptacle grounding terminal on flush-mounted units.

E. Where receptacles are indicated as split-wired and half of the receptacle is on a wall switch, the top receptacle shall be switched and bottom shall be on normal power.

F. Switches mounted vertically shall have the "ON" position at the top.

G. Receptacles shall be mounted in the vertical position with the ground terminal on bottom.

H. Install wall dimmers achieving minimum wattage of connected load including sufficient capacity after de-rating for ganging according to manufacturer’s written instructions. Sufficient clearances shall be maintained where dimmers are ganged. Provided dimmers controlling fluorescent ballasts shall be compatible.

I. Devices installed in areas for use by physically disabled persons, such devices shall be mounted in accordance to Americans Disabilities Act. Refer to architectural drawings, Architect or on-site representative for ADA designated areas.

J. Wiring devices shall have power feed wiring labeled within device box with circuit and panelboard source.

3.2 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports when requested.

1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

B. Remove malfunctioning units, replace with new units and retest as specified above.

END OF SECTION 262826

SECTION 262730 – TAPS, SPLICES & TERMINATIONS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements, Division 1 Specifications, apply to this Section.

1.2 DESCRIPTION

A. Provide taps, splices and termination devices approved and sized for copper cables at voltage and current rating matching characteristics of terminating conductor.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Conductors splices in No. 10 AWG and smaller wire to be made with Minnesota Mining Manufacturing Co. insulated "Scotch Locks", Ideal Co. "Wing Nut", T. & B "Piggy" connectors, or with mechanically crimped sleeves as manufactured by T & B or Ideal Company, which shall be insulated with pressure sensitive electrical tape equal to Scotch No. "33+" or No. 88. Splicing components shall be rated for copper and aluminum conductors.

B. Conductors #8 AWG and larger shall be terminated, spliced, and tapped with Thomas & Betts color-keyed compression connector’s series 54000 or equal. The manufacturers recommended tools and dies shall be used.

C. Copper cable lug connections #8 and larger to copper bus bar mains and branches shall use copper solderless connectors having either 2-bolt cast copper clamps or compression connectors, Thomas & Betts Series 54000 with manufacturer's recommended hexagonal dies and hydraulic compression tools.

D. Tighten electrical connectors and terminals according to manufacturer’s published torque-tightening values. If manufacturer’s torque values are not indicated, use those specified in UL 486A and UL 486B.

E. Connections to equipment shall be made with pressure type terminals. Stranded wire shall use spade type terminals or terminal approved for use. Connections shall contain one conductor unless otherwise rated for multiple conductors.

2.2 MANUFACTURERS

A. 3-M

B. O.Z.

C. Thomas & Betts

D. Approved manufacturer equal

2.3 WIRE LABELS

A. Each cable or wire termination shall be identified as noted on drawings, schedules or where not indicated, label shall note applicable branch circuit, phase and/or connected equipment. Labels shall be pressure sensitive or clip on PVC type. Approved Manufacturers: Brady, 3M or approved equal.

2.4 TERMINAL BLOCKS

A. Where terminal blocks/strips are indicated or otherwise required, provide a complete assembly of blocks/strips having each terminal equipped with two clamp type pressure lugs or two washer bead binding screws. Use terminal strips with voltage and ampere rating sufficient to carry intended loads. Provide a white marking strip along the center line of each row of terminal for identification. Use strips having plastic barriers between adjacent terminals. Provide indicated terminal quantities or otherwise required. If quantity is not indicated, provide one terminal for each conductor entering enclosure plus 20 percent spare terminals. Type or otherwise mark the identification strip to identify each connected circuit. Relate identification to wiring diagrams, panel schedules and other terminals in a logical manner, where specific identification requirements are not indicated. Under no circumstances shall more than one wire be terminated under each terminal unless rated otherwise. Use only approved type jumper to mechanically connect terminals to each other.

1. Approved Manufacturer: Allen Bradley
2. Ilsco
3. Marathon
4. Approved equal

PART 3 - EXECUTION

3.1 INSTALLATION

A. Make taps, splices, and terminations at junction boxes, pull boxes, switches, panel boards, and any other electrical equipment, etc. Wires shall be continuous between outlet to outlet, or from panel board to the first outlet, etc.

B. Backboxes, device boxes, fittings or junction boxes shall be suitably sized permitting adequate conductor fill capacity per Article 314 of the National Electrical Code.

C. All taps and splices shall be fully insulated meeting minimum insulating values of wire or conductors used.

D. After splices are mechanically secure, provide listed electrical tape to insulate splice to equal the original insulation voltage rating of the wires, or utilize Thomas & Betts heat shrinkable insulators Series H.S. If the type of connector installed provides equivalent insulation, taping may be omitted.

E. EC shall provide and install all feeders and branch circuit wiring to all disconnect switches, equipment, controllers, motors and wiring devices. Terminations shall be in

full compliance with project documents and meet the installation requirements of the manufacturer.

END OF SECTION 262830

SECTION 262813 – FUSES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION

A. Provide fuses in accordance with the contract documents in motor starters, switchgear assemblies, panel boards, disconnect switches, control devices, lighting fixtures or other required components or equipment.

B. Fuses shall be provided and installed in equipment being furnished by the respective contractor.

C. This Section includes: Cartridge fuses rated 600 V and less for use in equipment or components as specified or noted within contract documents.

D. Provide a complete set of three (3) spare fuses for each fuse size and type used.

E. All fuses provided shall be of the indicating type, employing either an indicating window or a mechanical indicator striker pin where available.

F. Where ambient temperature to which fuses are directly exposed is less than 40 degF or more than 100 degF, apply manufacturer’s ambient temperature adjustment factors to fuse ratings.

G. Fuses shall be current limiting with 200,000 ampere interrupting capacity and UL labeled or as specified by manufacturer.

H. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

1.3 QUALITY ASSURANCE

A. NFPA 70 – National Electric Code

B. UL – Underwriters Laboratories

C. NEMA FU 1 – Cartridge Fuses

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Obtain fuses from a single manufacturer.

B. Fuses shall be of the high interrupting rating, current limiting type and manufactured by the Bussman, Mersen, Cooper Edison or Littelfuse.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment in accordance to the National Electric Code.

B. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

C. Ensure that fuses are firmly and completely inserted into fuse holders and that mechanical joints are tightened.

END OF SECTION 262813

SECTION 262816 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:

1. Fusible switches.
2. Non-fusible switches.
3. Molded-case circuit breakers.
4. Enclosures.

1.3 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated.

1. Shop Drawings: Diagram power, signal, and control wiring.
2. Field quality-control test reports.
3. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1. Comply with NFPA 70.
2. Molded Case Circuit Breakers: UL 489, NEMA AB 1.
3. Fusible and Non-Fusible Switches, NEMA KS 1.
4. Bolted-Pressure Contact Switches UL 977.
5. Enclosures, NEMA AB 1 and NEMA KS 1.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Square-D/Group Schneider

4. Cooper/Bussmann – Power Module

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

A. Fusible Switch, 1200A and Smaller: NEMA 12, heavy duty type , with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

B. Non-fusible Switch, 600A and Smaller: NEMA-12, heavy duty type, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit (where required): Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

D. Elevator

1. Provide Elevator Control Switch in a single NEMA 12 enclosure with all necessary relay(s), control transformer and options (as listed below) and as shown within Contract Documents. The Elevator Control Switch shall be constructed, listed and certified for use with elevator control. The Elevator Control Switch shall have an ampere frame rating meeting minimum ampere requirements of selected elevator and shall include a horsepower rated fusible switch with shunt trip capabilities. The ampere rating of the switch shall be based upon elevator manufacturer requirements and utilize Class J Fuses which are provided by the Contractor. The Elevator Control Switch shall include 100 VA control power transformer with primary and secondary fuses. The primary voltage rating shall match the incoming elevator supply voltage with a 120 volt secondary. It shall also contain an isolation relay (3PDT, 10 amp, 120V). The coil of the isolation relay shall be 120v. A normally open dry contact shall be provided by the Fire Alarm Safety System to energize the isolation relay and activate the shunt trip solenoid (140 VA @ 120vAC). The switch shall include a 120 volt key to test switch and a 1-NO/1-NC mechanically interlocked auxiliary contact rated 5A, 120vAC as standard. The switch shall contain the following options:

   a. “ON” Green pilot light
   b. Isolated Full Capacity Neutral Lug
   c. Fire Alarm Voltage Monitoring Relay (Needed to comply with NFPA 72)
   d. Main Switch Auxiliary Contacts (1 NO/1 NC)

2.3 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. Molded-Case Circuit Breaker: NEMA-1, with interrupting capacity to meet available fault currents.

B. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250A and larger.

1. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
2. Current-Limiting Circuit Breakers: Frame sizes 400A and smaller and let-through ratings less than NEMA FU 1, RK-5.
3. GFCI Circuit Breakers: Single- and two-pole configurations with 5mA trip sensitivity.

C. Molded-Case Circuit-Breaker Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical style with lug kits suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
4. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
5. Shunt Trip: 120V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.

2.4 ENCLOSURES

A. NEMA-1 minimal rating or otherwise required meeting environmental conditions at installed location.

1. Outdoor Locations: NEMA 250, Type 4.
2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

1. Concrete base is specified in Division 26 Section "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 03.

B. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

C. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification."

3.2 FIELD QUALITY CONTROL

A. Prepare for acceptance testing as follows:

1. Inspect mechanical and electrical connections.
2. Verify switch and relay type and labeling verification.
3. Verify rating of installed fuses.

B. CLEANING

1. On completion of installation, inspect interior and exterior enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 262816

SECTION 262913 – MANUAL AND MAGNETIC MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE

A. Provide motor starters in accordance with the Contract Documents. Motor starters may or may not be furnished under this Division, but shall comply to the requirements indicated in this section. Receive, install and connect motor starters not pre-assembled and pre-wired by equipment manufacturer. Notify Associate if any starters do not conform to these requirements. Motor starters in heating equipment shall be supplied under Division 23 and installed under this Division.

B. Where motor horsepower is equal-to or greater than five, motor controllers shall be provided with integral phase loss protection. Under phase-loss conditions, the phase detection device shall remove power from all phases of the connected motor.

C. Related Work Specified Elsewhere: This specification describes the electrical work related to manual motor switches, manual motor starters, magnetic motor starters and combination motor controllers external to Motor Control Centers.

1.3 STANDARDS

A. Conform to NEMA voltage rating for motors and motor control equipment.

B. Motor branch circuit protective devices shall meet requirements of NEC 430.

C. UL 98 - Enclosed and Dead Front Switches

D. NEMA KS 1 - Enclosed Switches

E. NEMA 250 - Enclosures for Electrical Equipment

1.4 SUBMITTALS

A. Shop Drawings: Submit general shop drawings, brochures, catalog cuts, dimension sheets and full data schedule of starters to be furnished.

B. Wiring Diagrams: Submit full starter wiring diagrams showing project remote operating controls, interlocks, safeties, freeze stats, pressure switches, etc. Separate wiring diagram shall be provided for each type motor or by function.

C. Operational Data: Submit descriptions of working parts, list of replacement parts and adjustment instructions for components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.

1. General Electric
2. Allen Bradley
3. Square D
4. Eaton Electric

2.2 COMBINATION MOTOR STARTERS

A. Combination starters shall be combined with motor overload, short circuit protection and disconnecting means. Manufactured to NEMA standards with UL listing at 480vAC rated 100,000 amps fault current.

B. Disconnecting means via flange mount operating handle capable of being locked in the open position. Disconnect switches shall be heavy duty, quick make, quick break and interlocked with operating handle. Combination starter to be fusible, non-fusible, thermal magnetic breaker or supplied with motor circuit protector (MCP). Fuses where provided shall be class RK5 with 1-set furnished as spare. Settings of MCP type breaker shall be based on field installed motor nameplate amperage ratings following manufacturer adjustment procedures.

C. External manual reset mechanism provided for each combination starter as required to reset the single block three-coil motor overloads. Motor overloads shall be provided and correctly sized based upon nameplate data of field installed motors. Do not size over loads based upon typical rating charts.

D. Each starter shall have an extra auxiliary NO/NC contact for future control purposes.

E. Where not otherwise indicated, magnetic starters shall contain flange mounted stop start push button stations. Where remote automatic control is indicated a HAND-OFF-AUTO selector switch shall be mounted in the face or flange of each starter enclosure. The selector switch shall be so wired that when it is in the HAND or AUTO position, all safeties are wired in series with the selector switch; control devices shall be wired in the AUTO position only.

F. Control voltage shall be maximum voltage of 120vAC. Each starter enclosure shall have a suitable secondary control transformer fused separately on each phase of the primary and secondary, and the secondary grounded. Where indicated within Contract documents, 120v control voltage maybe sourced separately otherwise shall be internally sourced.

G. Each starter shall have a transformer type green pilot light mounted in the face at the starter enclosure indicating motor operating status: “Running”. The pilot light shall be wired so it will be on when the motor is energized.

H. Magnetic starters shall be furnished for motors, one-half horsepower and greater or any three-phase motor, unless indicated otherwise within Contract documents. Motor controllers shall have integral phase-loss protection and phase failure relays with auxiliary NO/NC contacts.

1. Motor monitoring shall include phase loss, phase reversal, voltage unbalance and under voltage. Features may include adjustable trip and restart delay, restart lock-out function and adjustable voltage unbalance settings.
2. Phase loss module shall be provided by the contractor by being an integral part of motor controller, mounted within motor controller or mounted in a labeled enclosure mounted adjacent to motor controller.
3. Unless otherwise restricted via manufactures installation requirements, wiring of phase loss module shall be on the load (motor leads) side. Line side monitoring is not preferred.
4. Manufacturers: Subject to compliance, provide phase-loss module by one (1) of the manufacturers specified.

    a. Same approved manufacture as motor controller/combination starter.
    b. ABB - HLMU Series
    c. Time Mark Corp. - Model 269R
    d. Macromatic - PMP (plug-in)
    e. Allen Bradley, Square D or GE approved equal.

I. Minimum starter size of NEMA 0 or as otherwise called for within Contract documents. Where installation restriction requires IEC style enclosure and equipment, approval of usage shall be obtained prior ordering. Starter control devices shall consist of Allen Bradley 800T/H components or approved equal by Square D or GE.

J. Remote control stations or related control components not mounted in cover of motor starter shall be heavy duty units of required devices mounted in an enclosure rated for area for which it’s installed. Control stations shall be assembled using Allen Bradley 800T/H components.

K. Square D Class 8500 or General Electric CR208, Allen Bradley Type 500, 800T/H.

2.3 MANUAL MOTOR SWITCHES

A. Provide for fractional horsepower motors where no remote control is required. Toggle switches may be used for controlling single phase motors of 1/8 horsepower or less and shall be equipped with integral thermal protection. Said switches shall include neon, LED or other indicating pilot light. Provide Square D, Class 2510, General Electric Type CR101, Allen Bradley Type 609.

B. Enclosures shall be rated for area where installed or as otherwise called for within Contract documents.

2.4 VARIABLE FREQUENCY CONTROLLER (AFD’s)

A. Variable frequency controllers furnished by others shall be installed including power wiring by the Contractor. Control wiring shall be provided by the Temperature Controls

Contractor. Programming of variable frequency drive by Contractor under the direction of Temperature Controls Contractor.

B. The Contractor shall provide all variable frequency controllers, cabinets, mounting hardware, cooling, heating, grounding, noise suppression and wiring. Programming of variable frequency drive by Contractor under the direction of Temperature Controls Contractor where required. Refer to Specification 26 29 23 and relating specifications in Division 26.

C. Installation and wiring of controller shall strictly confirm to the manufacturer installation requirements. No exceptions. Deviations taken by the Contractor may void drive or other related sub-components warranty resulting in financial responsibility of the Contractor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Overload heater charts shall be furnished mounted inside doors of cabinets or separately framed and mounted outside the equipment. Also provide in service manual.

B. Motors whose inrush current exceeds 40 percent of the building transformer rating shall be equipped with reduced voltage or soft start starter.

C. Connect hand off auto selector switches so that automatic control only is bypassed in "manual" position. All safety controls are maintained whether in the auto or manual position.

D. Where indicated, and approved by Code, motor controllers may be omitted when horsepower rated thermostat, float, or pressure switches and similar devices are provided which can control the motor directly. Omit motor controls only where starting and running motor protection is established by other means satisfactory to conform to National Electric Code Requirements. Motor overload protection on all phases is a requirement.

E. Install motor switches in flush enclosures in finished areas unless otherwise noted.

F. Examine schedules, control diagrams, and manufacturer's shop drawings before ordering motor controllers. Order controllers to satisfy diagrams and project document requirements. Should conflicting data exist in specifications, drawings, and diagrams, request corrected data prior to placing orders.

G. Where motor starting equipment is shown or required to be free standing, provide suitable galvanized steel framing to support required equipment.

H. Provide a raised 4 inch concrete slab to mount freestanding motor equipment.

I. Separately mounted motor starters furnished under Division 23 shall be installed by this contractor meeting respective manufacturer requirements.

END OF SECTION 262913.03

SECTION 262923 ADJUSTABLE FREQUENCY DRIVES (AFD's/VFD's)

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 23 Specification Sections, Division 26 Specifications with particular requirements to Specification 260519 "Wires and Cables" and 230513 "Common Motor Requirements for HVAC Equipment" apply to this Section.

1.2 SUMMARY

A. This Section includes solid-state, pulse-width modulated (PWM), adjustable frequency drive (AFD) for speed control of three-phase, squirrel-cage induction motors.

B. Provide adjustable frequency drive package(s) for air handling equipment, pump motors or specified motors where called for within contract documents with input power at the voltage and phase as indicated. AFD's including bypass combination starters shall be provided by the Electrical Contractor where not provided by the manufacturer or supplier. Air handling drives and pump drives shall be installed, programmed and commissioned by the Electric Contractor. The Electrical Contractor shall coordinate installation and particular programming requirements with Temperature Controls Contractor. The output power rating of the speed drive shall not be less than the full load rating of the motor, plus 10%.

1. Drive manufacturer and the Electrical Contractor shall supply drive, components and all necessary controls as herein specified and noted within Contract Documents.
2. Drive manufacturer shall have engaged in the production of this type for a minimum of twenty years.

C. Where the adjustable frequency drive is controlling a multiple motor fan wall in the air handling equipment, and is not located within the air handling equipment, the AFD shall have a single output sized for the total fan wall horsepower. Individual manual motor protectors are NOT to be provided in the AFD enclosure.

1.3 SUBMITTALS

A. Product Data: For each type of AFD.

B. Shop Drawings: For each AFD.

1. Include all relevant wiring diagrams.
2. Dimensions, weight and conduit entry locations.

C. Line and load conductor(s) characteristics including control cables

D. Operation and maintenance manuals

E. Load-current and list of recommended configuration settings.

F. Provisions to ascertain compliance with IEEE Standard 519 in limiting harmonic currents.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.

B. NEMA ICS 3.1 - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.

C. Drives and options shall be listed by Underwriters Laboratories, Inc. as a complete assembly.

D. Drive shall be UL listed for 65,000 amps IC without the need for input fuses.

E. Drives brand labeled by third party manufacturers are not acceptable.

F. Compliance of drive assembly via calculations showing THD less than 5% per IEEE standard 519.

G. Drive shall have a minimum MTBF rating greater than 25 years (220,000 hrs)

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions, unless otherwise indicated:

1. Ambient Temperature: 0 to 122 deg F.
2. Humidity: Less than 95 percent (non-condensing).
3. Altitude: Not exceeding 3300 feet.
4. Enclosure: Provide rated enclosure for area in which it's installed including meeting UL requirements of plenum areas. Minimum requirement: NEMA 12.

1.6 COORDINATION

A. Coordinate features of ASD's, installed units and accessory devices with pilot devices and control circuits to which they connect.

B. Coordinate features, accessories, and functions of each ASD and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load. Include final internal and external control requirements with Temperature Controls Contractor and Fire Alarm Contractor.

1.7 OPERATION AND MAINTENANCE DATA

A. Operation Data: Include instructions for starting and operating drives, and describe operating limits that may result in hazardous or unsafe conditions.

B. Maintenance Data: Include routine preventive maintenance schedule. Provide schematic diagrams for all printed circuit boards, to include part numbers of all components. Owner will sign letter of confidentiality for proprietary material. Per drive, provide three (3) copies of this information plus three (3) copies of service manual for trouble shooting the drive.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of division.

B. Accept drives on site in original packing. Inspect for damage.

C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle in accordance with manufacturer's written instruction. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to components, enclosure, and finish.

1.9 MAINTENANCE SERVICE

A. Furnish service and maintenance of each drive for one (1) year from date of project completion.

1.10 WARRANTY

A. Manufacturer shall provide a full three (3) year warranty on adjustable frequency drive. Warranty shall cover 100% of the cost to repair or replace any assembly part required over the first three (3) years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Provided drives shall be of one manufacturer and subject to compliance with requirements. Provide products by one of the following:

1. Yaskawa, by Stoermer-Anderson
2. ABB
3. Mitsubishi Automation

2.2 ADJUSTABLE FREQUENCY DRIVES

A. Description: NEMA ICS 2, IGBT, PWM, VFC; listed and labeled as a complete unit and arranged to provide adjustable speed of an NEMA MG 1, Design B, 3-phase induction motor by adjusting output voltage and frequency.

1. Design and Rating: Match operation load type such as fans, blowers, pumps and type of connection used between motor and load such as direct or through a power-transmission connection.

B. Furnish and install the latest design solid state speed drives (and assembly of) to vary the speed of the indicated motors. The drive to automatically adjust (modulate) the motor speed in response to a 4 to 20mA input signal to the drive or as required by the Temperature Control Contractor, with a 6 to 90 hertz output to the motor. All components and designs to be per NEC. The drive to be fully compatible with the motor; obtain motor manufacturer's concurrence.

C. The drive shall be suitable for motors driving fans or pumps. Refer to plans and specifications for motor and pump data and characteristics. Rectifier to be full wave type. Displacement power factor to be 0.96 minimum. Maximum total harmonic distortion (THD) to be limited to 5%.

D. Drive to be designed for stepless speed changing and continuous operation at any speed (frequency) within the specified frequency range. Drive design to be such that openings of motor leads and operation of protective features do not cause component failure. Linear speed control to be from 10 to 100% of maximum speed, unaffected by input voltage changes of plus or minus 10% rated voltage. Both the minimum and maximum speed limits; acceleration and deceleration rates; and volts-to-hertz ratio shall be adjustable. Provide current limit function to avoid excessive automatic acceleration and deceleration when an over current condition exists. Drive to provide for "soft" start, with adjustable starting frequency.

E. Output frequency to remain stable at its operating point in spite of input voltage, input frequency and temperature variations within the specified ranges.

F. The speed control output transistors are to be configured to switch frequency of up to 20 kHz to eliminate the audible noise associated with drive designs. The audible noise emitted from the motor must be within 5 db of the noise during across-the-line operations at all frequencies within the human audible spectrum (up to 10 kHz operating frequency).

G. The drive shall permit disconnection of power from the input or output line voltage with the drive running under load without damage to the drive components. The drive shall be able to withstand an output line short (phase-to-phase or phase-to-ground) without damage to the drive components. Drive shall shutdown on short circuit and detection of any of the following conditions: current 150% above rated current; phase loss; input over voltage and under voltage; high internal temperature; ground fault and under frequency.

H. The AFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to set point without safety tripping or component damage (flying start.)

I. The AFD shall include a coordinated AC transient protection system consisting of 4-120 joule rated MOV's (phase to phase and phase to ground), a capacitor clamp, and 5% impedance reactors.

J. The drive shall have an automatic restart function to attempt restart after the unit trips off when power is lost to the unit. A time delay shall be provided between restarts. The

unit shall not attempt to restart more than five (5) times in the automatic mode. In addition, the drive shall have a "power dip" ride-thru feature to prevent unnecessary trip-out due to momentary input power interruptions.

K. The drive shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The drive shall be programmable to signal this condition via a keypad warning, relay output and over the serial communications bus. Relay outputs shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false under load condition.

L. The drive shall not create any feedback noise on the input line that will adversely affect electronic or microprocessor based equipment (such as computers or sensitive equipment) and the drive shall not impress voltage or current spikes on the supply system. The minimum requirements shall conform to IEEE Standard 519, Special Applications for Line Notching and Distortion. The manufacturer shall provide at no additional cost any equipment to comply with IEEE 519.

M. Communications: The drive shall have an RS-485 port as standard. The Building Automation System (BAS) protocol used shall be compatible with devices provided by the Temperature Controls Contractor such as BACnet, Lon Works, Metasys N2, Modbus/Memobus, and Apogee. Final protocol shall be verified with Controls Contractor prior to ordering AFD's and supporting hardware/software.

1. If additional hardware is required to obtain BAS protocol as required by the Temperature Controls Contractor, the drive manufacturer shall supply required interfaces. Multiple drives sharing one gateway shall not be acceptable.
2. Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, accel/decel time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC to monitor feedback such as process adjustable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The DDC shall also be capable of monitoring the drive relay output status, digital input status and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus.
3. A minimum of 15 field parameters shall be capable of being monitored.
4. The AFD shall allow the DDC to control the drive's digital and analog outputs via the serial interface. This control shall be independent of any AFD function. For example, the analog outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive's digital (relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the drive's digital and analog inputs shall be capable of being monitored by the DDC system.

N. Combination Motor Circuit Protector (MCP) circuit breaker and integral disconnect switch shall be provided to disconnect from the line source prior to clearing of upstream branch circuit protection.

O. Provide controls mounted in face of the enclosure or keypad for the following functions:

1. The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (alpha-numeric codes are not acceptable).

    a. Output Frequency
    b. Motor Speed (RPM, %, or Engineering units)
    c. Motor Current
    d. Calculated Motor Torque
    e. Calculated Motor Power (kW)
    f. DC Bus Voltage
    g. Output Voltage

P. The following indicating lights (LED type) shall be provided. A test mode or push to test feature shall be provided.

1. Power-on (Ready)
2. Run enable (safeties) open
3. Drive mode select damper opening
4. Drive running
5. Drive fault
6. Safety open
7. Damper opening
8. Damper end-switch made

Q. Protective and miscellaneous features, to include:

1. The digital inputs for the system shall accept 24V or 115VAC (selectable).
2. Customer Interlock Terminal Strip – provide a separate terminal strip for connection of freeze, fire, smoke contacts, status and external start command. Drive digital I/O points shall be prewired to interlock terminal strip and labeled accordingly.
3. Control power for field interlocks shall be provided by the drive and shall be interlocked with drive operating disconnect switch.
4. The drive shall include a "run permissive circuit" that will provide a normally open contact whenever a run command is provided. The drive shall not operate the motor until it receives a dry contact closure from a damper, valve end-switch or DDC (BAS) permissive signal. When the drive system safety interlock (fire detector, freezestat, high static pressure switch, etc) opens, the motor shall coast to a stop and the run permissive contact shall open, closing the damper or valve or other control interfaces.
5. Output current limiting, without tripping by momentary overloads.
6. Instantaneous over current tripping on phase to phase short circuits, high overloads and ground faults for both drive and connected motor.
7. Under voltage tripping on power or phase loss.
8. Over voltage tripping.
9. Over temperature tripping.
10. Visual indication of tripping causes. (Current limit, instantaneous cover current trip, under voltage, over voltage).
11. Over temperature, decelerating limit.
12. Speed indicator.

13. Bi-directional "Speed Search" capability to start into a rotating load. Two types: current detection and residual voltage detection.
14. A spare set of fuses of each type and ampere rating shall be provided.
15. Operating disconnect handle on front of the drive with provisions for locking in OFF position.
16. Drive output reactors to protect motors from reflected waves on long motor lead lengths.
17. Filters of radio frequency interference to attenuate possible drive generated noise shall be provided.

R. Drive enclosure with required accessories shall be mounted within enclosure rated for environment with UL certification label. Provide forced ventilation with filtration when installed in environments which negatively affect drive performance, longevity and functionality.

2.3 PROVIDED ACCESSORIES

A. Devices shall be factory installed in drive enclosure, unless otherwise indicated.

B. Historical Logging Information and Displays:

1. Real-time clock with current time and date.
2. Running log of total power versus time.
3. Total run time.
4. Fault log, maintaining last four faults with time and date stamp for each.

C. Latest software version and required accessories (cables) required for parameter upload/download shall be provided.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Select features of each drive to coordinate with ratings and characteristics of supply circuit and motor; required control sequence and duty cycle of motor, drive, and load.

B. Select horsepower rating of drives to suit motor being controlled.

3.2 INSTALLATION

A. Installation by Electrical Contractor. Settings and system performance coordinated with Temperature Controls Contractor.

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems" or as required by drive manufacturer.

C. Drive Fuses (where provided): Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."

D. Motors connected to inverter controllers shall also comply with requirements of Division 23 Specification 230513 "Common Motor Requirements for HVAC Equipment" when

such equipment is included in Contract Documents. At a minimum, motors connected to inverters shall comply with the following:

1. Motors shall comply with Energy Independence and Security Act of 2007.
2. Motors shall comply with NEMA MG 1 table 12-11 and 12-12 unless noted otherwise.
3. Motors connected to inverter controllers shall be inverter rated complying with NEMA MGI parts 30 and 31. Shaft mounted grounding ring such as AEGIS bearing protection ring shall be provided.

3.3 IDENTIFICATION

A. Identify AFD's, components, and control wiring according to Division 26 Section "Electric Identification"

B. Operating Instructions: Frame printed operating instructions for drives, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of drive units.

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between drives and remote devices. Bundle, train, and support wiring in enclosures. Each unit to be complete with all interconnecting wiring and connections between components within unit and to terminal board for connection to remote devices. Each wire to have an identifying number at each end.

B. Connect hand-off-automatic switch and other automatic-control devices where applicable.

1. Connect selector switches to bypass only manual and automatic-control devices that have no safety functions when switch is in hand position.
2. Connect selector switches with control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

C. Terminal Board: Each unit to be provided with terminal boards completely accessible from the front by which line, load and control connections may be made and disconnected. Each terminal board to have all terminals clearly marked and all wiring between terminals to be provided, including connections to all extra and unused terminals on auxiliary contacts, relays and control devices, etc.

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each enclosed drive element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:

1. Inspect drives, wiring, components, connections, and equipment installation. Program, configure and test drives, components, and equipment.

2. Assist in field testing of equipment including pretesting and adjusting of solid-state drives.
3. Report results in writing.

C. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.6 TRAINING

A. Manufacturer to provide competent, well-trained supervisor to instruct the Owner's personnel in the proper maintenance and care of the equipment. Instruction period, exclusive of installation and startup time, to consist of one (1) eight (8) hour period for all equipment specified in this section of specification. Cost shall be included in Electrical Contractor's bid.

END OF SECTION 262923

SECTION 263213 – ENGINE GENERATOR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Provide all labor, materials and equipment to furnish, install and place in operation a natural gas power generation system in accordance with the contract documents and manufacturer's drawings and installation instructions. These specifications also describe requirements for the design, fabrication and testing of the power system. The total installation shall conform to manufacturer's recommendations.

B. Fuel supply and connection to generator set shall be made by installation contractor.

C. The installation of the power generation system shall include the following:

1. Engine-driven generator set
2. Control and monitoring system
3. Cooling system
4. Generator set accessories
5. Remote annunciator
6. Mounting system
7. Base slab and vibration isolation
8. Weatherproof housing, sound attenuated

D. Any and all exceptions to the published specifications shall be subject to the approval of the Engineer.

E. The power system shall be furnished by a single manufacturer who shall be responsible for the design, coordination, and testing of the complete system. The entire system shall be installed as shown on the plans, Contract documents, drawings, and specifications herein.

F. The equipment shall be produced by a manufacturer who is ISO 9001 certified for the design, development, production, installation, and servicing of complete product line.

G. It is the intent of this specification to secure electrical power systems that have been tested during design verification, production and at the final job site. All furnished equipment shall be of the latest commercial design and will be complete with all of the necessary accessories for complete installation as shown on the plans, drawings, and specifications herein. The equipment supplied and installed shall meet the

requirements of the National Electrical Code, along with all applicable local codes and regulations. All equipment shall be new and of current production of a national firm that manufactures generator sets and controls, transfer switches, and assembles the generator sets as a complete and coordinated system. There will be one (1) source responsibility for warranty, parts, and service through a local representative with factory-trained servicemen.

H. Related Sections include the following:

1. Division 26 Section "Automatic Transfer Switch" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 SYSTEM DESCRIPTION

A. The electric power generating system shall have sufficient capacity under continuous standby operation including inrush allowance as specified within Contract documents or otherwise scheduled. (Basis of Design) Kohler Model #; 200REZXB,EPA,NG, with 4AU10 alternator operating at 480Y/277V, 3Ph, 4W, 60Hz, rated 200kW/250kVA. Output amperage 301 Amps. Standby 130C Rise; unit mounted radiator, 50C, skid, APM402; 400A LSIG (GF indicating), 100% rated breaker, NEC remote estop, flexible fuel line; Remote annunciator, RSA III, annunciator.

B. Voltage: voltage, phasing and wire quantity characteristics as specified within Contract documents or otherwise scheduled.

C. The system shall consist of a natural gas driven generator set which includes all controls, protection, output circuit breaker(s), wiring, and accessories for automatic start-stop operation.

D. The generator set shall include the capability of automatically controlling generator set operation. After starting, the unit will attain rated speed and voltage, and accept rated load. Generator set speed shall be controlled by the engine governor, while generating output voltage regulation shall be a function of the generator automatic voltage regulator. Manual adjustment of generator speed and voltage shall be provided.

E. The generator set start-stop sequence shall be initiated manually or automatically by closing or opening of a contact. The control system shall automatically engage the cranking motor, sense engine starting speed, disengage the motor and arm the engine protection circuit.

F. The set shall immediately shut down in the event of over speed, low oil pressure, high water temperature and over crank. Cause of shutdown shall be indicated by a light annunciator. System logic shall prevent restart until fault is cleared.

G. Provisions for manual shutdown in the event of an emergency shall be provided.

H. Generator system shall be suitable for the maximum available fault current.

I. Generator system shall restore power within 10 seconds of loss of normal power.

J. Engine block heater. Thermostatically controlled and sized to maintain manufacturers recommended engine coolant temperature to meet the start-up requirements of NFPA-99 and NFPA-110, Level 2. Voltage shall be 120vAC.

K. The engine exhaust silencer shall be coated to be temperature and rust resistant, rated for critical application. The silencer will reduce total engine exhaust noise by 25-35 dB(A).

L. Remote annunciator panel enabling the generator status to be viewed remotely. This remote annunciator panel shall communicate with the generator controller via 2-conductor twisted pair serial bus. The panel shall be mounted at location shown on plans.

1.4 SYSTEM PERFORMANCE

A. The power generating system shall conform to the following performance criteria:

1. Rating - Engine brake horsepower shall be sufficient to deliver full rated generator set KW/KVA at the installation site when operated at rated rpm and equipped with all engine-mounted parasitic and external loads such as radiator fans and power generators.

2. Start Time and Load Acceptance - Engines shall start, achieve rated voltage and frequency, and be capable of accepting load within 10 seconds when properly equipped and maintained.

3. Block Load Acceptance - Transient response shall conform to ISO 8528 requirements.

1.5 SUBMITTALS

A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:

1. Submittals shall include but not be limited to:

2. Breakdown of all components and options including controls.

3. Manufacturer produced generator set specification, data sheets and shop drawings identifying make and model of engine and generator, and including relevant component design and performance data.

a. Engine:

1) Type, aspiration, compression ratio, and combustion cycle. Bore, stroke, displacement, and number of cylinders.

2) Engine lubricating oil capacity.

3) Engine coolant capacity without radiator.

4) Engine coolant capacity with radiator.

5) Coolant pump: external resistance (maximum). Where remote radiator is specified

b. Generator:

1) Model

2) Frame

3) Insulation class

4) Number of Leads

5) Weight, total

6) At rated voltage: Efficiency at 0.8 power factor for: 50% load, 75% load, 100% load

7) Fault current, 3 phase symmetrical

8) Decrement curve

c. Radiator: (High Ambient, Brass)

1) Model

2) Type

3) Weight: Dry, Wet

d. System:

1) Dimensions: Length, Width, Height

2) Weight: Dry, Wet

3) Performance at rated temperature extremes

4) Continuous power rating at 0.8 power factor (KW) kVA rating

5) Fuel consumption at standard conditions for: 50%, 75% and 100% load Heat rejection to coolant, after-cooler,

6) Exhaust temperature from engine to atmosphere.

7) Verification of 10% overload capability

8) Transient response of frequency and voltage for the generator set.

4. Wiring Diagrams: Power, signal, and control wiring.

5. Auxiliary Equipment - Specification or data sheets, including overcurrent protection and spring type vibration isolators.

6. Warranty Statements - Warranty verification published by the manufacturer.

B. Source quality-control test reports.

1. Certified summary of prototype-unit test report.

2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.

3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.

4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.

5. Report of sound generation.

6. Report of exhaust emissions showing compliance with applicable regulations.

7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

C. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. List of tools and replacement items recommended being stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.

1.6 QUALITY ASSURANCE

A. The complete power generation system, including engine, generator, and controls shall be the product of one manufacturer who has been regularly engaged in the production of complete generating systems for at least 15 years. All components shall have been designed to achieve optimum physical and performance compatibility and prototype tested to prove integrated design capability. The complete system shall have been factory fabricated, assembled, and production tested.

B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.

C. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 200 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

D. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

F. Comply with ASME B15.1.

G. Comply with NFPA 37.

H. Comply with NFPA 70.

I. Comply with NFPA 110 requirements for Level 2 power supply system.

J. Comply with UL 2200.

K. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

L. Noise Emission: Comply with applicable state and local government requirements for maximum noise levels due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of electrical service.

2. Do not proceed with interruption of electrical service without Owner's written permission.

B. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: -20 to 115 deg F

2. Relative Humidity: 0 to 95 percent.

3. Altitude: Sea level to 2400ft.

1.8 COORDINATION

A. Coordinate size and location of concrete bases for package engine. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 2 years or 2000 running hours from date of final startup of system and shall include repair parts, labor, reasonable travel expense necessary for repairs at the jobsite, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair.

2. Submittals received without written warranties as specified will be rejected in their entirety.

1.10 WARRANTY NAMEPLATE

A. Warranty nameplate of not less than 6” x 8” affixed to the generator set with the following data:

1. Warranty Period:

2. Start-up Date:

3. Termination Date:

4. Supplier Name:

5. Supplier Address:

6. 24-Hour Emergency Number:

7. Preventive maintenance to be performed by:

1.11 MAINTENANCE CONTRACT

A. The generator set supplier shall offer maintenance and repair contract which guarantees all support costs of the specified system. It shall include routine and 24 hour emergency access to a factory account manager to expedite emergency repairs.

B. The generator set supplier shall provide a scheduled oil sampling service to monitor engine condition on an ongoing basis. The sampling method shall be of the atomic

absorption spectrophometry method. This service shall be included within the maintenance contract alternate.

C. Contract: Shall be priced during the bid process as an alternate bid item.

1.12 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every type and rating, but no fewer than three of each.

2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.

3. Filters: Two sets each of lubricating oil, fuel, and combustion-air filters.

1.13 RESPONSIBILITY

A. The responsibility for performance to this specification shall not be divided among individual component manufacturers, but must be assumed solely by the primary manufacturer. This includes generating system design, manufacture, test, and having a local supplier responsible for service, parts, and warranty for the total system.

B. Generator set mounted subassemblies such as cooling system, base, air intake system, exhaust outlet fittings, sound attenuation and generator controls shall also be designed, built, and assembled as a complete unit by the engine/generator manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Caterpillar; Engine Div.
2. Kohler Co.; Generator Division. (base of design)
3. Onan/Cummins Power Generation; Industrial Business Group.
4. Approved Equal

B. These requirements are intended to define a power generation system of proven type and design, current production and with all components commercially available.

2.2 ENGINE-GENERATOR SET

A. Factory-assembled and tested prior to shipment.

B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation. Include lifting attachments.

1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

C. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated.
2. Output Connections: Three-phase, four wire.
3. Nameplates: Each major system component to identify manufacturer's name and address, and model and serial number of component.

D. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 2 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
3. Steady-State Frequency Operational Bandwidth: 0.25 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
6. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
8. Start Time: Comply with NFPA 110, Type 10, system requirements.
9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.

    a. Provide permanent magnet excitation (where required) for power source to voltage regulator.

10. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.3 ENGINE

A. Fuel: Natural Gas

B. Rated Engine Speed at 60 Hz. output: 1800 rpm.

C. Lubrication System: The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow with bypass valve to continue lubrication in the event of clogged filter media.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
4. System shall utilize synthetic lubricants with compatible filtration, and compatible engine seals, approved by the engine manufacturer.

D. Governor: Electronic (speed sensing) to control engine speed and transient load response within commercial and ISO 8528 tolerances. Governor will be selected, installed, and tested by the generator set manufacturer.

E. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Heater and control voltage operate at 120vAC. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

F. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
3. Expansion Tank (Where Required): Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.

    a. Rating: 50-psig maximum working pressure with coolant at 180 deg F and non-collapsible under vacuum.
    b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

G. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 25 dB at 500 Hz.
2. Sound level measured at a distance of 10 feet from exhaust discharge after installation is complete shall be 85dBA or less.

H. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

I. Starting System: low voltage 12v with negative ground.

1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Battery: Adequate capacity within ambient temperature range to provide specified cranking cycle at least three times without recharging.
4. Battery Cable: Size and length as recommended by engine manufacturer. Include required interconnecting conductors and connection accessories. The system shall be capable of starting engine within 10 seconds.
5. Battery Compartment: Factory fabricated of corrosion resistant case with acid-resistant finish and thermal insulation. Include accessories required to support and fasten batteries in place.
6. Battery-Charging Alternator: Solid-state voltage regulation.
7. Batteries shall be maintenance free, lead acid type mounted near the starting motor.
8. Battery warranty shall be the responsibility of the generator set manufacturer.

2.4 CONTROL AND MONITORING

A. The engine mounted instrument panel shall consist of a shock-mounted formed, welded with corrosion resistant finish.

B. Annunciation and controls shall conform to NFPA 110 Level 2.

C. Provide English marked controls and indicators on panel as specified or otherwise required by manufacturer such as but not limited to the following:

1. Gauges: AC meters, volts, amperes, frequency, water temperature, oil pressure, battery voltage and running time hour meter.
2. Switches: AUTO-OFF-RUN selector switch
3. Switches: Horn silence
4. Switches: Voltage adjustment potentiometer
5. Indicators: High Engine Temperature
6. Indicators: Low Coolant Level
7. Indicators: Low Oil Pressure
8. Indicators: Overcrank
9. Indicators: Overspeed

D. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

E. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gauges shall be grouped in a common control and monitoring panel. Refer to Contract documents for location of remote panel(s).

1. Wall-Mounting Cabinet NEMA 1 (or otherwise noted) construction: rigid, self-supporting steel unit. Enclosure must be rated for area in which it's installed.
2. Current and Potential Transformers: Instrument accuracy class.
3. Generator overload.

F. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

G. Remote Alarm Annunciator: Comply with NFPA 99 and NEC 700. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- mounting type to suit mounting conditions indicated.

H. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.5 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Circuit Breaker: Electronic type LSI; 100 percent rated; complying with NEMA AB 1 and UL 489.

1. Tripping Characteristic: Designed specifically for generator protection.
2. Trip Rating: Matched to generator rating.
3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
4. Mounting: Adjacent to or integrated with control and monitoring panel.

B. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector shall perform the following functions:

1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
2. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.
4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

C. Ground-Fault Indication (Where Required): Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

2.6 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Enclosure: Exterior rated of drip proof construction.

G. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.

1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.

H. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

I. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

2.7 OUTDOOR GENERATOR-SET SOUND ATTENUATING ENCLOSURE

A. Description: Vandal-resistant, weatherproof corrosion resistant steel housing, wind resistant up to 100 mph with corner posts, uprights and headers. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. The roof shall aid in the runoff of water and include a drip edge. The enclosure shall be completely lined with not less than 1” thick, UL 94 HF-1 listed, sound deadening material. This material must be of a self extinguishing design. The critical silencer shall be included to further reduce the unit sound level. Instruments and control shall be mounted within enclosure.

1. Louvers (When Equipped): Equipped with bird screen and filter arranged to permit air circulation when engine is not running while excluding exterior dust, birds, and rodents.
2. Hinged Doors: With padlocking provisions.
3. Ventilation: Louvers equipped with bird screen and filter arranged to permit air circulation while excluding exterior dust, birds, and rodents.
4. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine-generator-set components.
5. Muffler Location: Internal to enclosure. Exhaust silencer(s) shall be provided of the size as recommended by the manufacturer and shall be of critical grade to attenuate the sound to the level noted above. It shall be supplied with a flexible,

seamless, stainless steel exhaust connection. A rain cap will be supplied to terminate the exhaust pipe. These components must be properly sized to assure operation without excessive back pressure when installed.

B. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.

1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.

2.8 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Restrained Spring Isolators: Freestanding, steel, open-spring isolators.

2.9 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.10 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
2. Full load run using resistive load bank unit capable of providing a balanced 3-phase, delta-connected load to generator set at 100 percent rated-system capacity, at 80 percent power factor, lagging. Testing shall be in loads of 25 percent steps up to 100 percent load.
3. Maximum power.
4. Voltage regulation.
5. Transient and steady-state governing.
6. Single-step load pickup.
7. Safety shutdown.
8. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 PREDELIVERY INSPECTION

A. Pre-delivery inspection must be performed by the system manufacturers' local dealer to insure no damage occurred in transit and all components, controls, and related generator assemblies are included as specified herein.

3.2 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Install packaged engine generator with isolators having a minimum deflection of 1 inch on 4-inch- high concrete base. Secure sets to anchor bolts installed in concrete bases.

C. Install devices furnished by manufacturer but include items not factory mounted.

3.4 CONNECTIONS

A. Piping installation requirements are specified in Division 23 Sections. Drawings indicate general arrangement of piping and specialties.

B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.

C. Connect engine exhaust pipe to engine with flexible connector or otherwise directed by manufacturer installation requirements.

D. Connect fuel piping to engines with valves, unions and flexible connector.

E. Ground equipment according to Division 26 Section.

F. Connect wiring according to Division 26.

3.5 IDENTIFICATION

A. Identify system components according to Division 23 Section "Identification for HVAC Piping and Equipment" and Division 26 Section "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. All consumables necessary for testing shall be furnished by the bidder. Any defects which become evident during the test shall be corrected by the bidder at his own expense prior to shipment to the jobsite.

B. The complete installation shall be checked for procedural and operational compliance by a representative of the system manufacturer's authorized local dealer. The engine lubricating oil and antifreeze, as recommended by the system manufacturer, shall be provided by the generator set dealer. Any deficiencies shall be noted and corrected by the Contractor.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

D. Perform tests and inspections and prepare test reports.

E. Tests and Inspections:

1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.

3. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks. Repair faulty devices and correct leaks conforming to manufacturer specifications.

4. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.

5. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.

6. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge.

F. Coordinate tests with tests for transfer switches and run them concurrently.

G. Test instruments shall have been calibrated within the last 6 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.

H. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

I. Test and adjust controls and safeties. Remove and replace malfunctioning units. Correct deficiencies identified by tests and observations and retest until specified requirements are met.

J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel. Allocate minimum of 48 hours to cover topics such as but not limited to: control operation, schematics, wiring and diagrams, meters, indicators, warning lights, shutdown system, transfer switch operations and routine maintenance.

3.8 SERVICE MANUALS AND PARTS BOOKS

A. The system manufacturer's authorized local dealer shall furnish copies each of the manuals and books listed below for each unit under this contract:

1. OPERATING INSTRUCTIONS - with description and illustration of all switchgear controls and indicators and engine and generator controls.

2. PARTS BOOKS - Illustrations listing all assemblies, subassemblies and components, except standard fastening hardware (nuts, bolts, washers, etc.).

3. PREVENTATIVE MAINTENANCE INSTRUCTIONS - on the complete system that cover daily, weekly, monthly, biannual, and annual maintenance requirements and include a complete lubrication chart.

4. ROUTINE TEST PROCEDURES - for all electronic and electrical circuits and for the main AC generator.

5. TROUBLESHOOTING CHART - covering the complete generator set showing description of trouble, probable cause and suggested remedy.

6. RECOMMENDED SPARE PARTS LIST - showing all consumables anticipated to be required during routine maintenance and test.

7. WIRING DIAGRAMS AND SCHEMATICS - showing function of all electrical components.

END OF SECTION 263213

SECTION 263600 – AUTOMATIC TRANSFER SWITCH

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 263213 Section Standby Generator.

1.2 SUMMARY

A. This Section includes automatic transfer switches rated 600 V and less.

B. Automatic transfer switches not intended for continuous duty or repetitive load transfer switching are not acceptable.

C. Automatic transfer switch basis of design: Kohler model # KSS-AMTA-0400S. Provide 3 pole, 4 wire, solid neutral, 400A, 480V, 60Hz, Kohler specific breaker rated standard automatic transfer switch, NEMA 1 enclosure, input/output module quantity (2).

1.3 SUBMITTALS

A. Product Data: Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

1. Dimensioned Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

2. Detailed description of equipment anchorage devices on which the certification is based.

C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NEMA ICS 2-447: AC automatic transfer switches.

C. Comply with NFPA 70.

D. Comply with NFPA 99.

E. Comply with NFPA 110.

F. Comply with IEEE 446: Recommended Practice for Emergency and Standby Power Systems (Orange Book).

G. Comply with IEEE Standard 241 - Recommended Practice for Electric Power Systems in Commercial Buildings (Gray Book)

H. The ATS shall be listed in accordance with UL 1008 as follows:

1. Rated in amps for total system transfer including control of motors, electric-discharge lamps, electric-heating and tungsten-filament lamp loads as referred to in Paragraph 38.13 of UL 1008.
2. Switches rated 400 amps and below shall be suitable for 100 percent tungsten-filament lamp load. Switches rated above 400 amps shall be suitable for 30 percent tungsten-filament load.
3. Characteristics: 600 volts class, 3-phase 4-wire, current rating having minimum amperage as called for on contract documents, 60Hz or otherwise indicated.
4. Overload and endurance at 480 volts AC per Tables 25.1, 25.2, 27.1 and 27.2 of UL 1008 when enclosed according to Paragraph 1.6.
5. Temperature rise tests after the overload and endurance tests to confirm the ability of the transfer switches to carry their rated current within the allowable temperature limits.
6. No welding of contacts. Transfer switch must be electrically operable to alternate source after the withstand current tests.
7. Dielectric tests at 1960 volts RMS minimum after the withstand current test.

1.5 WITHSTAND CURRENT RATINGS

A. The ATS shall be rated to withstand minimum symmetrical short-circuit current at the terminals as shown within Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Contactor Transfer Switches:

    1. Caterpillar; Engine Div.
    2. Emerson; ASCO Power Technologies.
    3. Kohler Power Systems; Generator Division. (base of design)
    4. Onan/Cummins Power Generation; Industrial Business Group.
    5. Approved Equal.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

B. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C. The controller shall be equipped with self diagnostics performing periodic internal checks.

C. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

D. Electrical operation mechanically-held: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

E. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Switch Action: Electrically operated double throw; mechanically held in both directions.
2. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

F. Neutral Terminal: Solid unless otherwise indicated. The neutral conductor terminal plate with fully rated AL-CU pressure connectors shall be provided.

G. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

H. All contacts, coils, springs, and control elements shall be conveniently removable from the front of the transfer switch without major disassembly or disconnection of power conductors.

I. All moveable parts of the operating mechanism shall remain in positive mechanical contact with the main contacts during the transfer operation without the use of separate mechanical interlocks.

J. Auxiliary contacts shall be provided to indicate switch position. Provide at least four (4) sets of form-C contacts.

2.3 BATTERY CHARGER: FOR GENERATOR STARTING BATTERIES

A. Meet minimal requirements of NFPA 110 3-5.4.6

B. Float type rated 10 ampere.

C. Ammeter to display charging current.

D. Fused ac inputs and dc outputs.

2.4 AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 2 equipment according to NFPA 110.

B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

C. Signal-Before-Transfer Contacts: Provide (4) four sets of normally open/normally closed dry contacts which operate in advance of transfer from normal source. Interval is adjustable from 1 to 30 seconds.

1. One (1) set of contacts shall be used for DDC monitoring of building supply source voltage. Electrical contractor shall provide raceway and cabling to DDC controller as called for by Temperature Controls Contractor.

2. One (1) set of contacts shall be routed via raceway to elevator controller/elevator (where operated via generator) as called for by the Elevator Installer.

D. All printed circuit boards must be conformal coated on both sides for environmental protection.

E. Automatic Transfer-Switch Features:

1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    b. Push-button programming control with digital display of settings.
    c. Integral battery operation of time switch when normal control power is not available.

2.5 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide power, communication and monitoring conduits and wiring making all necessary connections at transfer switch and at the emergency generator. Coordinate all terminations and transfer switch terminations with the manufacturer.

B. Identify components according to Division 26 Section "Identification for Electrical Systems."

C. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS (By Electrical Contractor)

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

    a. Check for electrical continuity of circuits and for short circuits.
    b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
    c. Verify that manual transfer warnings are properly placed.
    d. Perform manual transfer operation.

4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

    a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
    b. Simulate loss of phase-to-ground voltage for each phase of normal source.
    c. Verify time-delay settings.
    d. Verify pickup and dropout voltages by data readout or inspection of control settings.
    e. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

C. Coordinate tests with tests of generator and run them concurrently.

D. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions.

1. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
2. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
3. Verify acceptance of charge for each element of the battery after discharge.
4. Verify that measurements are within manufacturer's specifications.

E. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.

F. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

G. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Allocate minimum of 48 training hours. Refer to Division 01 Section "Demonstration and Training."

B. Coordinate this training with that for generator equipment.

END OF SECTION 263600

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SECTION 264113 LIGHTNING PROTECTION SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements and Division 1 Specification Sections, apply to this Section.

1.2 GENERAL

A. Provide a functional and unobtrusive Class I lightning protection system in accordance with the provisions of the latest "Code for Protection Against Lightning" for buildings as adopted by the National Fire Protection Association, Lightning protection Institute and the Underwriters Laboratories, Inc. for a Master Label System.

B. The drawings indicate proposed locations and routings for lightning rods, and lightning down conductors, as proposed by the associate. If any departures from the contract drawings are deemed necessary, details of such departures shall be submitted as soon as practicable to the associate for approval. No such departures shall be made without the prior written approval of the associate.

C. This is a performance specification. The lightning protection system shall be designed and installed by a Lightning Protection Contractor who specializes in this field.

D. The following specifications and standard of the latest issue form a part of this specification:

1. Lightning Protection Institute Installation Code LPI-175
2. National Fire Protection Association Code No. 780 (2000 edition)
3. Underwriters Laboratories Inc. 96/96A

1.3 QUALITY ASSURANCE

A. The lightning protection system shall conform to the requirements and standards for lightning protection systems in accordance with UL, NFPA and LPI. Upon completion of the installation, application shall be made to the Underwriters Laboratories, Inc. for issuance of the UL Master Label C. Upon receipt of the UL Master Label C from Underwriter Laboratories, said Label including Forms LPI-175A and 175B will be presented to Miami University or representative of.

B. The system to be provided under this specification shall be the standard product of a manufacturer regularly engaged in the production of lightning protection systems and shall be the manufacturer's latest approved design. The equipment manufacturer shall also be UL listed and approved manufacturer and a fully certified manufacturer member in good standing of the Lightning Protection Institute.

1.4 SUBMITTALS

A. Complete design submittal drawings showing the type, size, and location of all grounding, roof conductors, down conductors, through-roof connectors and air terminals shall be submitted to the associate for approval prior to commencement of work.

B. Samples and pertinent catalog data shall be submitted to the associate for approval.

1.5 SYSTEM DESIGN

A. The work covered under this section of the specifications consists of furnishing labor, materials and services required for the completion of a functional and inconspicuous lightning protection system approved by the Associate. The design of this system is to be in strict accordance with this section of the specifications and all contract drawings that apply.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. All equipment used in this installation shall be product of a single manufacturer new, factory inspected, of design to suite the application where components are used and properly labeled in accordance with UL, NFPA and LPI requirements.

B. All material specified for this work is manufactured by Maxwell Lightning Protection Company, Inc., Dayton, Ohio, or approved MLPC,Inc. equal. For approval of Lightning Protection manufacturer other than specified, proposed material data and installation drawings must be submitted for review not less than 10 days prior to bid.

2.2 EQUIPMENT

A. All lightning protection materials and components shall comply in weight, size and composition with UL 96, NFPA-780 and LPI-175 for type of structure defined within specifications. Materials used shall be copper/bronze in composition. Aluminum material shall be used only in locations where connections of components produce galvanic corrosion due to dissimilar metals. Bolts, nails, screws or other approved fasteners shall be stainless steel.

B. Downlead conductors from roof to ground shall meet minimum requirements of: 32 strands 17 gauge copper, 65,667 circular mils or as otherwise required for Master Label certification.

C. Air terminals shall be solid, round copper bar of 1/2 inch minimum diameter by 12” in length.

D. Air terminal bases shall be of cast bronze with bolt pressure cable connections and shall be securely mounted with stainless steel screws, bolts or as specified per roofing system details. Crimp type connectors are not acceptable.

E. Bases on EPDM rubber roofs shall be secured with the applicable pourable sealer. All bases for equipment shall be securely mounted to roof, parapet, etc., as directed by roofing manufacturer, and all sealers, compounds, etc., shall be compatible with roofing materials.

F. Ground rods shall be a minimum of 3/4 inches in diameter by 10 feet long. Connection to the system shall be made of exothermic in addition to proving cable clamps connections to ground rods.

G. Cable fasteners shall be substantial in construction, electrolytically compatible with the conductor and mounting surface and shall be spaced according to LPI and NFPA code requirements.

H. Bonding devices, cable splicers, and miscellaneous connectors shall be of cast bronze or of copper construction with bolt pressure connections to cable.

I. Equipment on stacks or chimneys shall be protected from corrosion in accordance with LPI and NFPA requirements.

J. Ground test wells 12” diameter, 18” length, schedule 80 PVC, high traffic area, bolt down cast iron lid, 4 slots for installation after grounding connections are made.

K. All miscellaneous bolts, nuts, and screws shall be stainless steel.

PART 3 - EXECUTION

3.2 GENERAL

A. The installation shall be accomplished by an experienced installer who is a certified Master Installer and in good standing with the LPI. This Contractor's LPI Master Installer number shall be listed on the Contractor's bid form. All material shall be installed in a neat, workmanlike manner, as inconspicuously as possible.

B. All cable runs shall be chalk line straight and plumb. All air terminals shall be plumbed. All adhesive fastening shall be accomplished with EPDM pourable sealer. Air terminal bases and adhesive cable pads shall be installed in straight lines, apply pourable sealer to the base and fastener and let dry for a minimum of 48 hours before inserting cable. Pouring adhesive over cable, base, and fastener is strictly prohibited.

C. Where cable runs are not neat and plumb (within 5 degrees), the installer shall correct cable runs at the installer's expense. It shall be the lightning protection contractor's responsibility to install the pourable sealer and fasten his equipment. Other trades are prohibited from installing items associated with lightning protection system. Down conductors shall be installed inside the building via routing’s proposed on the drawing. Down conductors shall be installed in PVC conduit. Furnish PVC conduit guards to 8 feet above grade. Install ground rods at a minimum distance of 3 feet from building foundation.

D. Roofing contractor will be responsible for sealing and flashing all lightning protection roof penetrations per manufacturer’s recommendations.

3.3 COORDINATION

A. The lightning protection installer will work with other trades to insure a correct, neat, and unobtrusive installation. It shall be the responsibility of the lightning protection installer to assure a sound bond to the main grounding ring conductor and insuring interconnection with other building ground systems such as telephone, communication, water piping or gas piping meeting applicable codes.

B. System shall be coordinated with Owner (Architectural representative) for final approval of down conductor locations.

C. If the protected structure is an addition to or is attached to an existing structure that does not have a lightning protection system, the lightning protection contractor shall advise the Associate of installation requirements on the existing structure to obtain the Master Label. If the existing structure does have a lightning protection system, the contractor shall integrate achieving a complete compliance system within current UL Master Label requirements. Upon completion of the installation, the contractor shall furnish the Master Label issued by Underwriters Laboratories, Inc. for the complete system

3.4 TESTING

A. Upon completion of the lightning protection work, test the resistance of ground. Test employed shall be the 3 Point Fall of Potential method with a Null Balance megger. Record instrument's serial number. Date of last calibration shall be less than 1 year from date of test. Resistance to ground shall not exceed 10 ohms.

B. Should the ground resistance exceed 10 ohms, excavate an area approximately 1 square foot by 2 feet deep around the top of all driven ground electrodes then insert GEM material as manufactured by the Erico Corporation. This compound shall be hydrated to a slurry-type consistency and then spread in the excavation. The area should then be left for approximately 24 hours. Then retesting procedures should be performed. Record final readings.

3.5 COMPLETION

A. The lightning protection installer shall secure and deliver the LPI system certification to the Owner (Construction Manager) upon completion of the installation.

END OF SECTION

SECTION 264310 - SPD / WAVEFORM CORRECTOR

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements and Division 1 Specification Sections, apply to this Section.

1.2 GENERAL

A. This section describes materials and installation requirements for low voltage waveform correctors for the protection of all AC electrical circuits. Devices to be installed at designated service entrance equipment, distribution panels, electronic equipment, and receptacle devices.

1.3 REFERENCES

A. Regulatory Labeling:

1. Provide units that are listed and labeled by NRTL.

B. The specified unit shall be designed, manufactured, tested and installed in compliance with the above references. The unit shall be “Listed by Underwriters Laboratories” to UL 1449 3rd Edition.

C. ANSI Compliance: Use waveform corrector devices in compliance with the recommendations of IEEE C62.41.1, IEEE C62.41.2, and IEEE C62.45.

D. All the units should comply with NEMA LS-1, Low Voltage Surge Protective Devices.

E. Each product should be tested individually for quality control

F. Each product should have unique serial number so that it can be easily tractable.

1.4 WARRANTY

A. Five years on non-modular units

B. Ten years on Modular units.

1.5 SUBMITTALS

A. Submit product data on each waveform corrector indicating the following:

1. Type of construction and components.

2. Model number and conductor sizes.

3. Dimensional drawings for each model showing mounting and connection arrangements.

4. Clamping voltage for each model number.

5. Attenuation roll of curve and noise attenuation in dB per decade.

6. Operating temperature and frequency.

7. Listing, safety standards and compliances.

B. Submit manufacturer's NRTL certified test data and nameplate data for each model of Waveform corrector.

C. Submit electrical single-line diagram showing location and model of each Waveform corrector.

1.6 TESTING

A. Single pulse surge current capacity: single pulse surge current tested in a mode at rated surge currents.

B. Single pulse surge current capacity test: an initial UL 1449 defined 1.2 x 50us, 6000V open circuit voltage waveform and an 8 x 20us, 500A and 3kA short circuit current waveform is applied to benchmark the unit's voltage protection rating (VPR).

C. IEEE C62.41 category A1 .5uS*100 kHz, 2kV, 70 amp ring wave should be tested on Waveform corrector. Testing should be performed with the initial pulse in the positive direction. Testing should be performed at 90,180 and 270 electrical degrees to help establish Waveform corrector performance at the positive peak, the zero crossing and the negative peak of the waveform.

D. IEEE C62.41 category B3 .5uS*100 kHz, 6kV, 500 amp ring wave should be tested on Waveform corrector. Testing should be performed with the initial pulse in the MASTER 2 WAVEFORM CORRECTORS positive direction. Testing should be performed at 90,180 and 270 electrical degrees to help establish Waveform corrector performance at the positive peak, the zero crossing and the negative peak of the waveform

E. IEEE C62.41, Category B1 1.5/50uS & 8/20uS, 2kV, 1kA amp combination wave (pulse in positive direction) should be tested on Waveform corrector. Testing should be performed with the pulse in the positive direction.

F. IEEE C62.41, Category B3 1.5/50uS & 8/20uS, 6kV, 3kA amp combination wave (pulse in positive direction) should be tested on Waveform corrector. Testing should be performed with the pulse in the positive direction

G. Random noise testing should be tested on Waveform corrector. Random noise should be from 1 kHz to 100 kHz, analogous to noise generated by VFD's (Variable Frequency Drives). Waveform corrector should suppress the noise levels to at least 20dB from 1 kHz to 100 kHz. 1.2.2.

H. IEEE C62.41, Category B3 1.5/50uS & 8/20uS, 6kV, 3kA amp combination wave should be imposed on the Waveform corrector. Waveform corrector attenuation levels should be monitored and recorded to at least 1900 repetitive consecutive surges.

I. Performance (energy absorption) of the Waveform corrector after 1900 surges should not deviate more than 5% from the waveform corrector's response of the initial surge test.

PART 2 - PRODUCTS

2.1 ELECTRICAL REQUIREMENTS

A. All waveform correctors for power circuits, provided under this section, shall be the product of a single manufacturer.

B. All waveform correctors for power circuits, provided under this section shall be designed to meet the following housing and mounting criteria:

1. For waveform corrector devices used in exterior applications where the device is internal to a cabinet the waveform corrector shall be capable of wall mounting with its housing rated to at least NEMA 4.

C. Waveform correctors can be either modular or non-modular in design.

D. Waveform corrector devices shall be capable of performance at ambient temperatures between -40 ^{o}C to 65 ^{o}C at relative humidity ranging from 0 percent to 95 percent, and at altitudes ranging from sea level to 12,000 feet.

E. Waveform corrector devices shall be fused such that they disconnect the waveform corrector from the electrical source should the waveform corrector fail. The product's fusing shall be certified to survive the full rated surge handling capacity of the unit and to afford safety protection from thermal overloads and short circuits. Waveform corrector shall meet UL 1449 3rd Edition

F. Waveform corrector devices shall have been tested and certified (Listed) by an NRTL to have a short circuit current rating (SCCR) equal to or greater than the available fault current in accordance with NEC Section 285. Series ratings expressly prohibited.

G. Waveform corrector devices shall be labeled such that they show the short circuit current rating (SCCR) in compliance with the requirements of the most current revision of UL 1449 in force upon the date of installation.

H. Waveform corrector devices that absorb, dissipate, correct the waveform, and do not utilize the ground conductor as a path for power surge energy, supersede SPD devices that meet UL 1449 minimum requirements in force upon the date of installation.

I. Design waveform corrector devices for the specific type and voltage of the electrical service. Single-phase, split phase and three-phase wye-configured systems shall have L-N. Grounded delta-configured systems shall have L-L. As recommended by the IEEE Emerald Book, waveform correctors shall not shunt energy to ground or contribute frequency energy leakage to the ground conductor.

J. Waveform corrector's active waveform tracking components shall have a maximum continuous operating voltage (MCOV) of not less than 125% of the nominal phase-to-neutral operating voltage for 120 volt power systems and not less than 115% of the nominal phase-to-neutral voltage for 230 volt and higher power systems. And, not less than 115% of the nominal phase to phase voltage for delta systems.

K. All waveform corrector devices will provide filtering across an extended range from 1.5 kHz to 2.5 MHz with greater than -30 db filtering across the total frequency spectrum.

L. SPD filter options that meet minimum standards only at peak resonance shall not meet specification and are expressly prohibited regardless of UL minimum compliance. MASTER 4 WAVEFORM CORRECTORS

M. Waveform Correctors performance shall be 3rd party tested to IEEE C62.41 standards for Category A1 (low system exposure, 2kV, 70 amp ring wave), B1 (low system exposure, 2kV, 1kA combination wave), B3 (high system exposure, 6kV, 500 amp ring wave), and B3 (high system exposure, 6kV, 3kA combination wave). Third party data shall be submitted for review.

N. Waveform correctors performance for the frequency noise between 1kHz to 90kHz should be third party tested and data should be submitted for review.

2.2 MANUFACTURER

A. Environmental Potentials

B. Approved equal.

2.3 SERVICE - MAIN DISTRIBUTION EQUIPMENT

A. Where shown within Project Documents, provide waveform corrector meeting IEEE C62.41.1 and IEEE C62.41.2 Location in accordance with Category B or C.

B. Type of construction shall be of RLC based circuit. Construction must have absorption, dissipation and filtering circuits. SPD devices incorporating MOV, SAD, gas tube, and/or Selenium technology solely are expressly prohibited as to maintain safety ground integrity.

C. Due to sensitivity of electronic based devices and negative effects of high frequency noise on an electrical system, waveform corrector must be installed and it must filter noise from 1.5 kHz to 2.5 MHz with greater than -30 dB filtering across the total frequency spectrum. Filters/SPD that only meet requirements at peak resonance or simply shunt to ground shall be expressly prohibited.

D. Waveform Corrector should not only provide low impedance between phase and neutral, but physically convert the electrical energy (noise) and voltage surges to heat, preventing the noise/surge from staying inside the facility, and preventing noise/surge from being shunted to ground. Third party test and certifications data shall be submitted for review.

E. Waveform corrector housing shall be in an enclosure that has the same NEMA rating, or higher, as the equipment it protects.

F. Waveform correctors shall be installed EXTERNAL to cabinet or in an explosion and vapor proof separate enclosure inside the gear. Waveform corrector enclosure does not count as an explosion and vapor proof enclosure.

G. UL 1449 maximum suppression voltage shall not be more than:

1. 1500 Volt for 120/208 Volt, 3 phase, 4 wire.

H. Surge current capacity shall be not less than the following:

1. L-L Capacity: 320 kA/mode

2. L-N Capacity: 320 kA/mode

2.4 DISTRIBUTION & PANELBOARDS

A. Provide waveform corrector meeting IEEE C62.41.1 and IEEE C62.41.2 Location Category A.

B. Shall have the same characteristics as specified for switchboards and distribution panelboards except the following:

1. Surge current capacity shall be not less than the following:

a. L-L Capacity: 80 kA/mode

b. L-N Capacity: 80 kA/mode

2. UL 1449 maximum clamp voltage shall not be more than:

a. 700 Volt for 120/208 Volt, 3 phase, 4 wire.

2.5 ACCESSORIES

A. Provide units with mounted LED-type indication lights to show the normal and failed status of each module.

B. For service main distribution equipment, the waveform, surge unit shall be provided with one set of normally open and one normally closed remote alarm contacts which operates when the unit fails. In addition, the waveform, surge unit shall contain dual surge counters displaying the number of voltage transients that have occurred on the unit input. The counter shall retain the count through system power outages. One counter shall be resettable while the other registers aggregate lifecycle surge counts.

PART 3 - EXECUTION

3.1 APPLICATION REQUIREMENTS

A. Install Waveform Correctors as indicated on manufacturer installation instructions and drawings.

B. Install waveform correctors directly to the cabinet which houses the circuit to be protected so that the waveform corrector leads are straight and short, with all conductors laced, running directly to the point of connection within the panel, without loops or bends. If bends are unavoidable, no bend may exceed 90 degrees and bending radius may not be less than 6 inches.

C. Connecting wires shall be as short as possible. Connecting wires shall not exceed 24 inches on main service equipment and 12 inches in length at any other point.

D. For field installed leadless filter-protectors, AC conductors shall be the same as specified for building wire, not smaller than No. 8 AWG and not larger than No. 2/0 AWG. Device leads shall not be longer than the length recommended by the manufacturer, unless specifically reviewed and approved by the manufacturer.

E. Provide dedicated disconnecting means for AC waveform corrector devices installed at panel boards. Provide dedicated circuit breakers (size dependent upon cable size used) with number of poles as required, as disconnecting means for waveform corrector devices installed for panel boards, and outside plant applications. The interrupting capacity of the circuit breakers shall be that specified for the other breakers at that location.

F. Where provided, waveform surge unit alarm contacts shall be wired to the building automation system (DDC) by the Electrical Contractor. Provide raceway, wiring and terminations as coordinated with Controls Contractor.

END OF SECTION 264310

SECTION 264400 ELECTRIC SERVICE FOR ELEVATORS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION AND GENERAL REQUIREMENTS

A. EC to provide feeder(s) including branch circuits to elevator controller, cab and elevator machine room in accordance with NEC including coordination requirements with Elevator installer.

B. Provide heat and smoke sensing devices as required by code at each elevator lobby, control room/closet and within 2 feet of any hoistway sprinkler heads. Coordinate requirements with Fire Alarm Contractor and Fire Protection Contractor.

C. Provide all interconnecting wiring from fire alarm system to elevator controller. Coordinate requirements with Fire Alarm Contractor and elevator contract installer.

D. Provide all interconnecting wiring from local elevator phone to telecom distribution system. Coordinate requirements with elevator contract installer.

E. Provide branch circuits, raceway and wiring to receptacles, switches, sump pump and light fixtures in elevator pit. Where installed, provide wiring and terminations for sump pump alarm wiring to local indicator and building DDC.

F. Provide all required fused disconnect switches and/or shunt trip circuit breakers as required.

G. Provide GFCI receptacle in elevator machine room.

PART 2 - PRODUCTS

2.1 WIRE AND CABLE

A. Provide wire and cable.

B. Conduits in the elevator pit or shaft shall be installed in a NEMA-4 enclosure, with wiring suitable for wet locations per ASME A17.1 item 2.8.2.3.4.

2.2 DISCONNECT SWITCHES

A. Provide disconnect switches as required and as called for within Contract Documents.

B. Control circuits to shutdown elevator power shall be monitored for the presence of operating voltage. Loss of voltage to the control circuit(s) for the disconnecting means

shall cause a supervisory signal to be indicated at the control unit and required remote annunciators per NFPA 72. Refer to Specification 262816 Enclosed Switches.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install system in accordance with NFPA 70, ASME A17.1, and all local elevator codes.

B. Verify all disconnects, power wiring, control wiring, interconnection wiring, and voltages with elevator supplier / installer. Label Electrical Contractor provided equipment with origination of power source.

END OF SECTION 264400

SECTION 265119 – LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SCOPE

A. Contractor shall furnish and install interior lighting fixtures and lamps as indicated in Fixture Schedule shown within Contract documents, and specified herein.

B. Lighting fixtures are indicated within Contract documents with an identifying letter and number. Refer to the fixture schedule which identifies the light fixtures.

1.2 SUBMITTALS

A. Product Data: For each type of lighting fixture scheduled, arranged in order of fixture designation. Include data on features, accessories, finishes and the following:

1. Physical description of fixture, including dimensions and verification of indicated parameters.

B. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, method of field assembly, components, features and accessories.

C. Wiring Diagrams: Power, signal and control wiring.

D. Product Certificates: For each type of driver for dimmer-controlled fixtures, signed by product manufacturer.

E. Source quality-control test reports.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation and maintenance manuals. In addition to items specified in Division 1 include the following:

1. Catalog data for each fixture. Include the diffuser, driverast and lamps installed in that fixture.

H. Warranties: Special warranties specified in this Section.

I. Safety chain details.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.

B. Comply with NFPA 70.

C. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

D. Underwriters Laboratory

1. Track - UL 1574

2. Low Voltage Lighting systems – UL 2108
3. Standard for Flexible Lighting Products – UL 2388
4. Emergency Lighting and Power Equipment – UL 924
5. Exit and Emergency - UL 924

1.4 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system and partition assemblies.

B. Electrical contractor is responsible to determined ceiling areas used as plenums. Fixtures installed in these areas shall be rated and listed for use.

1.5 WARRANTY

A. Special Warranty for LED drivers: Manufacturer's standard form in which driver manufacturer agrees to repair or replace drivers that fail in materials or workmanship within specified warranty period.

1. Warranty period for LED drivers: One (1) years from date of substantial completion.

PART 2 - PRODUCTS

2.1 FIXTURES AND COMPONENTS, GENERAL

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Metal Parts: Free of burrs and sharp corners and edges.

C. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

D. Doors, Frames and Other Internal Access: Smooth operating, free of light leakage under operating conditions and designed to prevent doors, frames lenses, diffusers and other components from falling accidently during driver or component replacement and when secured in operating positions.

E. Plastic Diffusers, Covers and Globes:

1. Acrylic Lighting Diffusers: 100% virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat and UV radiation.

a. Lens Thickness: At least 0.125" minimum unless different thickness is scheduled.
b. UV stabilized.

2. Glass: Annealed crystal glass, unless otherwise indicated.

F. Low voltage transformer: Where provided by the Electrical Contractor or furnished by lighting manufacturer, the low voltage transformer shall be protected by fuses sized

according to transformer manufacturer. Provide fuses and spares per Specification 262813 “Fuses.”

G. Solid state transformers for low voltage lighting shall not be used for dimming applications unless the assembly (transformer and dimmer) are UL listed specifically indented for such application.

2.2 LIGHTING FIXTURES

A. Fixtures type and features: See schedule for basis of design.

B. Manufacturers: Submitted manufacturer must meet minimal features, options and specifications per base of design manufacturer as scheduled or noted.

2.3 LED LIGHTING FIXTURES

A. Description: Include the following features, unless otherwise indicated:

1. Fixture to be rated for LM-79, LM-80 and/or TM-21
2. Life span of LED must be a minimum of 50,000hrs
3. Minimum CRI of 80
4. Interior fixtures to be 3500 degrees K
5. LED drivers shall be electronics type, labeled as compliant with radio frequency and interferences (RFI) requirements of FCC Title 47 Part 15, and comply with NEMA SSL1 “Electronic Drivers for LED devices, Arrays, or systems”. LED drivers shall have a sound rating of “A”, have a minimum efficiency of 85%, and be rated for a THD of less than 20% at all input voltages.
6. Dimmable LED drivers shall be 0-10V type. Dimmable drivers shall be capable of dimming without LED strobing or flicker across their full diming range

2.4 EXIT SIGNS

A. Type and features: See schedule for design bases.

B. General: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.

C. Manufacturers: Submitted manufacturer must meet minimal features, options and specifications per base of design manufacturer as scheduled.

D. Internally Lighted Signs:

1. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum of rated lamp life.

2.5 LAMPS

A. The Electrical Contractor shall provide all project required lamps at wattage, voltage and of base type as indicated or implied on contract documents or otherwise scheduled.

2.6 LIGHTING CONTROLS

1. Refer to schedules or Contract documents for project lighting control devices. See specification Section 262726 “Wiring Devices” and 260923 “Lighting Control Devices”.
2. All lighting controls and associated equipment shall comply with applicable State, UL and National Electrical Code requirements, and shall be installed to conform to manufacturer's and code specifications.
3. All occupancy (motion) sensors shall be approved by the Authority having jurisdiction where applicable.
4. Light Level Sensor:

    a. UL listed light level sensor shall be capable of detecting changes in ambient lighting levels and shall be designed for use with a dimming ballast, occupancy control system at system voltage to which they are connected. Sensor light level shall be adjustable and have a set level range from 10 to 100 footcandles (100 to 1000 lux), minimum. Sensor shall have a bypass function to electrically override sensor control where made available.
    b. Photocells which control lighting equipment shall be compatible with the drivers they control, and shall be installed as directed by the photocell and ballast manufacturers. Photocells shall comply with applicable State requirements.
    c. Photocell and other sensors used for lighting control shall be installed with five feet of slack wire (nearest junction box) to permit subsequent relocation without the need for rewiring.
    d. Photocell(s) where used for exterior lighting time clock control or building automation system shall be compatible with said system and comply in function with IECC-2003 Section 805.2.3.

5. Control systems that include both occupancy sensors and photocells shall be installed as indicated by the control manufacturer to assure compatibility.
6. Before calibrating a dimming control system, all lamps shall be operated at full output for at least 100 hours to assure stable dimming operation.
7. Passive infrared occupancy sensors or ultrasonic type shall be "masked" as required to prevent sensors from detecting motion outside the area they are controlling. The masking material shall be provided by the occupancy sensor manufacturer expressly for this purpose.

2.7 FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Supporting Devices" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2" steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2" steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641, Class 3, soft temper, zinc-coated, 12 gauge.

E. Wires for Humid Spaces: ASTM A 580, Composition 302 or 304, annealed stainless steel, 12 gauge.

F. Rod Hangers: 3/16" minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord and locking-type plug.

H. Aircraft Cable Support: Use cable, anchorages and intermediate supports recommended by fixture manufacture.

2.8 FINISHES

A. Fixtures: Manufacturer’s standard, unless otherwise indicated.

1. Paint Finish: Applied over corrosion-resistant treatment or primer free of defects.
2. Metallic Finish: Corrosion resistant.

2.9 SOURCE QUALITY CONTROL

A. Factory test fixtures with ballasts and lamps; certify results for electrical ratings and photometric data.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fixtures: Set level, plumb and square with ceilings and walls. Install lamps in each fixture.

B. Support for fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.

1. Support Clips: Electrical Contractor shall secure fixtures to ceiling grid members at or near each fixture corner with manufacture clips which are UL listed for the application or by securely fasten to ceiling members via bolts, screws or rivets. Where fixtures weighing 56 pounds or more shall be connected via four wires, one at each corner terminating to above structure.
2. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two (2) 3/4" metal channels spanning and secured to ceiling tees.
3. Recessed incandescent or compact fluorescent downlight fixtures in suspended ceilings weight 20 pounds or more shall be supported by connecting at least one fixture support wire to the fixture housing terminating to above structure.
4. Wire hangers may be wrapped cable or closed link chain. In all cases, the hanger shall be of sufficient strength to support the weight of the unit with a factor of safety of four (4). Where “S” hooks are used and allowed per manufacture installation guidelines, both ends shall be completely closed after installation.

C. Suspended Fixture Support: As follows:

1. Pendants and Rods: Where longer than 48", brace to limit swinging.

2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Continuous Rows: Suspend from cable.
5. As recommended by fixture manufacturer.

D. Adjust fixtures to provide required light intensities.

3.2 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. A few of the first recessed fixtures shall be checked as soon as they are suspended, to determine if any sagging or twisting of the ceiling system exists and if fixtures are firm and hang straight.

C. Finally, after fixtures and lamps have been installed, the ceiling shall be rechecked for sagging, and any corrections shall be the responsibility of the Electrical contractor.

D. Verify normal operation of each fixture after installation.

E. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify normal transfer to battery power source and retransfer to normal.

F. Prepare a written report of test, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standard.

G. Corroded Fixtures: During warranty period, replace fixtures that show any signs of corrosion.

END OF SECTION 265119

SECTION 265619 – LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SCOPE

A. Contractor shall furnish and install exterior lighting fixtures with lamps as indicated in Fixture Schedule shown within Contract documents and specified herein.

B. Lighting fixtures are indicated on the contract documents with an identifying letter and number. Refer to the fixture schedule on contract documents which identifies the light fixture.

1.2 SUBMITTALS

A. Product Data: For each luminaire, arranged in the order of lighting unit designation. Include data on features, accessories, finishes and on the following:

1. Physical description of fixture, including dimensions and verification of indicated parameters.
2. Luminaire dimensions, effective projected area, details of attaching luminaires, accessories and installation and construction details.
3. Luminaire materials.
4. Photoelectric relays and controls.
5. Manufacturer pole data.
6. Concrete light pole foundations. Foundation construction details, including material descriptions, dimensions, anchor bolts, support devices, and calculations, signed and sealed by a professional engineer licensed in the state of installation.

B. Shop Drawings: Anchor-bolt templates keyed to specific poles and certified by manufacturer.

C. Wiring Diagrams: Power and control wiring.

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For luminaires to include in maintenance manuals.

G. Warranties: Special warranties specified in this section.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.

B. Comply with IEEE C2, "National Electrical Safety Code".

C. Comply with NFPA 70.

D. Comply with IECC 2003.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace luminaires or components of luminaires and lamps that fail in materials or workmanship; corrode; or fade, stain or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage vandalism, abuse or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: Three (3) years from date of Substantial Completion.

a. Warranty Period for Metal Corrosion: Three (3) years from date of Substantial Completion.
b. Warranty Period for Color Retention: Three (3) years from date of Substantial Completion.

2. Warranty Period for Lamps: Replace lamps and fuses that fail with 12 months from date of Substantial Completion; furnish replacement lamps and fuses that fail within the second 12 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRES, GENERAL

A. Fixtures type and features: See schedule on Contract Documents for design Basis.

1. Manufacturers: Submitted manufacturer must meet minimal features, options and specifications per base of design manufacturer as scheduled or noted within Contract documents.
2. Complying with UL 1598 and listed for installation in wet locations.

a. CERTIFICATION: UL listed to safety standards for wet locations. Fixture manufacturer shall employ a quality program that is audited to ISO9001 standards.

B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers and other components from falling

accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

2.2 LED LIGHTING FIXTURES

A. Description: Include the following features, unless otherwise indicated:

1. Fixture to be rated for LM-79, LM-80 and/or TM-21
2. Life span of LED must be a minimum of 50,000hrs
3. Minimum CRI of 80
4. Interior fixtures to be 4000 degrees K
5. LED drivers shall be electronics type, labeled as compliant with radio frequency and interferences (RFI) requirements of FCC Title 47 Part 15, and comply with NEMA SSL1 “Electronic Drivers for LED devices, Arrays, or systems”. LED drivers shall have a sound rating of “A”, have a minimum efficiency of 85%, and be rated for a THD of less than 20% at all input voltages.
6. Dimmable LED drivers shall be 0-10V type. Dimmable drivers shall be capable of dimming without LED strobing or flicker across their full diming range

2.3 SOURCE QUALITY CONTROL

A. Factory test fixtures with ballasts and lamps; certify results for ISO foot candle curves, zonal lumen, average and minimum ratios, and electrical and energy-efficiency data for ballasts.

2.4 FIELD WIRING

A. Install a listed in-line fuseholder and fuse in each light base for all ungrounded conductors using an insulating/waterproofing boot for each fuseholder per manufacturer's instructions. A type CC non-time-delay, rejection type fuse shall be installed in each fuseholder. Size fuses in accordance to ballast or fixture manufacturer requirements. Provide adequate load and line side conductor slack in the form of U-bends at each in-line fuseholder. Fuseholders and fuse shall be of same manufacturer per Specification 262813 “Fuses”. Fuseholder by Littelfuse, type LEC or LEY per specification.

2.5 GROUNDING

A. Ground fixtures and metal poles according to the NEC and per details shown on contract documents. Unless otherwise noted within Contract documents, install 3/4 inch by 10 foot copperclad ground rod at each pole and connect to pole ground lug using #6 bare stranded copper conductor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lamps in each fixture compatible with and of wattage as scheduled.

B. Luminaire Attachment: Fasten to indicated structure supports.

C. Adjust luminaires that require field adjustment or aiming.

D. Provide shields or distribution barriers per schedule, drawings plans or as required by AHJ.

3.2 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 CONTROL

A. Provide lighting controls, systems, components of, raceway, wiring, terminations and programming as noted on contract documents for code compliance and desired function.

B. Photocell(s) where used for exterior lighting time clock control or building automation system shall be compatible with said system and comply in function with IECC-2003 Section 805.2.3.

3.4 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Tests and Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source. Measure light intensities at night. Use photometers with calibration referenced to NIST standards.

C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265619

LIGHTING SPECIFICATION
PREPARED FOR

Hagerstown New Stadium MiLB

LED Lighting Project
Hagerstown, MD
August 12, 2022

Project # 187952

SUBMITTED BY:

Musco Sports Lighting, LLC

2107 Stewart Road
PO Box 260
Muscatine, Iowa 52761
Local Phone: 563/263-2281
Toll Free: 800/756-1205
Fax: 800/374-6402

We Make It Happen®

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SECTION 26 56 68 – EXTERIOR ATHLETIC LIGHTING

Lighting System with LED Light Source

PART 1 – GENERAL

1.1 SUMMARY

A. Work covered by this section of the specifications shall conform to the contract documents, engineering plans as well as state and local codes.

B. The purpose of these specifications is to define the lighting system performance and design standards for Hagerstown Stadium using an LED Lighting source. The manufacturer / contractor shall supply lighting equipment to meet or exceed the standards set forth in these specifications.

C. The sports lighting will be for the following venues:

1. Hagerstown Stadium

D. The primary goals of this sports lighting project are:

1. Guaranteed Light Levels: Selection of appropriate light levels impact the safety of the players and the enjoyment of spectators. Therefore light levels are guaranteed to not drop below specified target values for a period of 25 years.
2. Environmental Light Control: It is the primary goal of this project to minimize spill light to adjoining properties and glare to the players, spectators and neighbors.
3. Cost of Ownership: In order to reduce the operating budget, the preferred lighting system shall be energy efficient and cost effective to operate. All maintenance costs shall be eliminated for the duration of the warranty.
4. Control and Monitoring: To allow for optimized use of labor resources and avoid unneeded operation of the facility, customer requires a remote on/off control system for the lighting system. Fields should be proactively monitored to detect luminaire outages over a 25-year life cycle. All communication and monitoring costs for 25-year period shall be included in the bid.
5. Entertainment Features: Incorporation of theatrical light shows enhance the presentation and enjoyment of players and spectators. Control system shall incorporate pre-programmed light shows such as "chase", “wave”, and “score.” Control system shall incorporate the ability to initiate these shows locally. System shall be able to time light shows to customer-supplied music.

E. All lighting designs shall comply with MiLB Lighting Standards.

1.2 LIGHTING PERFORMANCE

A. Illumination Levels and Design Factors: Playing surfaces shall be lit to an average target illumination level and uniformity as specified in the chart below. Lighting calculations shall be developed and field measurements taken on the grid spacing with the minimum number of grid points specified below. Appropriate light loss factors shall be applied and submitted for the basis of design. Average illumination level shall be measured in accordance with the IESNA LM-5-04 (IESNA Guide for Photometric Measurements of Area and Sports Lighting Installations). Illumination levels shall not to drop below desired target values in accordance to IES RP-6-15, Page 2, Maintained Average Illuminance and shall be guaranteed for the full warranty period.

Area of Lighting	Average Target Illumination Levels	Maximum to Minimum Uniformity Ratio	Grid Points	Grid Spacing
Baseball PBA Grid	100/70 FC	1.2/2: 1	16/29	15’ x 15’
Bullpen	50 FC	2:1	87	5’ x 5’
Soccer	75 FC	2:1	96	30’ x 30

Lower Seating Bowl	65 FC	50:1	492	5’ x 5’
Upper Seating Bowl	40 FC	35:1	47	5’ x 5’
Main Concourse	50 FC	50:1	79	10’ x 10’
Outfield Concourse	15 FC	-	522	10’ x 10’
Picnic Deck	30 FC	4:1	35	10’ x 10’
RF Seating	35 FC	2:1	19	10’ x 10’
Parking	5fc	40:1	131	10’ x 10’

B. Color: The lighting system shall have a minimum color temperature of 5700K and a CRI of 75.

C. Mounting Heights: To ensure proper aiming angles for reduced glare and to provide better playability, minimum mounting heights shall be as described below. Higher mounting heights may be required based on photometric report and ability to ensure the top of the field angle is a minimum of 10 degrees below horizontal.

# of Poles	Pole Designation	Pole Height
4	C1-C2, D1-D2	90’
2	B1-B2	100’
2	A1-A2	110’

1.3 ENVIRONMENTAL LIGHT CONTROL

A. Light Control Luminaires: All luminaires shall utilize spill light and glare control devices including, but not limited to, internal shields, louvers and external shields. No symmetrical beam patterns are accepted.

B. Glare Control: Maximum candela values for the batter with a view back to the pitcher not to exceed 7,500 candela. Maximum candela value for the three outfield positions looking back at home plate not to exceed 10,000 candela.

C. The first page of a photometric report for all luminaire types proposed showing horizontal and vertical axial candle power shall be provided to demonstrate the capability of achieving the specified performance. Reports shall be certified by a qualified testing laboratory with a minimum of five years experience or by a manufacturer’s laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products. A summary of the horizontal and vertical aiming angles for each luminaire shall be included with the photometric report.

1.4 Cost of Ownership

A. Manufacturer shall submit a 25 year Cost of Ownership summary that includes energy consumption, anticipated maintenance costs, and control costs. All costs associated with faulty luminaire replacement - equipment rentals, removal and installation labor, and shipping - are to be included in the maintenance costs.

PART 2 – PRODUCT

2.2 SPORTS LIGHTING SYSTEM CONSTRUCTION

A. Manufacturing Requirements: All components shall be designed and manufactured as a system. All luminaires, wire harnesses, drivers and other enclosures shall be factory assembled, aimed, wired and tested.

B. Durability: All exposed components shall be constructed of corrosion resistant material and/or coated to help prevent corrosion. All exposed carbon steel shall be hot dip galvanized per ASTM A123. All exposed aluminum shall be powder coated with high performance polyester or anodized. All exterior reflective inserts shall be anodized, coated, and protected from direct environmental

exposure to prevent reflective degradation or corrosion. All exposed hardware and fasteners shall be stainless steel, passivated and coated with aluminum-based thermosetting epoxy resin for protection against corrosion and stress corrosion cracking. Structural fasteners may be carbon steel and galvanized meeting ASTM A153 and ISO/EN 1461 (for hot dipped galvanizing), or ASTM B695 (for mechanical galvanizing). All wiring shall be enclosed within the cross-arms, pole, or electrical components enclosure.

C. System Description: Lighting system shall consist of the following:

1. Galvanized steel poles and cross-arm assembly.
2. Non-approved pole technology:
   a. Direct bury steel poles which utilize the extended portion of the steel shaft for their foundation will not be accepted due to potential for internal and external corrosive reaction to the soils and long term performance concerns.
3. Lighting systems shall use concrete foundations. See Section 2.4 for details.
   a. For a foundation using a pre-stressed concrete base embedded in concrete backfill the concrete shall be air-entrained and have a minimum compressive design strength at 28 days of 3,000 PSI. 3,000 PSI concrete specified for early pole erection, actual required minimum allowable concrete strength is 1,000 PSI. All piers and concrete backfill must bear on and against firm undisturbed soil.
   b. For anchor bolt foundations or foundations using a pre-stressed concrete base in a suspended pier or re-inforced pier design pole erection may occur after 7 days. Or after a concrete sample from the same batch achieves a certain strength.
4. Manufacturer will supply all drivers and supporting electrical equipment
   a. Remote drivers and supporting electrical equipment shall be mounted approximately 10 feet above grade in aluminum enclosures. The enclosures shall be touch-safe and include drivers and fusing with indicator lights on fuses to notify when a fuse is to be replaced for each luminaire. Disconnect per circuit for each pole structure will be located in the enclosure. Integral drivers are not allowed.
   b. Manufacturer shall provide surge protection at the pole equal to or greater than 40 kA for each line to ground (Common Mode) as recommended by IEEE C62.41.2_2002.
5. Wire harness complete with an abrasion protection sleeve, strain relief and plug-in connections for fast, trouble-free installation.
6. All luminaires, visors, and cross-arm assemblies shall withstand 150 mi/h winds and maintain luminaire aiming alignment.
8. Contactor cabinet to provide on-off control.
9. Manufacturer shall provide lightning grounding as defined by NFPA 780 and be UL Listed per UL 96 and UL 96A.
   a. Integrated grounding via concrete encased electrode grounding system.
   b. If grounding is not integrated into the structure, the manufacturer shall supply grounding electrodes, copper down conductors, and exothermic weld kits. Electrodes and conductors shall be sized as required by NFPA 780.The grounding electrode shall be minimum size of 5/8 inch diameter and 8 feet long, with a minimum of 10 feet embedment. Grounding electrode shall be connected to the structure by a grounding electrode conductor with a minimum size of 2 AWG for poles with 75 feet mounting height or less, and 2/0 AWG for poles with more than 75 feet mounting height.

D. Safety: All system components shall be UL listed for the appropriate application.

2.2 ELECTRICAL

A. Electric Power Requirements for the Sports Lighting Equipment:
   1. Electric power: 480 Volt, 3 Phase

2. Maximum total voltage drop: Voltage drop to the disconnect switch located on the poles shall not exceed three (3) percent of the rated voltage.

B. Energy Consumption: The kW consumption for the field lighting system shall be 155.38kW.

2.3 CONTROL

A. Instant On/Off Capabilities: System shall provide for instant on/off of luminaires.

B. Lighting contactor cabinet(s) constructed of NEMA Type 4 aluminum, designed for easy installation with contactors, labeled to match field diagrams and electrical design. Manual off-on-auto selector switches shall be provided.

C. Dimming: System shall provide for custom dimming options via DMX control.

D. Remote Lighting Control System: System shall allow owner and users with a security code to schedule on/off system operation via a web site, phone, fax or email up to ten years in advance. Manufacturer shall provide and maintain a two-way TCP/IP communication link. Trained staff shall be available 24/7 to provide scheduling support and assist with reporting needs.

The owner may assign various security levels to schedulers by function and/or fields. This function must be flexible to allow a range of privileges such as full scheduling capabilities for all fields to only having permission to execute “early off” commands by phone. Scheduling tool shall be capable of setting curfew limits.

Controller shall accept and store 7-day schedules, be protected against memory loss during power outages, and shall reboot once power is regained and execute any commands that would have occurred during outage.

E. Remote Monitoring System: System shall monitor lighting performance and notify manufacturer if individual luminaire outage is detected so that appropriate maintenance can be scheduled. The controller shall determine switch position (manual or auto) and contactor status (open or closed).

F. Management Tools: Manufacturer shall provide a web-based database and dashboard tool of actual field usage and provide reports by facility and user group. Dashboard shall also show current status of luminaire outages, control operation and service. Mobile application will be provided suitable for IOS, Android and Blackberry devices.

Hours of Usage: Manufacturer shall provide a means of tracking actual hours of usage for the field lighting system that is readily accessible to the owner.

1. Cumulative hours: shall be tracked to show the total hours used by the facility
2. Report hours saved by using early off and push buttons by users.

G. Communication Costs: Manufacturer shall include communication costs for operating the control and monitoring system for a period of 25 years.

H. Communication with luminaire drivers: Control system shall interface with drivers in electrical components enclosures by means of wireless communication.

I. Entertainment Features: Show controller shall provide six (6) preprogrammed light shows per field with option for customized scenes, plus three (3) custom preprogrammed light shows set to music supplied by customer. Manufacturer-provided user interfaces include touchscreens, pushbuttons, and/or other external control devices.

2.4 STRUCTURAL PARAMETERS

A. Wind Loads: Wind loads shall be based on the 2015 International Building Code. Wind loads to be calculated using ASCE 7-10, an ultimate design wind speed of 115mph and exposure category C.

B. Pole Structural Design: The stress analysis and safety factor of the poles shall conform to 2013 AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (LTS-6).

C. Foundation Design: If no geotechnical report is available, the foundation design shall be based on soils that meet or exceed those of a Class 5 material as defined by 2015 IBC Table 1806.2.

D. Foundation Drawings: Project specific foundation drawings stamped by a registered engineer in the state where the project is located are required. The foundation drawings must list the moment, shear (horizontal) force, and axial (vertical) force at ground level for each pole. These drawings must be submitted at time of bid to allow for accurate pricing.

PART 3 – EXECUTION

3.1 SOIL QUALITY CONTROL

A. It shall be the Contractor's responsibility to notify the Owner if soil conditions exist other than those on which the foundation design is based, or if the soil cannot be readily excavated. Contractor may issue a change order request / estimate for the Owner's approval / payment for additional costs associated with:

1. Providing engineered foundation embedment design by a registered engineer in the State of Maryland for soils other than specified soil conditions;
2. Additional materials required to achieve alternate foundation;
3. Excavation and removal of materials other than normal soils, such as rock, caliche, etc.

3.2 DELIVERY TIMING

A. Delivery Timing Equipment On-Site: The equipment must be on-site 8-10 weeks from receipt of approved submittals and receipt of complete order information.

3.3 FIELD QUALITY CONTROL

A. Illumination Measurements: Upon substantial completion of the project and in the presence of the Contractor, Project Engineer, Owner's Representative, and Manufacturer's Representative, illumination measurements shall be taken and verified. The illumination measurements shall be conducted in accordance with IESNA LM-5-04.

B. Field Light Level Accountability

1. Light levels are guaranteed not to fall below the target maintained light levels for the entire warranty period of 25 years. These levels will be specifically stated as "guaranteed" on the illumination summary provided by the manufacturer.
2. The contractor/manufacturer shall be responsible for conducting initial light level testing and an additional inspection of the system, in the presence of the owner, one year from the date of commissioning of the lighting.
3. The contractor/manufacturer will be held responsible for any and all changes needed to bring these fields back to compliance for light levels and uniformities. Contractor/Manufacturer will be held responsible for any damage to the fields during these repairs.

C. Correcting Non-Conformance: If, in the opinion of the Owner or his appointed Representative, the actual performance levels including footcandles and uniformity ratios are not in conformance with the requirements of the performance specifications and submitted information, the Manufacturer shall be required to make adjustments to meet specifications and satisfy Owner.

3.4 WARRANTY AND GUARANTEE

A. 25-Year Warranty: Each manufacturer shall supply a signed warranty covering the entire system for 25 years from the date of shipment. Warranty shall guarantee specified light levels. Manufacturer shall maintain specifically-funded financial reserves to assure fulfillment of the warranty for the full term. Warranty does not cover weather conditions events such as lightning or hail damage, improper

installation, vandalism or abuse, unauthorized repairs or alterations, or product made by other manufacturers.

B. Maintenance: Manufacturer shall monitor the performance of the lighting system, including on/off status, hours of usage and luminaire outage for 25 years from the date of equipment shipment. Parts and labor shall be covered such that individual luminaire outages will be repaired when the usage of any field is materially impacted. Manufacturer is responsible for removal and replacement of failed luminaires, including all parts, labor, shipping, and equipment rental associated with maintenance. Owner agrees to check fuses in the event of a luminaire outage.

PART 4 – DESIGN APPROVAL

4.0 PRE-BID SUBMITTAL REQUIREMENTS (Non-Musco)

A. Design Approval: The owner / engineer will review pre-bid submittals per section 4.0.B from all the manufacturers to ensure compliance to the specification 10 days prior to bid. If the design meets the design requirements of the specifications, a letter and/or addendum will be issued to the manufacturer indicating approval for the specific design submitted.

B. Approved Product: Musco's Light-Structure System™ with TLC for LED™ is the approved product. All substitutions must provide a complete submittal package for approval as outlined in Submittal Information at the end of this section at least 10 days prior to bid. Special manufacturing to meet the standards of this specification may be required. An addendum will be issued prior to bid listing any other approved lighting manufacturers and designs.

C. All listed manufacturers not pre-approved shall submit the information at the end of this section at least 10 days prior to bid. An addendum will be issued prior to bid; listing approved lighting manufacturers and the design method to be used.

D. Bidders are required to bid only products that have been approved by this specification or addendum by the owner or owner's representative. Bids received that do not utilize an approved system/design, will be rejected.

REQUIRED SUBMITTAL INFORMATION FOR ALL MANUFACTURERS (NOT PRE-APPROVED) 10 DAYS PRIOR TO BID

All items listed below are mandatory, shall comply with the specification and be submitted according to pre-bid submittal requirements. Complete the Yes/No column to indicate compliance (Y) or noncompliance (N) for each item. ***Submit checklist below with submittal.***

Yes/ No	Tab	Item	Description
	A	Letter/ Checklist	Listing of all information being submitted must be included on the table of contents. List the name of the manufacturer's local representative and his/her phone number. Signed submittal checklist to be included.
	B	Equipment Layout	Drawing(s) showing field layouts with pole locations
	C	On Field Lighting Design	Lighting design drawing(s) showing: a. Field Name, date, file number, prepared by b. Outline of field(s) being lighted, as well as pole locations referenced to the center of the field (x & y), Illuminance levels at grid spacing specified c. Pole height, number of fixtures per pole, horizontal and vertical aiming angles, as well as luminaire information including wattage, lumens and optics d. Height of light test meter above field surface. e. Summary table showing the number and spacing of grid points; average, minimum and maximum illuminance levels in foot candles (fc); uniformity including maximum to minimum ratio, coefficient of variance (CV), coefficient of utilization (CU) uniformity gradient; number of luminaries, total kilowatts, average tilt factor; light loss factor.
	D	Off Field Lighting Design	Lighting design drawing showing initial spill light levels along the boundary line (defined on bid drawings) in footcandles. Lighting design showing glare along the boundary line in candela. Light levels shall be taken at 30-foot intervals along the boundary line. Readings shall be taken with the meter orientation at both horizontal and aimed towards the most intense bank of lights.
	E	Photometric Report	Provide first page of photometric report for all luminaire types being proposed showing candela tabulations as defined by IESNA Publication LM-35-02. Photometric data shall be certified by laboratory with current National Voluntary Laboratory Accreditation Program or an independent testing facility with over 5 years experience.
	F	Performance Guarantee	Provide performance guarantee including a written commitment to undertake all corrections required to meet the performance requirements noted in these specifications at no expense to the owner. Light levels must be guaranteed to not fall below target levels for warranty period.
	G	Structural Calculations	Pole structural calculations and foundation design showing foundation shape, depth backfill requirements, rebar and anchor bolts (if required). Pole base reaction forces shall be shown on the foundation drawing along with soil bearing pressures. Design must be stamped by a structural engineer in the state of Maryland, if required by owner. (May be supplied upon award).
	H	Control & Monitoring System	Manufacturer of the control and monitoring system shall provide written definition and schematics for automated control system and entertainment packages. They will also provide ten (10) references of customers currently using proposed system in the state of Maryland.
	I	Electrical Distribution Plans	Manufacturer bidding an alternate product must include a revised electrical distribution plan including changes to service entrance, panels and wire sizing, signed by a licensed Electrical Engineer in the state of Maryland.
	J	Warranty	Provide written warranty information including all terms and conditions. Provide ten (10) references of customers currently under specified warranty in the state of Maryland.
	K	Project References	Manufacturer to provide a list of 5 projects where the technology and specific fixture proposed for this project has been installed in the state of Maryland. Reference list will include project name, project city, installation date, and if requested, contact name and contact phone number.
	L	Product Information	Complete bill of material and current brochures/cut sheets for all product being provided.

	M	Delivery	Manufacturer shall supply an expected delivery timeframe from receipt of approved submittals and complete order information.
	N	Non-Compliance	Manufacturer shall list all items that do not comply with the specifications. If in full compliance, tab may be omitted.
	O	Cost of Ownership	Document cost of ownership as defined in the specification. Identify energy costs for operating the luminaires. Maintenance cost for the system must be included. All costs should be based on 25 Years
	P	Environmental Light Control Design	Environmental glare impact scans must be submitted showing the maximum candela from the field edge on a map of the surrounding area until < 500 or other, F11> candela or less is achieved.

The information supplied herein shall be used for the purpose of complying with the specifications for Hagerstown New Stadium MiLB. By signing below I agree that all requirements of the specifications have been met and that the manufacturer will be responsible for any future costs incurred to bring their equipment into compliance for all items not meeting specifications and not listed in the Non-Compliance section.

Manufacturer: _____ **Signature:** _____

Contact Name: _____ **Date:** _____/_____/_____

Contractor: _____ **Signature:** _____

SECTION 271000 - STRUCTURED CABLING SYSTEM

1.GENERAL

1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

2. SUMMARY

A. The intent of this specification is to ensure a successful installation of an American National Standards Institute (“ANSI”) and Telecommunications Industry Association (“TIA”) Standards-Based Structured Cabling System (“SCS”) throughout the Project.

B. The SCS is to be constructed and tested to ANSI/TIA-568-C Standards for Category 6 and Category 6A performance. Certification requirements will include a minimum 15 year product and performance warranty.

C. The SCS provides the physical media for the Project’s Local Area Network (LAN) and, as such, provides connectivity for:

1. Data and telecommunication outlets.
2. Facility Monitoring System network devices, e.g., surveillance cameras.
3. Voice over Internet Protocol (VoIP).
4. Wireless Local Area Network (WLAN).
5. Building Automation System

D. The drawings and specifications and requirements between governing Codes and Regulations may vary. The more restrictive requirements shall be followed on this project.

E. Nothing in the Contract Documents grants authority or permission to disregard or violate any legal requirements.

F. Materials are to be purchased new for this project.

G. Materials that are listed by UL must bear the UL label. In the event UL has no published standard for a particular item, then other independent testing standards are to apply and the applicable labeling utilized.

H. Coordinate exact location and installation of equipment, power, grounding and raceway requirements with the Architect.

I. Provisioning is required for labor, equipment, materials, supplies and plant.

J. Related Sections:

1. The following list is intended only as a reference for the Contractor’s cognizance and may not represent a complete list of divisions of the Project Manual related to this section.

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a. Division 01: General Requirements.
b. Division 08: Openings.
c. Division 09: Finishes.
d. Division 26: Electrical.
e. Division 28: Electronic Safety and Security

K. The work of this section also includes:

1. Required licenses, insurance and permits including payment of charges and fees.
2. Verification of dimensions and conditions at the job site.
3. Preparation of submittal information.
4. Installation of Owner Furnished Equipment (OFE) listed in Part 2 of this Section.
5. Installation in accordance with the contract document, manufacturer's recommendation, and in conformity with applicable codes and the authority having jurisdiction (AHJ).
6. Coordination of electrical service, including ground, for SCS/IT equipment locations.
7. Final tests and adjustments, written report, and documentation.
8. Instruction of system operation to Owner’s technical representative.
9. Provision of manuals.
10. Maintenance services and warranty.

3. REFERENCED CODES AND STANDARDS

A. Compliance with the following published codes, standards, and tests and recommended methods of trade, industry, or governmental organizations are required for Work in this section.

1. Telecommunications Industry Association (TIA)

a. ANSI/TIA-568-C (series),Telecommunications Cabling Standards.
b. ANSI/TIA-569-D, Commercial Building Standard for Telecommunications Pathways and Spaces
c. ANSI/TIA-606-C, Administration Standard for Commercial Telecommunications Infrastructure
d. ANSI/TIA-607-C, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
e. ANSI/TIA-758-B, Customer-owned Outside Plant Telecommunications Infrastructure Standard
f. TIA-526-7-A, Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
g. TIA-526-14-C Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
h. TIA/TSB-140 Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems

2. Other

a. National Electrical Manufacturers Association (NEMA), VE 2-2018 Cable Tray Installation Guidelines
b. BICSI Telecommunications Distribution Methods Manual (TDMM), 14th Edition
c. BICSI Outside Plant Design Reference Manual, 5th Edition
d. National Electric Code (NEC), 2017 Edition
e. Underwriters Laboratory, Inc. (UL)
f. Americans with Disabilities Act (ADA)
g. Requirements of the local Authority Having Jurisdiction (AHJ).

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4. DEFINITIONS

A. In addition to definitions of Division 01, the following list of terms used in this section are defined as follows.

1. “Furnish” indicates to purchase, procure, acquire, and deliver complete with related accessories.
2. “Install” indicates to set in place, join, attach, link, set up or otherwise connect together and test until complete before turning over to the Owner, all parts, items, or equipment.
3. “Provide” indicates to furnish and install.
4. Some processes, methods, and procedures, as well as spaces, rooms and structure, may be abbreviated or used interchangeably within this section. The following list is presented to reconcile these differences within this section.

a. SCS: Structured Cabling System. A SCS is defined as all required cabling including hardware, termination blocks, cross connect wire or cordage, patch panels, patch cords, telecommunication outlets, work area cords, UTP and fiber optic cable installed and configured to provide computer data and voice connectivity from each data or voice device to the network file server or voice network/switch designated as the service point of the local area network.
b. TS: Telecommunications Space. A common area used for telecommunications cabling terminations and the location of telecommunications equipment, typically a secure environmentally controlled area
c. EF: Entrance Facility. A TS is the entrance to a building for both public and private network service cables, including the entrance point at the building wall or floor, and continuing to the entrance room or entrance space.
d. ER: Equipment Room. This is the TS that contains main electronics of the telecommunications system, such as servers, controllers and phone systems. This room is also often the center of the SCS that connects with all other TSs.
e. TR: Telecommunications Room. This is typically the TS where cables from workstations terminate. The TR is designated for an exclusive purpose of housing telecommunication communications equipment and related wiring that serves a specific area of the building.
f. TE: Telecommunication Enclosure. This is a stand-alone wall mounted or floor mounted enclosure that provides the same service as the TR to a specific area of the building.
g. WAO: Work Area Outlet. The workstation end-point of horizontal distribution cable. An icon legend is provided on the related drawings, and symbols or legends represent the type and quantity of cables terminated at the WAO.
h. Backbone: The Backbone subsystem links the ER to TRs and TEs. It consists of the fiber optic or copper cables between these locations and the associated connecting hardware terminating this media.
i. PBB: Primary Bonding Busbar - The common source for bonding telecommunications equipment within the ER and the ER with building ground.
j. SBB: Secondary Bonding Busbar - The common source for bonding telecommunications equipment within the EF, TR or TE and with the PBB.
k. TBB: Telecommunications Bonding Backbone: Copper cable that connects the PBB to SBBs throughout the building
l. TBC: Telecommunications Bonding Conductor: Copper cable that connects the PBB to the main electrical ground

5. PROJECT CONDITIONS

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A. Verify dimensions and conditions on the job site applicable to this work. Notify the Architect in writing of discrepancies, conflicts, or omissions promptly upon discovery.

B. The drawings diagrammatically show cabling and arrangements of equipment fitting the space available without interference. If conditions exist which make it impossible to install work as shown, recommend solutions and/or submit drawings to the Architect for approval, showing how the work may be installed.

C. If a conflict develops between the contract documents and the appropriate codes and is reported to the Architect prior to bid opening, the Architect will prepare the necessary clarification. When a conflict is reported after contract award, propose a resolution of the conflict and, upon approval, perform work.

D. During the course of construction, room names and/or room numbers may be changed. For continuity during installation the Contractor shall refer to rooms and spaces by their identities as shown on the technology series drawings. This shall apply to all correspondence, RFI's, proposal requests, and submittal packages pertaining to this Section.

E. Provide temporary or permanent protection of materials bearing the UL label that risk exposure to conditions that may compromise any portion of the material.

6. SCOPE SUMMARY

A. This entire specification section and the project drawings define the requirements for the installation of a SCS. The following is intended to summarize the Work and clarify design intent and is not an exhaustive description of the SCS.

B. Coordinate exact location and installation of the following:

1. Conduits, wire-ways, cable trays external to the telecommunication spaces, floor boxes, wall boxes, pull boxes, and junction boxes
2. Slots and sleeves
3. Firestopping products
4. AC power circuits for telecommunications equipment
5. AC power circuits within telecommunications spaces
6. Plywood wall linings within telecommunications spaces
7. Lighting requirements within telecommunications spaces
8. MEP systems and equipment terminating within or intersecting telecommunications spaces
9. Telecommunications grounding and bonding system required for telecommunications spaces
10. Wireless access points with light fixtures, HVAC ductwork, and architectural elements
11. Incoming service provider circuits

C. Deliver Submittals, Shop Drawings and Cable Test Records as specified herein.

D. Obtain permits, licenses, or other municipal requirements and pay any fees required for the execution of this Work.

E. Provide copper or fiber optic cabling for network communication applications homerun from the TR to individual work area outlets or network devices as shown on the related drawings.

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1. Provide faceplates, surface mount boxes, raceway products, copper and fiber optic inserts, blank inserts, patch panels, termination blocks, and copper and fiber optic patch cables.
2. Provide surge protection modules as specified and shown on drawings or required to protect circuits from damaging electrical surges.

F. Provide backbone cabling consisting of twisted pair copper, fiber optic cable, and ground wire as specified and shown on drawings.

1. Twisted pair cable terminations shall include both punch-down blocks and patch panels.
2. Fiber optic termination shall be fusion spliced, utilizing specified pigtails or connectors.
3. Ground wire terminations shall utilize irreversible crimp style lugs.

G. Provide primary and branch pathway distribution systems which may consist of cable tray, conduit, J-hooks, of ladder runway for the support and protection of horizontal and backbone cabling.

H. Provide racks, cabinets, cable management, and cable runway to route cables and securely house telecommunications equipment and cabling termination panels.

I. Provide bonding of equipment racks, armored cable sheaths, and cable pathway system in accordance with equipment manufacturer's requirements and ANSI/TIA 607-C Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.

J. Provide labeling of the completed systems, components, and cabling in accordance with TIA-606-B or Owner's standards. Verify labeling scheme with Owner prior to implementation.

K. Provide mechanical and non-mechanical firestopping systems as specified or required by code.

L. Perform tests of the completed SCS installation in accordance with the following:

1. ANSI/TIA-568-C.2, for twisted pair cabling
2. ANSI/TIA-568.3-D, for fiber optic cabling

M. Supply accessories and minor equipment parts required for a complete working system, even if not specifically mentioned in these Specifications or on the drawings, without claim for additional payment.

N. Provide POE Extenders as specified and shown on drawings.

1. POE Extender solution requires fiber optic switches provided by the Owner. Coordinate with Owner IT for switch requirements.
2. Size specified DC power supply to support quantity of POE Extenders as shown on drawings.
3. Coordinate with Owner IT to place DC power supply on the LAN to allow Owner access to management GUI.

O. Perform installation and testing utilizing trained and certified staff in order to provide the Owner's vendor of choice SCS extended product and application warranty certification. The Contractor shall extend this certification on behalf of the manufacturer.

P. Provide instructions to the Owner's designated personnel on the system documentation, proper methods of use and maintenance of the system and related components.

Q. Provide the SCS complete and ready for use by the Owner.

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7. CONTRACTOR QUALIFICATIONS

A. Must be a Certified Integrator/Installer factory trained and authorized to provide the Owner's vendor of choice SCS extended warranty covering all network cable and connectivity hardware products comprising this project.

B. Must submit current manufacturer certification documentation for installation training and ability to provide the manufacturer warranty.

C. Must maintain a factory trained and certified staff covering the duration of the project.

D. Must have an on staff Registered Communications Distribution Designer (RCDD®) for the performance of quality control during installation, equipment set-up, and testing.

E. Must have five plus (5+) years of experience with equipment and systems of the specified types.

F. Must have completed a minimum of three comparable scaled projects within the last two years.

G. Must have proven abilities to test and certify telecommunications cabling systems, and to create test records in compliance with the referenced standards of this specification section and in accordance with the calibration requirements as stated by the test equipment manufacturer.

H. Must maintain a fully staffed and equipped service facility.

I. Must perform operations necessary to complete the installation of a SCS in accordance with these specifications utilizing related drawings.

J. At the request of the Architect, the Contractor must demonstrate an adequate staff with commensurate technical experience available.

K. At the request of the Architect, the Contractor must demonstrate adequate plant and equipment available to complete the work.

8. PRE-CONSTRUCTION SUBMITTALS

A. The pre-construction submittal is required to verify the Contractor will obtain the specified product, understands the processes and procedures, and understands the requirements to install, test, certify and create test record documentation for the SCS.

B. Requests for substitutions of specified product must be done using procedures specified in Division 01. Requests must be done prior to submittals. Substitutions submitted that have not been approved will be rejected.

C. The Submittal package is to be delivered for approval prior to commencement of Work.

1. Any submittals beyond the original submittal and one resubmittal may result in charges to the Contractor (charged for third and any subsequent reviews).
2. Additional review fees will be at the prevailing rate in effect at the time that the additional review takes place

D. The Submittal for this portion of the Work must be assembled and packaged as specified.

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E. Provide submittals in an electronic version in Adobe PDF format as follows:

1. Document set shall be in a folder named as follows:

   a. “27 10 00 SUBMITTAL – PROJECT NAME – {*CONTRACTOR name*}”.

2. The submittals shall contain information in the following order

   a. “Project Compliance
   b. “Certificates”
   c. “Test Equipment”
   d. “Materials”
   e. “Labels & Markings”
   f. “Shop Drawings”

F. “Project Compliance” folder shall contain a PDF document that includes:

1. The first page stating the project title, submittal number, and submittal date in the header. This cover sheet must be imprinted with Contractor’s stamp, initialed or signed, certifying that the Submittal Package offered is in compliance with the requirements of this Section, and the material is in compliance with this Section of the Project Manual or with approved substitutions.
2. The next page shall state any questions or concerns that might be relevant to clarifying the work
3. Provide a list of ‘Approved’ substitutions, if any.

G. “Certificates” folder shall contain a PDF document that includes:

1. Current manufacturer Certification that shows that the Warranty requirement of this Section can be provided by the Contractor.
2. RCDD certificate and any other BICSI certifications called out as a requirement in this Section

H. “Test Equipment” folder shall contain a PDF document that includes

1. Provide a manufacturers technical data sheet of the test equipment that will be utilized for test and certification of the specified cabling. Include the Manufacturer, make and model.
2. Submit an example of a test record document containing test records that have been created with the scheduled test equipment for the type of cabling to be tested.

I. “Materials” folder shall contain a PDF document that includes

1. A complete materials list or Bill of Materials that includes all products specified in this Section or previously approved through the substitution request process in Division 1.

   a. Present the materials list or Bill of Materials in the order in which the product is specified in Part 2 of this section.
   b. The column headings for the list must include a product description, manufacturer, part number, quantity of item required, use or location on project, and PDF page number of product data sheet in this document.

2. Product data sheets shall be combined into (1) PDF document. The PDF page number is the actual number of pages into the document where the product sheet can be found.
3. Example

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Description	Manufacturer	PN	Use	Page
Blue Category 6 jack	Ortronics	OR-TJ600-44	Data outlet	15

a. Immediately following the list, insert the manufacturers' product data sheet (PDS).
b. Arrange the sheets in the same sequence and order of the list of Materials.
c. The literature must provide sufficient detail to facilitate proper evaluation of the product's suitability for use within the Work.
d. Any PDS or literature sheets that provide product options, or sheets that also include items not intended for this work, must be clearly marked with an arrow or other appropriate symbol to indicate the model and/or option being submitted for the work.

J. "Labels & Markings" folder shall contain a PDF document that includes:

1. Photos or drawings of the proposed labels, tags and markers for cables, patch panels, termination blocks, busbars, fire sleeves, enclosures, racks, outlet faceplates and other components as necessary.
2. Representative nomenclature for equipment and cable labeling, with labeling as defined in ANSI/TIA-606-B Class 2 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings. Include font sizes and styles, an explanation of the rationale for the nomenclature, and a Key, which defines the descriptors and designators of the labeling system.
3. Labels shall be permanent and intended to last the life of the system, device, or equipment being labeled.
4. Product sheets for label materials shall be included in the "Materials" folder

K. "Shop Drawings" shall contain PDF documents including:

1. Large-sheet drawings;

a. Drawing rendered in AutoCAD™ or an AutoCAD™-compatible application.
b. Execute drawings at an appropriate scale but no less than 1/8"=1'-0".
c. Create drawings using industry-standard graphics and a monochromatic scheme with varied line types and weight so the attributes of the various elements of the image are readily discernable.
d. Enlarged floor plans and elevations of each equipment room in the project with equipment and ladder runway(s) placement in the rooms shall be shown to scale.
e. The Shop Drawings will be the source document for the As-Built drawings that the Contractor is required to provide at the close of the project.

2. Floor plan sheets that depict;

a. Device symbol legend
b. Individual service areas of the facility.
c. Equipment room locations.
d. Work area faceplate/outlets locations.
e. Cable pathways, raceway type, and locations.
f. Horizontal cable link length for longest cable lengths based on above routing.
g. Location and size of wall penetrations/sleeve pass-thru.
h. Quantity of cables passing through each wall penetration/sleeve pass-thru.

9. CONTRACT CLOSE-OUT SUBMITTALS

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A. Submit Closeout documentation in accordance with Division 01 of the Project Manual and any applicable supplements.

B. Each submittal shall be provided in a PDF format.

C. Provide each submittal PDF file with the project title and submittal number.

1. Transfer media, CD, or memory stick shall be labeled with same information.

D. Segregate documents into separate folders containing data relevant to operational, maintenance, and warranty issues.

E. Warranty and Maintenance:

1. Statement of warranty commencement date, length of warranty, and all warranty certificates issued by manufacturer.
2. Provide a list of contact names, telephone numbers, and hours of operation for normal warranty service.
3. Provide a contact name/number for 365/7/24 emergency warranty service with an explanation of limiting conditions if applicable.
4. Include maintenance phone number(s) and hours; maintenance schedule; description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.
5. Manufacturer data sheets and installation manuals/instructions for equipment installed shall be included.

F. Test Report CD(s)

1. Results of copper and fiber-optic tests specified in Part 3 of this section of the Project Manual.

   a. The test records are to be a full test report of individual copper media and fiber optical media test results for each fiber-optic cable strand.
   b. The test record must include information regarding the building, closet, patch panel and “port” number of the patch panel; the test device type and ID, the name of the test technician performing the test, and the date and time that the test was conducted.

2. The test records are to be placed in a “Test Record” file in ascending sequential order by building, closet and patch panel.
3. Provide an electronic file containing all individual test records and the software required to display and print the test records using a typical personal computer (PC).

G. As-Built Drawings

1. Provide “as-built” drawings of the completed cabling installation.
2. The as-built drawings must indicate:

   a. The actual locations of the work area faceplate/outlets
   b. Pathways and pathway fill
   c. Media identification information at each faceplate/outlet
   d. The identity information for each Equipment Room
   e. Revised equipment rack layout detail drawings
   f. All field changes, corrections, modifications, and updates to the shop drawings

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3. One (1) color/laminated full-size drawing must be attached to the wall of each TR to include the aforementioned information. Only the drop locations served from each particular TR are to be included on each color/laminated drawing for that TR.
4. Provide owner copies of “as-built” drawings on CD media in AutoCAD, Revit and PDF format.

H. Provide Owner any keys to cabinets and/or equipment and special maintenance tools required to repair, maintain, or service the system.

I. Furnish a list (in excel format) of all data drops listed by TR number, patch panel number, and port number with the associated assigned room number.

10. DELIVERY, STORAGE, AND HANDLING

A. Ship product in its original container, to prevent damage or entrance of foreign matter.

B. Handling and shipping in accordance with manufacturer’s recommendation.

C. Provide protective covering during construction, to prevent damage or entrance of foreign matter.

D. Provide warning placards, warning tape or protective barrier systems for temporary protection of products or personnel during installation processes to include but not limited to the following:

1. Cabling subject to foot or vehicle traffic laid on the floor/ground as a service loop.
2. Exothermic welding of telecommunications bonding conductors.
3. Open trench work during cabling installation.

E. Provide a minimum temperature schedule for cold climate installations of the SCS. Do not install cabling or equipment in climate conditions less than the manufacturer’s recommended minimum temperature.

F. Replace at no expense to Owner, product damaged during storage, handling or the course of construction.

11. PRODUCT WARRANTY AND APPLICATION ASSURANCE

A. The SCS Manufacturer’s Extended Product Warranty and Application Assurance requirements are as follows:

1. Extended Product Warranty
2. Application Assurance
3. Term of Warranty

a. A minimum of 15 years from the date of substantial completion.
b. Moves, additions, or changes are covered by the original registration certificate if performed by an approved installer in compliance with the supplier’s SCS design, installation and registration requirements.

B. Contractor’s warranty covering installed products and labor against defects in materials and workmanship for a period of 1 year.

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1. Within the 1-year warranty period, answer service calls within 4 hours and begin work to correct the deficiency within twenty-four hours.

C. Manufacturer Warranty starts the date of projects warranty certification issue to the District from the manufacturer.

D. A manufacturer's Representative shall inspect and certify all work to validate the manufacturer's warranty.

2.PRODUCTS

1. GENERAL

A. Related Divisions and articles remain applicable to the products specified herein. Any repetition of related specification is for emphasis only.

B. Products shall be new, free from defects and listed by UL or ETL when an applicable standard exists.

C. Regardless of the length or completeness of the descriptive paragraph herein, provide product complying with the specified manufacturer's published specifications.

D. Product not specifically identified within this document, but which is required for the successful implementation of the intended system(s), shall be of the same class and quality as the specified product and equipment.

E. Products of one type must be from the same manufacturer throughout the entire project.

F. Products included in this Section are to establish performance requirements to be used on this project; equivalent products are acceptable with Owner approval.

G. Any materials required in the completion of the cabling infrastructure and make-ready for use by the Owner that is not listed is to be provided as if it were specified.

2. CABLE PATHWAYS AND SUPPORT

A. Conduit

1. Refer to Division 26 for product details
2. Requirements for bend radius, run lengths, and pull boxes are called out in this Section and on the drawings.

B. Fabric innerduct

1. 2" 3 cell fabric innerduct

a. Color-coded pull tapes are preinstalled
b. Factory lubricated
c. Approved products

1) Maxcell Part # MXR2003BK####

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2) Substitutions: Under provisions of Division 01

2. 4” 3 cell fabric innerduct

a. Color-coded pull tapes are preinstalled
b. Factory lubricated
c. Approved products

1) Maxcell Part # MXR4003BK####
2) Substitutions: Under provisions of Division 01

C. Outdoor innerduct

1. 1” innerduct, HDPE corrugated with pull tape

D. Cable Ladder Tray, 24”W x 4”H

1. Aluminum I-beam design with 9” rung spacing with 7” rail height
2. UL classified

E. Cable Ladder Tray Fittings

1. Aluminum I-beam design with 9” rung spacing or solid bottom matching tray width and rail height
2. Provide for use at cable tray intersections, bends, and offsets
3. Adjustable splice plates are not acceptable for use in place of factory fittings
4. UL classified

F. Cable Ladder Tray Splice Plates

1. Provide UL classified splice plates for use with adjoining straight sections of cable ladder tray
2. Provide UL classified splice plates for use with adjoining straight sections of cable ladder tray to factory fittings
3. Provide with pre-drilled mounting holes
4. Provide with manufacturer recommended mounting hardware with the hex nut on the outboard side of the rail.
5. Provide expansion splice plates in accordance with NEMA VE-2, Table 3-2
6. Provide manufacturer recommended bonding jumpers on both side rails of adjoining sections of cable ladder tray at expansion joints

G. Cable Ladder Tray Strut Support

1. Provide strut support no less than 4” greater than the width of the cable tray
2. Provide with manufacturer’s recommended securing hardware in accordance with NEMA VE-2, Figure 3-6

H. Cable Ladder Tray Wall Support

1. Provide with manufacturer’s recommended securing hardware in accordance with NEMA VE-2, Figures 3-20 and 3-21
2. Provide for use with cable tray widths of 18” and less

I. Cable Ladder Tray Vertical Support

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1. Provide with manufacturer recommended mounting hardware
2. Provide at minimum (2) support locations for vertical sections of tray greater than 12’

J. J-hooks

1. Made for support of Category cables
2. Wide support
3. Available with multiple sizes for cable quantities
4. Available with variety of building attachment methods
5. Approved products

    a. Erico CADDY CAT series
    b. Panduit J-Mod series
    c. CEAS 200 – 224 series
    d. Cooper B-Line BCH series
    e. Substitutions: Under provisions of Division 01

K. Standard firestop sleeve

1. UL classified
2. Rolled edges to eliminate bushings
3. Escutcheon plates and intumescent gaskets
4. Intumescent sealing putty
5. Approved products:

    a. STI Firestop

        1) 1” penetrations Part # FS100
        2) 2” penetrations Part # FS200
        3) 4” penetrations Part # FS400

    b. Unique FireStop

        1) 1” penetrations Part # SF-1
        2) 2” penetrations Part # SF-2
        3) 4” penetrations Part # SF-4

    c. Substitutions: Under provisions of Division 01

L. Re-enterable firestop sleeve

1. UL classified for 2-4 hours depending upon wall construction
2. Allows addition of cables while in service without removal or replacement of materials.
3. Can be ganged.
4. Approved products

    a. STI EZ-Path

        1) 2” penetrations EZ- Path 22 series
        2) 3” penetrations EZ- Path 33 series
        3) 4” penetrations EZ- Path 44 series

    b. HILTI Speed Sleeve CP 653

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1) 2” penetrations Part # CP 653-2
2) 4” penetrations Part # CP 653-4

c. Unique Smooth Firestop Sleeve (2 hour rated only for horizontal penetrations)

1) 1” penetrations Part # SP-1
2) 2” penetrations Part # SP-2
3) 4” penetrations Part # SP-4

d. Substitutions: Under provisions of Division 01

M. Conduit Waterfall

1. Designed for 4”
2. UL recognized
3. Control cable to minimum 4” radius
4. Approved products

a. Panduit CWF400
b. Substitutions: Under provisions of Division 0

N. Fabricated cable tray firestop sleeves

1. UL classified for use with 2 hour rated walls
2. 20 inch long sleeve with permanent flange 6 inches from one end
3. Second flange is adjustable for various wall thickness
4. Available in various sizes to match cable tray
5. Require use of intumescent fire stop bricks and wall connecting hardware (not included)
6. Approved products

a. Legrand Part # xL2-0440-yy-S6: x is depth and yy is width
b. Substitutions: Under provisions of Division 01

O. Nonmechanical firestop systems

1. UL classified
2. Intumescent flexible block
3. Intumescent non-hardening putty
4. Intumescent pillows

3. COMMUNICATIONS EQUIPMENT ROOM FITTINGS

A. Plywood backboard

1. ¾” x 4’ x 8’ sheets
2. Void free A/C grade
3. Fire retardant
4. UL listed
5. All visible surfaces painted with 2 coats of light colored fire retardant paint, leaving (1) fire rating stamp visible on each sheet.

B. Network Equipment Cabinet:

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1. 42U x 36” usable depth x 31.5” wide
2. Black
3. Split rear doors
4. Maximum weight capacity 2205 lbs.
5. UL listed
6. Approved products:

    a. APC Part # AR2580
    b. Substitutions: Under provisions of Division 01

7. Provide with (1) APC # AP9551 PDU

    a. Vertical
    b. 20A, 120V, (14)5-15

8. Provide with APC # AR7707 vertical cable management rings

    a. Design for mounting inside network equipment rack

C. NEMA 4 NETWORK EQUIPMENT CABINET WITH 3000 BTU AC

1. 39U - 72”H x 24”W x 36”D
2. 2 Door Lockable
3. Light gray powder coated steel
4. 6” floor kit
5. 4 post rack rails #10-32 TAP
6. 230V, 3000 BTU AC, 350 Watt heater with corrosion package and remote ethernet connection
7. Approved products

    a. NEMACO base cabinet shell Part #N4-722436-F2DXX19 (X2)
    b. Equal

8. Provide with (1) APC # AP9551 PDU

    a. Vertical
    b. 20A, 120V, (14)5-15

D. 2 post equipment rack:

1. 19” x 7’ with 3” channel
2. High strength aluminum
3. Black
4. 1000 lb. weight capacity
5. UL listed
6. RMU markings
7. Approved products:

    a. Chatsworth Part # 55053-703
    b. Cooper B-Line Part # SB556084XUFB
    c. Substitutions: Under provisions of Division 01

8. Provide with (1) PDU

    a. 120V Basic PDU

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b. 13 NEMA 5-15/20R Outlets,
c. NEMA 5-20P Input
d. 1RU
e. Approved product

1) Tripp Lite # PDU1220
2) Substitutions: Under provisions of Division 01

E. 6” vertical cable manager:

1. Double sided, back gated
2. For 7’ 45U racks
3. Front side dual opening door
4. Pass through opening
5. Black
6. Approved products:

a. Chatsworth Part # 35571-703
b. Cooper B-Line Part # SB86486D084FB
c. Substitutions: Under provisions of Division 01

F. 10.5” vertical cable manager:

1. Double sided, back gated
2. For 7’ 45U racks
3. Front side dual opening door
4. Pass through opening
5. Black
6. Approved products:

a. Chatsworth Part # 35573-703
b. Cooper B-Line Part # SB864810D084FB
c. Substitutions: Under provisions of Division 01

G. 3U horizontal cable manager:

1. Dual directional door
2. T shaped finger guides
3. Approved products:

a. Chatsworth Part # 30131-719
b. Substitutions: Under provisions of Division 01

H. 2U horizontal cable manager:

1. Dual directional door
2. T shaped finger guides
3. Approved products:

a. Chatsworth Part # 30130-719
b. Substitutions: Under provisions of Division 01

I. 1U horizontal cable manager:

1. Dual directional door

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2. T shaped finger guides
3. Approved products:

    a. Chatsworth Part #30139-719
    b. Substitutions: Under provisions of Division 01

J. 12” ladder runway:

1. 10’ length (9’-11 ½”)
2. 3/8” x 1 ½” steel tubing
3. 12” cross member intervals
4. Available with mounting and cable routing accessories.
5. UL Classified
6. Black
7. Approved products:

    a. Chatsworth Part # 10250-712
    b. Cooper B-Line Part # SB17U12BFB
    c. Substitutions: Under provisions of Division 01

K. Primary Bonding Busbar:

1. 4” x 12 x ¼” copper
2. UL listed
3. BICSI AND ANSI /TIA hole patterns
4. Comes with mounting brackets
5. Approved products:

    a. Chatsworth Part # 40153-012
    b. Cooper B-Line Part # SBTMGB12
    c. Substitutions: Under provisions of Division 01

L. Secondary Bonding Busbar:

1. 2” x 12 x ¼” copper
2. UL listed
3. BICSI AND ANSI /TIA hole patterns
4. Comes with mounting brackets
5. Approved products:

    a. Chatsworth Part # 13633-012
    b. Cooper B-Line Part # SBTGBK
    c. Substitutions: Under provisions of Division 01

M. #6 CU ground wire:

1. Green THHN
2. UL listed

N. #6 grounding lug:

1. Provide irreversible crimp style
2. 2-hole, long barrel
3. ¼” hole size and 5/8” hole spacing
4. UL listed

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5. Approved products:

    a. Chatsworth Part # 40162-913
    b. Cooper B-Line Part # SB47902
    c. Substitutions: Under provisions of Division 01

4. COMMUNICATIONS FIBER BACKBONE CABLING

A. Products combinations must allow for a long term manufactures warranty required by this Section.

B. 48 strand single mode armored indoor/outdoor fiber optic cable:

1. Riser rated
2. Approved products:

    a. Corning Part # 048ZSF-T4101DA1
    b.
    c. Substitutions: Under provisions of Division 01

C. 12 strand SM armored fiber optic cable:

1. Riser rated
2. Approved products:

    a. Corning Part # 048E81-31131-A1
    b. Substitutions: Under provisions of Division 01

D. Armored and shielded cable grounding clamp

1. Approved products

    a. Panduit ACG series
    b. Corning FDC-CABLE-GRND
    c. 3M 4460-D or 4460-DS
    d. Substitutions: Under provisions of Division 01 in

E. Single mode LC connector:

1. 900 micro boot
2. Fusion spliced
3. Approved products:

    a. Corning Part # SOC-LCU-900-SM
    b. Substitutions: Under provisions of Division 01

F. Single mode LC adapter panels:

1. 12 fiber panel
2. Aqua adapters
3. Approved products:

    a. Corning Part # CCH-CP12-A9

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b. Substitutions: Under provisions of Division 01

G. Blank adapter panel:

1. Approved products:

a. Corning Part # CCH-BLNK
b. Substitutions: Under provisions of Division 01

H. Rack mount fiber enclosure:

1. 1RU or 2RU
2. Minimum 3 panel
3. Approved products:

a. Corning Part # CCH-02U
b. Substitutions: Under provisions of Division 01

I. Fiber optic patch cord:

1. LC-LC
2. Yellow
3. Single mode
4. Approved products:

a. 1 meter Corning Part # 040402R5120001M
b. 2 meter Corning Part # 040402R5120002M
c. Substitutions: Under provisions of Division 01

5. Provide cords in a quantity to patch 100% of the fiber ports, 50% 1 meter, 50% 2 meter. Confirm with owner prior to purchase.

5. COMMUNICATIONS UTP BACKBONE CABLING

A. 25 pair PE 89:

1. Outside plant cable
2. Filled core
3. Shielded
4. 24 AWG
5. Approved products:

a. Superior Essex Part # 09-97-02
b. Substitutions: Under provisions of Division 01

B. Armored and shielded cable grounding clamp

1. Approved products

a. Panduit ACG series
b. Corning FDC-CABLE-GRND
c. 3M 4460-D or 4460-DS
d. Substitutions: Under provisions of Division 01

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C. 25 pair Category 3 cable:

1. Riser rated
2. Approved products:

a. Superior Essex Part # 18-499-33
b. CommScope Part # 106824329
c. General Cable Part # 2133033.99
d. Substitutions: Under provisions of Division 01

D. Category 3 or better patch panel:

1. 110 style, RJ-45 ports
2. Approved products:

a. Ortronics

1) 24 port Part # OR-PSD5E6U24
2) 48 port Part # OR-PSD5E6U48

b. CommScope

1) 24 port Part # CC0031534/1
2) 48 port Part # 760180018

c. Panduit

1) 24 port Part # DP245E88TGY
2) 48 port Part # DP485E88TGY

d. Belden

1) 24 port Part # AX104013
2) 48 port Part # AX104014

e. Substitutions: Under provisions of Division 01

E. 100 pair 110 block with legs

1. Ortronics Part # OR-110ABC5E100
2. CommScope Part # 569439-1
3. Panduit Part # P110KB1005Y
4. Belden Part # AX100694-S
5. Substitutions: Under provisions of Division 01

F. 25 pair Building Entrance Terminal (BET):

1. Accepts 5 pin modules
2. 110 in / 110 out
3. UL listed
4. With cover and splice chamber
5. Approved products:

a. Circa Part # 1880ECA1-25

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b. Substitutions: Under provisions of Division 01

G. 5 Pin Surge Protection Module:

1. 75V solid state
2. PTC
3. UL listed
4. Provide quantity to fully populate the applicable BET
5. Approved products:

a. Circa Part # 4B3S-75
b. Substitutions: Under provisions of Division 01

6. TELECOMMUNICATION BONDING BACKBONE

A. #3/0 CU ground wire:

1. THHN
2. UL listed

B. #3/0 grounding lug:

1. Mechanical compression
2. 2 hole
3. Approved products:

a. Burndy Part # YA272N
b. Cooper B-Line Part # SBCL 3
c. Substitutions: Under provisions of Division 01

7. COMMUNICATIONS HORIZONTAL UTP CABLING

A. Products combinations must allow for a long term manufactures warranty required by this Section

B. 4 pair Category 6 plenum rated UTP communications cable:

1. Blue jacket
2. Approved product

a. Superior Essex Part # 77-240-2B
b. CommScope Part # UN874043014/10
c. Panduit Part # PUP6004BU-UY
d. Belden Part # 2413 D15A1000
e. Substitutions: Under provisions of Division 01

C. 4 pair Category 6A plenum UTP communications cable:

1. White jacket
2. Approved product

a. Superior Essex Part # 68-272-4B

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b. CommScope Part # 8765504/10
c. Panduit Part # PUP6ASD04WH-CG
d. Belden Part # 10GSX33009A1000
e. Substitutions: Under provisions of Division 01

D. 4 pair Category 6 OSP communications cable:

1. Black jacket
2. Manufacturer approved for below grade duct installation
3. Approved products:

a. Superior Essex Part # 04-601-68
b. Panduit Part # PUO6C04BL-U
c. Belden Part # OSP6U

1) Suggested transition point is the REVConnect core coupler, part number RVACPKUBK-S1

d. Substitutions: Under provisions of Division 01

E. 4 pair Category 6A OSP communications cable:

1. Black jacket
2. Manufacturer approved for below grade duct installation
3. Approved products:

a. Belden Part # OPS6AU
b. CommScope #1592
c. Panduit Part #PFO6X04BL-CEG
d. Superior Essex Part # 04-001-A4
e. Substitutions: Under provisions of Division 01

F. Category 6 RJ-45 jack:

1. 8-position, 8-wire RJ45 receptacle
2. Approved products:

a. Ortronics

1) Blue Part # OR-HDJ6-36
2) Gray Part # OR-HDJ6-78
3) Yellow Part # OR-HDJ6-44
4) Green Part # OR-HDJ6-45

b. CommScope

1) Blue Part # 760237778
2) Gray Part # 760237785
3) Yellow Part # 760237783
4) Green Part # 760237780

c. Panduit

1) Blue Part # CJ688TGBU

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2) Gray Part # CJ688TGIG
3) Yellow Part # CJ688TGYL
4) Green Part # CJ688TGGR

d. Belden

1) Blue Part # RV6MJKUBL
2) Gray Part # RV6MJKUGY
3) Yellow Part # RV6MJKUTY
4) Green Part # RV6MJKUGN
5) Requires REVConnect Universal Termination Tool Part # RVUTT01

e. Substitutions: Under provisions of Division 01

G. Category 6A RJ-45 jack:

1. 8-position, 8-wire RJ45 receptacle
2. White
3. Approved products:

a. Ortronics Part # OR-HDJ6A-88
b. CommScope Part # 760149989
c. Panduit Part # CJ6X88TGWH
d. Belden Part # RVAMJKUEW

1) Requires REVConnect Universal Termination Tool Part # RVUTT01

e. Substitutions: Under provisions of Division 01

H. Flush mount workstation faceplates:

1. Stainless steel
2. With label window
3. Approved products:

a. Ortronics

1) 1 port Part # OR-403STJ11
2) 2 port Part # OR-403STJ12
3) 3 port Part # OR-403STJ13
4) 4 port Part # OR-403STJ14
5) 6 port Part # OR-403STJ16
6) 1 port wall phone Part # OR-403STJ1WP

b. CommScope

1) 1 port Part # 760072074
2) 2 port Part # 760072181
3) 3 port Part # 760072199
4) 4 port Part # 760072207
5) 6 port Part # 760072215
6) 1 port wall phone Part # 760117572

c. Panduit

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1) 2 port Part # CFPL2SY
2) 4 port Part # CFPL4SY
3) 6 port Part # CFP62SY
4) Gray blank insert Part # CMBIG-X\
5) 1 port wall phone Part # KWP6PY (Cat 6)

d. Belden

1) 1 port Part # AX104230
2) 2 port Part # AX104231
3) 4 port Part # AX104232
4) 6 port Part # AX104480
5) 1 port wall phone Part # AX104126

I. Plate mounted workstation outlets:

1. Verify color with architect prior to purchase
2. Mounts in plate hole sized for electrical GFI receptacles
3. Approved products:

a. Ortronics

1) White 2 port Part # OR-41900017-88
2) White 4 port Part # OR-41900018-88

b. CommScope

1) White 3 port Part # 108265455

c. Panduit

1) White 2 port Part # CFG2WH
2) White 4 port Part # CFG4WH

d. Belden

1) White 2 port Part # AX106573-EW
2) White 4 port Part # AX106575-EW

e. Substitutions: Under provisions of Division 01
f. 106 style mounting frames are acceptable if project electrical plates are standard duplex.

J. Surface mount workstation:

1. Verify color with architect prior to purchase
2. Approved products:

a. Ortronics

1) White 2 port Part # OR- 404TJ2
2) White 4 port Part # OR-404TJ4

b. CommScope

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1) White 2 port Part # 107984056
2) White 4 port Part # 107952459

c. Panduit

1) White 2 port Part # CBX2WH-AY
2) White 4 port Part # CBX4WH-AY

d. Belden

1) 2 port Part # AX105353-EW
2) 4 port Part # AX105354-EW

e. Substitutions: Under provisions of Division 01

K. Category 6 patch panel:

1. Modular style panel
2. 24 ports per 1U rack space
3. Loaded with Category 6 RJ-45 jacks with colors to match workstation end.
4. Blank inserts in unused ports.
5. Approved products:

a. Ortronics

1) 24 port Part # OR-PHDHJU24
2) 48 port Part # OR-PHDHJU48

b. CommScope

1) 24 port Part # 760101220
2) 48 port Part # 760077842

c. Panduit

1) 24 port Part # CPP24FMBLY
2) 48 port Part # CPP48FMBLY

d. Belden

1) 24 port Part # AX103114
2) 48 port Part # AX103115

e. Substitutions: Under provisions of Division 01

L. Category 6A patch panel:

1. Modular style panel
2. 24 ports per 1U rack space
3. Loaded with white Category 6A RJ-45 jacks to support installed cables
4. Blank inserts in unused ports
5. Approved products

a. Ortronics

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1) 24 port Part # OR-PHDHJU24
2) 48 port Part # OR-PHDHJU48

b. CommScope

1) 24 port Part # 760207274
2) 48 port Part # 760049940

c. Panduit

1) 24 port Part # CPP24FMWBLY
2) 48 port Part # CPP48FMWBLY

d. Belden

1) 24 port Part # AX103114
2) 48 port Part # AX103115

e. Substitutions: Under provisions of Division 01

M. Category 6 patch cords:

1. Approved products:

a. Ortronics

1) Blue jacket Part # OR-MC6xx-06
2) Gray jacket Part # OR-MC6xx-08
3) Yellow jacket Part # OR-MC6xx-04
4) Green jacket Part # OR-MC6xx-05
5) Replace xx with length in feet.

b. CommScope

1) Blue jacket Part # UNC6-BL-xF
2) Gray jacket Part # UNC6-GY-xF
3) Yellow jacket Part # UNC6-YL-xF
4) Green jacket Part # UNC6-GR-xF
5) Replace x with length in feet.

c. Panduit

1) Blue jacket Part UTPSPxBUY
2) Gray jacket Part # UTPSPxGYY
3) Yellow jacket Part # UTPSPxYLY
4) Green jacket Part # UTPSPxGRY
5) Replace x with length in feet.

d. Belden

1) Blue jacket Part C601106xxx
2) Gray jacket Part # C601108xx
3) Yellow jacket Part # C601104xxx
4) Green jacket Part # C601105xxx

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5) Replace x with length in feet.

e. Substitutions: Under provisions of Division 01

2. Provide the following quantities in colors matching the installed ports

a. 25% of the installed workstation ports, 3 foot
b. 50% of the installed workstation ports, 5 foot
c. 75% of the installed workstation ports, 7 foot
d. 50% of the installed workstation ports, 10 foot

3. Confirm color, length and quantity with owner prior to purchasing

N. Category 6A patch cords:

1. Approved products:

a. Ortronics

1) White jacket Part # OR-MC6Axx-09
2) Replace xx with length in feet.

b. CommScope

1) White jacket Part # UNC10G-WH-x
2) Replace x with length in feet.

c. Panduit

1) White jacket Part # UTP6AxF
2) Replace x with length in feet.

d. Belden

1) White jacket Part # CA21109xxx
2) Replace x with length in feet

e. Substitutions: Under provisions of Division 01

2. Provide the following quantities

a. 25% of the installed workstation ports, 3 foot
b. 50% of the installed workstation ports, 5 foot
c. 75% of the installed workstation ports, 7 foot
d. 50% of the installed workstation ports, 10 foot

3. Confirm color, length and quantity with owner prior to purchasing

8. COMPONENTS

A. Battery backup/UPSs are Owner furnished and installed.

B. Wireless access points are Owner furnished and Contractor installed.

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C. Punch clock (bio-screen) are Owner furnished and installed.

3.EXECUTION AND SCOPE

1. GENERAL

A. Coordinate incorporation of the Work specified herein with other project work so as to facilitate a cohesive final product.

B. The installation recommendations contained within TIA-568-C, TIA-569-D, and the BICSI Telecommunications Distribution Methods Manual (TDMM), including manufacturer recommended installation methods or practices for a standards-based SCS, are mandatory minimum standards and requirements.

C. Mount equipment plumb and level. Permanently installed equipment to be firmly and safely held in place. Equipment supports must support loads imposed with a safety factor of at least five.

D. Each outlet must consist of an outlet box and plate listed on the legend provided on drawings.

E. Coordinate with Architectural and Electrical drawings for locations of telecommunication outlets, junction boxes, conduits and floor boxes within the project.

F. Route cables from outlets to the nearest TR unless the drawings designate cables to be routed to specific TR locations. Notify the Owner's representative if any cables are expected to exceed a total of 295 feet termination to termination.

G. Provide temporary or permanent protection of materials bearing the UL label that risk exposure to conditions that may compromise any portion of the material.

1. Do not paint or allow paint overspray on products bearing a UL label unless specifically approved by the manufacturer.

a. Cables exposed to paint or other chemicals are to be replaced.
b. Cables will be replaced at no cost to the owner

2. CABLE PATHWAYS AND SUPPORT

A. Conduit

1. Install raceway and conduit system complete with offsets, pull boxes, junction boxes and fittings.
2. No raceway shall be run horizontally inside of walls or partitions. Exceptions: building perimeter walls under windows, clerestory panel walls, and where structural conditions do not allow vertical access to tops of walls.
3. Install rigid wall hot-dipped galvanized steel conduit in the following locations:

a. Where exposed to physical damage
b. Outdoors
c. Indoors where exposed to moisture
d. Where required by code

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4. Install Electrical Metallic Tubing (EMT) – minimum size 1-inch in the following locations:

    a. Interior spaces not subject to moisture
    b. Where openly run communications cabling passes through inaccessible ceilings.
    c. As shown on drawings

5. PVC Conduit:

    a. Utilize PVC conduit for underground installations, minimum size 4-inch.

        1) PVC conduit runs shall have PVC coated rigid steel stub outs from the ground, including the last 90 degree bend.
        2) Elbows for conduit installed below grade shall be rigid steel conduit with two coats of corrosion-resistant paint or tape wrap.

6. Maintain proper conduit bend radius. For conduit with an internal diameter of 2” or less, maintain a bend radius of a least six (6) times the internal diameter. For conduit with an internal diameter greater than 2”, maintain a bend radius of at least ten (10) times the internal conduit diameter.
7. Multiple Conduit Installation:

    a. Install conduits parallel to or at 90 degrees to the structure. Multiple conduits shall not be installed using a single rod support. Multiple conduits running the same direction with spacing 48 inches apart or less shall be installed on the same trapeze.
    b. Trapeze hangers shall be supported on minimum 3/8-inch diameter all-thread rod attached to the structure with coupling nuts and expansion bolts or beam clamps.
    c. Conduit straps or other devices specifically designed for the purpose shall be used to secure conduits to the metal framing. Wire ties and hanger wires are not permitted.
    d. Conduits shall only be installed on the top surface of the metal framing, with multiple layered trapeze supports if required.
    e. Hanger rods shall not extend more than 1 inch past the lower trapeze metal framing. Use double nuts for all-thread rods.

8. Single Conduit Installation:

    a. Install single conduits parallel to or at 90 degrees to the structure and suspended from the structure on all-thread rods (1/4-inch minimum) or clamped and/or clipped to the structure with manufactured clamps/clips.
    b. When single conduits are suspended from all-thread rods, conduit clamps with bolts and nuts shall be used.

        1) Through partition wall penetration shall not be construed as a means of conduit support.
        2) Wire ties and hanger wires are not permitted.

    c. Single conduits may be secured as follows:

        1) Toggle bolts on hollow masonry.
        2) Bolts and expansion anchors in concrete or brick.
        3) Machine screws, threaded rods and clamps on steel.
        4) Conduit clips on steel joists.
        5) Plastic anchors are not allowed.

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9. Install expansion fittings in metal conduit as follows:

    a. Conduit Crossing Building Expansion Joints:

        1) EMT all sizes.
        2) Rigid Galvanized Steel (RGS) all sizes.

    b. Conduits entering environmental rooms and other locations subject to thermal expansion and as required by NEC.
    c. Provide conduit expansion fitting with an integral bonding braid.
    d. Expansion fittings are not required where offsets, expansion loops, or flexible conduit are placed in conduit runs.

10. Install conduit concealed in walls, partitions and above ceilings.
11. Install exposed overhead conduit (at structure) of mechanical rooms and in other similar rooms where ceilings are not provided.
12. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.
13. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.
14. Install pull wires in empty conduits. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
15. Cap ends of spare conduits and extend into space above accessible ceiling a minimum of 18 inches. Label conduit as spare.
16. Do not daisy chain conduit installations in or on walls, provide a single conduit wall drop per device.
17. Communications pathways exposed to public view shall be in conduit, stubbed to cable tray or accessible ceiling.
18. Exterior junction boxes, conduit/raceway, terminations, etc. at and those within enclosures where enclosures are exposed to outdoor conditions are to meet NEMA ratings for outdoor electrical applications.
19. Pull and junction boxes

    a. Pull and junction boxes shall be provided for conduit runs in excess of 100 feet.
    b. Provide boxes as shown on Drawings, and as required for wire pulling, equipment connection, and code compliance. Box locations shown on Drawings are approximate unless dimensioned. Verify location of outlets prior to rough in. Locate and install boxes to allow access and clearances per NEC.
    c. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.
    d. Support pull and junction boxes independent of conduit.
    e. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations. Set floor boxes level and adjust floor box flush with finish flooring material.
    f. Support pull and junction boxes independent of conduit.
    g. Provide knockout plugs for unused openings.
    h. Switch boxes shall not be used as junction boxes

20. Conduits originating from cable tray require a manufacturer recommended conduit-to-tray mounting bracket.

B. Workstation outlets

1. Install backboxes with reducer rings as called out on the drawings

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2. Each outlet must have a dedicated conduit extending 18 inches into an accessible ceiling, to cable tray or into a TR.

    a. Daisy chaining of outlets is not allowed unless otherwise noted o the drawings.
    b. Conduits must be equipped with bushings and a 200lb test pull line.

3. Coordinate with Architectural and Electrical drawings for locations of telecommunication outlets, junction boxes, conduits and floor boxes within the project.
4. Do not install boxes back-to-back in walls. Provide minimum 6-inch separation in non-fire-rated walls. Provide minimum 24-inch horizontal separation in acoustic-rated walls.
5. Install boxes in walls without damaging wall insulation.

C. Cable Tray

1. Cable tray must not be installed above hard ceiling such as sheetrock unless access is provided at intervals not exceeding 8 feet.
2. In a dropped ceiling environment, a minimum of 9-inch clearance shall be observed between the cable tray, including supports, and the false ceiling.
3. In all environments, a minimum working clearance of 12-inch s above the cable tray and 24-inch to one side shall be provided at each section of the cable tray system.
4. Cable tray support system must consist of trapeze style or tray manufacturer provided wall brackets.

    a. Center hung support systems are not allowed.
    b. Cable tray installed on walls must utilize manufacturer provided wall supports that space the tray off the wall.

5. Cable tray must be attached to the building structure using a minimum 3/8” all-thread connected to anchors or fittings designed for the purpose.

    a. All-thread shall not extend more than 1 inch past the lower trapeze metal framing. Use double nuts for all-thread rods.
    b. Use manufactures fittings for intersections, bends and offsets.
    c. Support specified cable tray at minimum intervals recommended by the manufacturer for the maximum loading capacity (lbs/ft).
    d. Provide manufacturer’s splice plates and expansion plates for junctions at tray-to-tray and tray-to-fittings.

6. Tray is to be 12” x 4” or larger with cables not to exceed 60% of the usable space on day one.
7. Cable tray installers must have successfully completed Manufacturers Certified Installer program.
8. Provide any seismic bracing required by local codes for cable tray designed and sealed by a registered professional engineer licensed to practice in the state.
9. Cables shall be segregated in the tray by cable media type and color.

D. Surface metal raceways

1. Raceway systems shall be installed complete, including insulating bushings and inserts where required by specified standards and/or required by manufacturer’s guidelines. Unused raceway openings shall be closed.
2. Install raceways above ceilings, exposed, on walls and casework parallel to or at right angles to structure and casework. Securely support raceway at intervals not exceeding 10 feet or in accordance with manufacturer’s recommendations.

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3. The number of conductors installed in any raceway shall not be greater than the number for which the raceway is approved.

E. J-Hooks

1. Support cabling not installed in conduit or cable tray with J-hooks sized for the quantity of cable installed plus 20%.
2. Maximum of 48 cables per bundle (multiple bundles cannot share j-hook).
3. Wherever practical install all cable running square with building structure.
4. Route cable bundles down hallways or other accessible routes.
5. Maintain an 8 inch minimum clearance between the bottom of the cable and accessible ceiling
6. Space J-hooks at no greater than 5 foot intervals unless a lesser interval will be required for product warranty.
7. J-hooks sized 1 5/16” and larger will have a cable retainer strap to contain cables on hanger. Straps must be suitable for use in air handling spaces, both removable and unusable.
8. Provide J-hooks with the proper configuration to attach to the building structure at each location.

    a. Where direct attachment to the building is not practical use of hanger wire or threaded rod attached to the building and dedicated to cable support is acceptable
    b. Do not attach J-hooks to any support used by other trades.

F. Fire wall penetrations

1. All penetrations through a fire rated wall or floor shall be sleeve with a metallic sleeve.
2. Seal the interior of the conduit sleeve around the cables and around the outside of the sleeve on each side of the penetration with fire-stop caulk or putty.
3. Attach the manufactures UL label on the wall adjacent to the penetration

3. COMMUNICATIONS EQUIPMENT ROOM FITTINGS

A. Provide rated fire retardant, painted plywood on walls of telecommunications rooms as shown on the drawings and secured flush with wall framework.

1. Install with fire rating stamp visible on each sheet of plywood.
2. Fire retardant paint shall be light in color to enhance lighting.
3. Install sheets side by side 6” off the floor with the 8’ length vertical unless otherwise noted on the drawings.
4. Provide two overlapping layers of the specified plywood when covering masonry walls.
5. Plywood shall be permanently fastened to the wall by means of wall anchors utilizing galvanized, zinc plated, or stainless steel hardware with a flat head.

    a. Finished installation shall have a flush appearance with countersunk screw heads to prevent splitting of the plywood.
    b. Drywall screws are not acceptable.

6. Plywood and paint shall be coordinated with the AHJ to meet applicable codes.

B. Provide floor standing network cabinets and racks with vertical cable managers at locations shown on the drawings.

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1. Install racks so that a minimum 3 foot clearance is maintained to the front, rear and at least one side.

    a. Clearance is measured from the wall or from the surface of permanently installed wall mount equipment to the leading vertical surface of the rack, cable manager or installed equipment.
    b. Notify owner/architect if any clearances will be less than 3 feet.

2. The equipment rack(s) must be anchored to the floor. Utilize (4) ½" bolts and associated hardware (anchors & washers) for rack anchoring.
3. Provide any seismic bracing required by local codes for free-standing racks designed and sealed by a registered professional engineer licensed to practice in the state.
4. The cabinets and racks must be bonded to the PBB or SBB.
5. Coordinate the installation of power circuits and conduit to prevent obstruction of equipment mounting rails.
6. Mounting screws not used shall be bagged and left with the rack upon completion of the installation.

C. Provide wall mounted cabinets and racks at locations shown on the drawings.

1. Install on plywood backboard matching the footprint of the cabinet/rack or larger.
2. Install with minimum 3 foot working clearance in front.
3. Install so swing out cabinets/racks have full clearance to open.
4. The cabinets and racks must be bonded to the PBB or SBB.

D. Provide horizontal cable managers for cabinets and racks.

1. When flat patch panels are provided for termination of copper cables, provide 1RU and 2RU cable managers so there is a least 1RU of cable management above or below every 24 ports. 2U of cable management is required between 48 port patch panels. Angled patch panels do not require horizontal cable managers and are designed for patch cords to route directly into vertical cable managers.
2. Provide additional horizontal cable managers as shown on the drawings.

E. Provide shelves and additional cabinet/rack accessories as called out on the drawings

F. Provide overhead ladder runway in the configuration as shown on the drawings.

1. Provide wall angle brackets and attach the ends of the ladder runway to walls.
2. Where possible, provide and attach the ladder runway to equipment cabinets with cabinet to runway mounting plates and elevation kits.
3. Provide support for the ladder runway every 5 feet.

    a. Cable runway will be mounted at a height of 7'-6" or 6" above equipment cabinets/racks unless noted otherwise.
    b. Support runway with equipment cabinets
    c. Support runway with triangle wall brackets
    d. Support runway from above with (2) support brackets and 3/8" threaded rod attached to building structure.

        1) Attach threaded rod to building structure using concrete anchors, beam clamps, or other devices designed for building attachment. Connections must have a pull-out strength and be spaced to provide support for the ladder runway to meet the manufacturer's load rating for the ladder runway.
        2) Provide plastic threaded rod covers to cover lower 2 feet of threaded rod.

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4. Provide any seismic bracing required by local codes for cable tray/runway designed and sealed by a registered professional engineer licensed to practice in the state.
5. Field cuts must be filed smooth, dressed square, and painted to match.
6. Provide end caps on exposed ladder runway ends.
7. Provide and connect ladder runway with appropriate butt splice kits, junction splice kits and other hardware designed for assembly of the runway system.
8. Provide cable radius drop out from ladder runway to vertical cable managers at every location where cables transition from the runway to the cable managers.
9. Use moveable cross members where required to mount the cable radius drop out so cables can be routed directly into the vertical cable managers.

G. Provide vertical ladder runway as shown on the drawings.

1. Attach to wall using vertical wall brackets or unistrut with J bolts.
2. Use cable runway foot kit to support vertical runway and secure it to the floor.

    a. Bolt foot kit to floor with minimum 1/4” concrete anchors, bolts, and washers.

3. Provide end caps for top end of vertical runway.

H. Provide re-enterable firestop sleeves in wall(s) as shown on the drawings

I. Provide a PBB and SBB sized as described in Part 2 and shown on the drawings.

1. Bond PBB to main electrical service ground with #3/0 CU insulated cable.

    a. Terminate with two-hole #3/0 ground lug.

2. Connect busbar to building structural steel with #6 CU ground wire.

    a. Terminate with two-hole #6 ground lug.

3. Use correctly sized compress tools.

J. Provide connection from equipment racks and ladder runway within the telecommunications room, and cable tray and conduit that enter the room to the PBB or SBB.

1. Provide a home run #6 CU ground wire from each equipment rack unless drawings provide alternative grounding scheme.
2. Provide a home run #6 CU ground wire from each independent group of ladder runway sections.
3. Provide #6 CU ground strap between ladder sections to create a single ground plane.
4. Provide a home run #6 CU ground wire from any cable tray or conduit that enters the room.
5. Terminate ground wire with a two-hole #6 ground lug.
6. Use correctly sized compress tools

K. Remove any finish and make-bare any metallic surface at the point where grounding wire is connected to and or terminated on equipment frames, racks or devices. Use antioxidant joint compound for connecting unlike metals.

L. Coordinate and verify final connection of related electrical power.

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4. CABLE - GENERAL PRACTICES

A. Confirm conduits have bushings prior to installation.

B. Confirm firewall penetrations have sleeves or openings that will allow for the fire rating to be restored after cable installation.

C. Confirm penetrations through acoustically rated walls have sleeves or openings that will allow for the acoustic rating to be restored after cable installation.

D. Confirm pathways have adequate capacity to support the cable type and quantity.

E. Cover edges of cable/wire pass-through holes in chassis, housings, boxes, and raceways with insulated grommets

F. Only install cable in areas it was rated for

1. Do not install outside plant cables (OSP) more than 50 feet inside buildings unless inside of continuous metallic conduit.
2. Do not install riser rated cables (CMR. OFNR, OFCR) in plenum air spaces.
3. Do not install plenum rated cables (CMP, OFNP, OFCP) or riser rated cables (CMR. OFNR, OFCR) in outside plant environments, including conduits below/in slab that maybe exposed to moisture, unless they have a dual rating for outside plant.

G. Do not install cable in climate condition less than the manufacturer's recommended minimum temperature.

H. Install the cable so that the tension applied to the cables does not exceed the manufacturer's recommendation for the type and size of cable.

I. The cable shall not be crushed, deformed, skinned, crimped, twisted, or formed into tight radius bends that could compromise the integrity of the cabling.

J. Communication cables must not be run loose or lay upon ceiling grid or ceiling tiles.

K. Communications cable shall not be fastened to or supported by electrical conduits, mechanical ductwork/piping, sprinkler pipes, or routed to obstruct access to doors, utility access panels, or service work areas.

L. Maintain a 6 inch minimum clearance above accessible ceiling tiles.

M. Isolate cables and wires of different signals or different levels; and separate, organize, and route to restrict channel crosstalk or feedback oscillation.

N. Label cables within 12 inches of termination with the specified labeling scheme.

O. Dress cables neatly where exposed in the telecommunication room, securing cable bundles with hook and loop tie wraps.

P. Cabling is to remain clean of all paint, or any other construction overspray / material. Contractor to take precautions necessary to ensure this requirement.

1. Damaged or contaminated cables shall be replaced at no cost to the owner.

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Q. Outside plant copper cables that are exposed to potential damaging electrical surges must be terminated on Building Entrance Terminals (BET).

5. COMMUNICATIONS FIBER OPTIC BACKBONE CABLE

A. Provide fiber optic cables between telecommunications rooms as shown on the drawings.

1. Use a pulling grip or factory installed pulling eye for proper distribution of pulling forces.

a. When pulling in conduit use a ball bearing swivel between the pulling grip and pull line.
b. When pulling in conduit use a pulling lubricant designed for fiber optic cables.

2. Minimum bend radius during pull is 20 times the diameter of the cable, 10 times the diameter after the pull.
3. Provide a minimum of a 15 foot service loop at each telecommunication room termination. Stage service loop at the top of deck in the TR, ER or in the cable runway.
4. Armored fiber optic cable must have the armor grounded on each end.

B. Provide fiber optic connectors on both ends of each fiber.

1. Maintain a clean environment for terminating fiber optic cables.
2. Clean and visually inspect the fiber before terminations.

a. Use a magnifying scope to look for contaminants.
b. Reclean if necessary

3. Follow manufacturer's instructions for correct connection procedure.
4. Visually inspect the connector after termination.
5. Cap the end of the connector until ready for connection to the adapter panel.

C. Provide fiber optic enclosures as called out on the drawings.

1. Mount in rack locations or on walls shown on the drawings.
2. Fiber optic enclosures should be sized for the number of adapter panels required to support the fiber cables plus blanks as described the next section.

D. Provide fiber optic adapter panels required for connection to each installed fiber.

1. Each adapter panels shall have fibers from only (1) cable connected to them.
2. When multiple panels are required for termination of a single cable, these panels shall be adjacent to each other.
3. When multiple fiber types connect each telecommunications room, group panels by fiber type.
4. Provide (1) blank adapter panel between each grouping of adapter panels.
5. Keep port covers on adapter panel ports until backbone fibers or fiber patch cords are attached.

E. 100% of fibers shall be tested in accordance with testing requirements in this Section.

6. COMMUNICATIONS UTP COPPER BACKBONE CABLE

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A. Provide multipair UTP copper cables between telecommunications rooms as shown on the drawings.

1. Install with a minimum inside bend radius of 10 times the diameter of the cable.
2. Cable with a metallic shield must have the shield grounded on each end.
3. Terminate multipair UTP copper backbone or cross connect from the BET on wall or racked mounted 110 blocks, or wall or rack mounted RJ-45 patch panels, as shown on the drawings.

    a. Provide 12 inches of clear working space from room inside corners and 6 inches of working space above, below and to the sides of wall mount termination blocks to accommodate cable routing.

4. Test installed pairs for continuity and polarity in accordance with testing requirement in this Section.

    a. Certified test reports must bear the date tested, the technician's name, and the pair and cable identifier for each cable tested. Test results/reports in electronic copies by closet must be delivered to the Project Manager according to the submittal procedures.

B. Provide 4 pair UTP copper cables between telecommunications rooms as shown on the drawings.

1. Install the cable so that the tension applied to the cables does not exceed 25 lbf or the manufacturer's guidelines whichever is lesser.
2. Maintain the following distances from sources of electrical interference:

    a. 6 inches from fluorescent lighting
    b. 6 inches from grounded conduit cable used for electrical power distribution
    c. 12 inches from unshielded electrical power cables
    d. 48 inches from electric motors and transformers

3. Minimum bend radius during and after installation is no less than six times the cables outside diameter.
4. Terminate 4 pair UTP copper backbone or cross connects from the BET on wall or racked mounted 110 blocks, or wall or rack mounted RJ-45 patch panels, as shown on the drawings.

    a. Provide 12 inches of clear working space from room inside corners and 6 inches of working space above, below and to the sides of wall mount termination blocks to accommodate cable routing.

5. Test cables as follows:

    a. If cables terminate on 110 blocks or on RJ-45 patch panels with less than 4 pairs per port, test each pair for continuity and polarity. Provided test results.
    b. If cables terminate on RJ-45 patch panels with 4 pairs per port, test each cable for compliance with the Category of cables installed using the testing requirements in this Section for horizontal cables.
    c. Certified test reports must bear the date tested, the technician's name, and the cable identifier for each cable tested. Test results/reports in electronic copies by closet must be delivered to the Project Manager according to the submittal procedures.

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C. Provide Building Entrance Terminals (BET) as called out on drawings or if cable routing indicates a requirement.

1. Install Terminal where it will be accessible to technicians and as close to the incoming entrance cable as possible.
2. Install a #6 ground wire from the Terminal ground lug to the local ground.
3. Use a punch down tool for termination of incoming and outgoing cable pairs.
4. Install BETs for 4 pair Category cables that meet or exceed the cables Category rating.

a. 4 pair Category BETs may require connection using RJ-45 plugs.

D. Provide 110 blocks as called out on drawings.

E. Provide RJ-45 patch panels as called out on the drawings.

1. Install telco grade or better patch panels for termination of multipair UTP copper cables.

a. Typical installation requires 1 pair per port. Confirm with the owner prior to installation.

2. Terminate 4 pair Category cables with 4 pairs per port on Category patch panel that meets or exceed the cables Category rating.
3. Test cable as multipair or Category cable depending upon termination used.

7. TELECOMMUNICATION BONDING BACKBONE (TBB)

A. Provide a telecommunications bonding backbone conduit between telecommunications rooms as shown on the drawings.

1. The TBB should be installed without splices.

a. Taps are acceptable where pathways would otherwise be duplicated.

1) Taps shall be located within a telecommunications room.
2) Joined segments shall be connected using exothermic welding, irreversible compression-type connectors, or equivalent.
3) Joints shall be adequately supported and protected from damage.

B. Provide telecommunications bus bar of adequate size to provide bonding to equipment within telecommunications spaces.

C. Provide two-hole grounding lugs to connect the telecommunication bonding backbone to the telecommunications bus bars.

1. Connection to the backbone cable shall utilize exothermic welding or irreversible compression type connections.
2. Connection to the telecommunications bus bars shall utilize exothermic welding or irreversible compression type connections.

8. COMMUNICATIONS HORIZONTAL UTP CABLING

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A. Provide specified Category UTP cables homerun from workstation outlets shown on the drawings to the nearest telecommunications room unless otherwise noted.

1. Install in compliance with manufacturers installation procedures.
2. Do not install cables with a total length greater than 295 feet without written permission from the Owner's representative.
3. Install cable so that the pulling tension applied to the cable does not exceed 25 lbf or the manufacturer's guidelines whichever is lesser.
4. Install cable so that a radius bend of no less than six times the cables outside diameter is maintained during and after installation.
5. Maintain the following distances from sources of electrical interference

    a. 6 inches from fluorescent lighting
    b. 6 inches from grounded conduit cable used for electrical power distribution
    c. 12 inches from unshielded electrical power cables
    d. 48 inches from electric motors and transformers

6. Support and coil a 10 foot service loop at each workstation above accessible ceiling.

B. Provide Category rated RJ-45 jacks for various application in the colors called out in this specification and on the drawings.

1. Terminate cables on jacks with a T568B pinout for new building construction.

    a. Match existing pinout for facilities undergoing remodel or expansion.
    b. Strip cable jackets and untwist pairs only as much as is required to terminate individual pairs.
    c. Match cable colors to jack colors called out for specific applications.
    d. Install jacks at workstations in configurations shown on the drawings

C. Provide workstation outlet types in locations shown on the drawings

D. Provide Category rated patch panels to support workstation cables.

1. Terminate cables on patch panels grouped by applications if shown on the drawings.

    a. Match existing pinout for facilities undergoing remodel or expansion.
    b. Strip cable jackets and untwist pairs only as much as is required to terminate individual pairs, following manufacturers installation procedure.

2. Terminate cables on patch panels matching the 568A or 568B pinout used for the jacks.
3. Arrange patch panels on racks and in cabinets as shown on the drawings.

E. Provide horizontal cable managers for patch cord management

1. Install 1RU and 2RU cable managers as shown on the drawings.

F. Furnish Category rated patch cords in colors, lengths, and quantities as specified or shown on the drawings.

1. Confirm with owner prior to purchasing.

9. LABELING

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A. Provide labeling in accordance with ANSI/TIA 606-B Level 1 numbering and ID format.

B. Mechanically print and install in accordance with drawing details.

C. Labels must be single line all capital letters bold font. Select font size that can be read on the applicable device or cable.

D. Ensure all surfaces are clean prior to placing labeling products. Follow manufacturer's recommendation for cleaning.

E. Both ends of telecommunications cables, outlet faceplates, terminal blocks, floor boxes, termination cabinets, patch panels, bonding busbars, ground cables, equipment racks, and equipment rooms must be labeled in accordance with the aforementioned standards.

1. At locations where outlets are out of sight above ceilings, provide an additional label with ½" lettering below the outlet on the ceiling grid or ceiling access panel.

F. Labels for cabling shall be self-laminating.

G. Hand written labels are unacceptable.

H. Locate the cable designator at the origination and destination of each cable within 12 inches of the point of termination or connection.

I. Provide machine printed wall plate labels meeting ANSI/TIA 606-B standards inserted behind built-in clear plastic windows.

10. TEST AND CERTIFICATION

A. Pretest notification

1. Prior to conducting any field-testing of the SCS the Contractor must deliver to the project Architect a written notification of the test commencement date and the sequence of testing.
2. If the Contractor elects to commence testing in a phased approach, prior to completion of cable installation, a test sequence schedule must be provided.
3. Notification must be delivered to the Architect at least three weeks prior to the scheduled test date.
4. Upon receipt of the notification the Architect will arrange for the Owner's technical representative to attend the commencement of testing.
5. The purpose of the Owner's technical representative's attendance will be to observe:

   a. The type of test equipment being utilized compared to the scheduled test equipment.
   b. The test equipment can perform the tests to comply with the specified Standards.
   c. The Contractor's technical personnel are prepared to conduct the tests.
   d. The Owner's technical representative will make an Observation Report to the Architect

6. Failure to offer notification as specified above will subject the Contractor to re-test any cabling that was tested prior to the OWNER's technical representative review, at no additional cost to the project.

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B. Testing equipment and devices

1. Test equipment must be capable of measuring the performance of the installed SCS and comparing the performance to the parameters specified in the applicable ANSI/TIA Standards.
2. Test equipment calibration must be current as defined by the test equipment manufacturer and included on individual test reports. Failure to perform SCS testing with equipment that meets this requirement will require retesting of applicable cabling at no additional cost to the Owner.
3. The following equipment list is provided to define the expected test equipment type. The test equipment is to be available for the entire test period through final inspection.

    a. Manufacturer – Fluke DSX series

        1) The most current software, firmware and appropriate launch cords must be used.

C. Horizontal twisted pair testing

1. The horizontal distribution cable must be tested to perform in accordance with ANSI/TIA-568-C. Cables must meet or exceed the requirements for horizontal, twisted pair cabling as specified in ANSI/TIA 568-C for a “PERMANENT LINK” test.

    a. Include this testing for Category 5e and above cables used for backbone or interconnect cables with distances less than 295 feet.

2. Any cable, which fails any given test, must be corrected or replaced. Such activity must be performed at no additional cost to the Owner.

    a. Only cables with PASS results will be accepted. Results that show PASS* will be considered a failed test.
    b. PASS* tests will be accepted if written approval is provided from the manufacturer providing the extended performance warranty on the system stating that these cable segments will be covered by the extended warranty.

D. Coaxial cable testing

1. Submit a cable certification report for each cable for insertion loss, length, resistance, and impedance.
2. Any cable, which fails any given test, must be corrected or replaced. Such activity must be performed at no additional cost to the Owner.

E. Backbone twisted pair cable testing, Category 3 or less.

1. Submit a cable certification report for each cable pair with test results for the following categories:

    a. Wiremap
    b. Length

F. Fiber cable testing

1. Perform bi-directional field testing of each terminated strand of fiber optic cable listed in this Section for length, loss and polarity. Field testing equipment must include both an optical loss test set (OLTS) and optical time domain reflectometer (OTDR). Testing

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measurements are required to meet transmission performances listed in ANSI/TIA-568.3-D/4.2/Table 1 at both 850 nm and 1300 nm for multimode fiber, and both 1310 nm and 1550 nm for single-mode fiber.

2. Submit cable certification reports of the following field testing measurement methods:

    a. Attenuation
    b. Length
    c. Polarity
    d. OTDR traces

3. Cable certification reports must bear the location/room number and cable identifier for each cable tested. Test results/reports in electronic copies by closet must be delivered to the Project Manager according to the submittal procedures.
4. Deliver an electronic file containing all individual test records and the software required to display and print the test records using a typical personal computer (PC).

    a. Deliver test results in a PDF format on a compact disk or DVD.

G. PoE Extender Testing

1. Verify each POE Extender is receiving DC power and powering the IP device. Coordinate with Owner IT to determine IP device is connecting to the network and functioning properly.

    a. Provide a report of voltages levels at each POE Extender from the power supply user interface.

11. FINAL INSPECTION

A. Be cognizant of the project schedule and execute work to comply with the Project Schedule for Final Inspection.

B. Ensure that the project management and the Architect are made aware of any issues that may prevent the completion of work prior to the scheduled final inspection time-frame.

C. Prior to the scheduled final inspection time-frame the following must be completed:

1. Complete installation, initial adjustments, tests and measurements
2. Submit Test Results and As-Built documentation to the Architect.
3. Notification of the Architect, in writing of the date that they will be ready for final inspection and test.
4. Submit warranty paperwork to the Owner’s vendor of choice for the completed SCS.

D. No earlier than two weeks after receipt of the Contractor’s notification the Architect’s representative will schedule a final inspection.

E. During the Final Inspection site-walk make available:

1. A minimum of two people for inspection who are familiar with all aspects of the System.
2. Ladders and scaffolding necessary to inspect cable in cable trays and ceiling mounted junction boxes.
3. Test equipment specified and used for testing the SCS.

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F. In the event the need for further adjustment or work becomes evident during the inspection, the Contractor is to continue his work until the System is acceptable at no addition to the contract price. If approval is delayed because of defective equipment or failure of equipment or installation to meet specifications, and if any extension of the inspection and testing period is required, the contract price will be reduced for the additional time and expenses of the Owner at the standard rate in effect at that time.

G. If the Contract Documents, law, ordinances, rules, regulations or orders of any public authority having jurisdiction require any Work to be inspected, tested or approved, the Contractor must give timely notice to the Owner and the Consultant of the readiness and the date arranged so they may observe such inspection, testing or approval procedure. In addition, the Owner or Consultant may require special inspection, testing or approval of material or Work for compliance with the requirements of the Contract Documents. Upon direction by the Owner and the Consultant, the Contractor must promptly arrange for such special testing, inspection or approval procedure. Should the material or Work fail to comply with the requirements of the Contract Documents, the Contractor must bear all costs to replace, fix, and/or re-terminate the failed work.

12. INSTRUCTION OF OWNER PERSONNEL

A. After final completion, instruct the Owner's designated personnel on the use, operation, maintenance, and care of the Systems.

END OF SECTION 271000

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SECTION 271343 - DISTRIBUTION TELEVISION SYSTEM

1.GENERAL

1. SECTION INCLUDES

A. Coordination, provision, installation, inspection, commissioning, testing, instruction, and warranties of a Distributed Television Systems (DTV). Plant, materials, equipment, transport, and labor necessary to accomplish this and have a complete and proper System.

B. Also includes:

1. Required licenses and permits including payment of charges and fees.
2. Verification of dimensions and conditions.
3. Provision of submissions.
4. Installation in accordance with the contract document, manufacturer's recommendation, and in conformity with applicable codes and authority having jurisdiction.
5. Extension of electrical service, including ground, to equipment locations.

2. RELATED WORK

A. Division 01: General Conditions

B. Division 11: Equipment

1. 11 63 50: Video Production Systems

C. Division 26: Electrical Work

D. Division 27: Communications

1. 27 41 16: Audio Visual Systems
2. 27 41 43: Installation of Television Displays & Mounts

3. REFERENCES

A. Published specification standards, tests or recommended methods of trade, industry or governmental organizations apply to Work in this section where cited below:

1. American National Safety Institute (ANSI).
2. American Society of Testing and Materials (ASTM).
3. Building Industry Consulting Service International (BICSI).
4. BICSI’s Telecommunications Distribution Methods Manual (TDMM).
5. Electronics Industries Association (EIA).
6. Federal Communications Commission (FCC).
7. Institute of Electrical and Electronic Engineers (IEEE).
8. National Electrical Manufacturer’s Association (NEMA).
9. National Electrical Code (NEC).

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10. Cable Television Technology (CTT), Kenneth T. Deschler, New York, McGraw-Hill, Inc., 1987.
11. Society of Cable Television Engineers (SCTE).
12. National Cable Television Association (NCTA).
13. Telecommunications Industries Association (TIA).
14. Underwriters Laboratories (UL).

4. DESCRIPTIONS AND REQUIREMENTS

A. The following is intended to further describe the Work and clarify design intent and is not an exhaustive description of the Distributed Television System. Refer to the Electronic Systems ("AV" series) drawings for further information relating to this Section.

1. It is the contractor's responsibility to coordinate with all plans and specification sections relating to the project for a complete and functioning system.

B. Provide a Distributed Television Hybrid Fiber Coax (HFC) type Headend system with frequency agile modulation. Pre-amplify, attenuate, equalize and filter each signal prior to being combined and distributed.

1. The system is based on a single mode fiber dedicated NODE HFC distribution system.

C. Determine head-end channel assignments during project submittal phase.

1. Ingest and RF QAM distribution of up to four (4) HD SDI signals from locally originated sources.
2. Ingest and RF QAM distribution of up to four (4) HDMI signals from locally originated sources
3. Ingest and RF QAM distribution of up to twenty-four (24) municipal cable TV channels.

D. Provide a forward path fiber optic system to distribute Cable TV signals between the Headend and the Building Services Rooms. Provide a dedicated horizontal coaxial cable (drop) to each TV drop outlet to distribute Cable TV signals within the complex from the Building Services Rooms.

1. Multitaps or splitters outside the NODE are not acceptable.
2. All fiber strands are to be terminated, labeled, and tested. All fiber connections are to be Angled Physical Contact (APC) connectors. Connector type is to be consistent from origination to destination without patch points and must be coordinated with the manufacturer of the equipment for fit and style.
3. Terminate all spare fibers to patch panels located in the DTV headend equipment rack.
4. Fusion splice breakout fiber cables will be required to allow for cables to be connected to the patch termination boxes in the NODE and at patch panels in the headend while allowing dedicated patch free connections to the fiber splitters at the headend and the receivers at the NODE.

E. Provide no less than two (2) spare service taps on each value of multi-tap in the NODE. This will allow for future expansion.

F. Provide DTV service to hospitality, concession stands, broadcast booths, coaching rooms, media, and other areas as shown on drawings

G. Provide a drop service outlet to each audio equipment rack servicing the clubs for use by the sound systems for audio source selections and distribution.

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H. Provide Standard and/or High Definition programming for distribution as indicated on the plans.

I. Television locations are primarily governed by those shown on the architectural drawings, and secondarily by the AV drawings.

J. The headend assumes provision of municipal cable television programming delivered in the clear (Clear QAM).

K. Provide signal to TV tuners indicated on the AV system documents.

1. It is the responsibility of this specification section to provide all cable and connectors to provide complete signal delivery from the NODE to the TV tuner inputs for both electronic and physical connections.

L. Provide a streaming media and recording appliance for private and public network distribution of content.

M. System DTV performance criteria:

1. Nominal digital carrier level: at 501 MHz (Channel 70), +5dBmV ± 3 dBmV, measured at the drop outlet.
2. Modulation Error Ratio (MER)

   a. At headend: ≥ 40dB
   b. At drop tap: ≥ 32dB

3. Bit Error Rate (BER)

   a. At headend: ≥ 10-9
   b. At drop tap: ≥ 10-7

4. Digital carrier level difference between adjacent channels: less than 1 dB.
5. Digital carrier level difference between non-adjacent channels: less than 3 dB.
6. Provide signal pads to adjust the drop service outlets not to exceed 15 dBmV.
7. Visual carrier level difference between adjacent channels: less than 1 dB.
8. Visual carrier level difference between non-adjacent channels: less than 7 dB.
9. Carrier-to-noise ratio, insofar as it is due to the contribution of noise by the System: greater than 46 dB.
10. Amplitude response across the visual portion of channels: flat, ± 2.0 dB.
11. Ratio, after demodulation, between the maximum level of the desired signal and the interference resulting from cross modulation from other signals on the System: greater than 50 dB.
12. Isolation between rooms, spaces, suites, and offices: greater than 30 dB. Isolation value of devices separating any two given outlets will be used for the purpose of this calculation as well as the return loss attributed to interconnecting cabling.
13. Reflections: greater than 40 dB below the respective picture carrier.
14. Verify visible components of interference do not appear when receivers are tuned to each of the distributed channels.

N. Coordinate location with surrounding equipment such as electrical motors, HVAC as well as structure or overhangs which may cause interference, blockage, or reflective signals.

O. Channels: Provide channels, as indicated on the drawings to the facility TV sets.

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P. Coordination with the audio system provider is required. It will be the responsibility of this specification section to provide all interconnects and necessary equalization and pads as required inserting the signal to the designated area.

1. Coordination with Sound Reinforcement and Audio Video control system is critical to the complete operation of the interfaced audio systems.

Q. Provide dedicated signal cable from each television or display to the nearest NODE.

1. Multitaps or splitters outside the NODE are not acceptable.

R. Provide a dedicated multi-strand single mode fiber cable to each NODE indicated on the plans. This cable will be a continuous run without splices. Each fiber must be terminated to connector panels (when not connected to equipment), patch panels and dedicated equipment connections as described earlier in the section.

S. Provide patch cables to make fiber connections within the headend with regard to spare fibers. Refer to spare parts (attic stock) section for quantities.

T. Provide a dedicated Encoder for network IP multicast program distribution of SDI/HDMI video with audio.

5. RESPONSIBILITY AND RELATED WORK

A. Coordinate and schedule work with other trades.

B. The drawings included with this specification convey general system concepts. The plans do not show complete and accurate building details. The Installer is responsible for making field measurements necessary to establish exact locations, relationships, load capacities necessary for the installation of these systems.

C. Conduit, wire ways, floor boxes, wall boxes, pull boxes, junction boxes, and AC power circuits and ground wiring to the DTV system are specified under the electrical specifications. This does not relieve this Installer from responsibility for a complete working system. Coordination with the Electrical Contractor is required to achieve a proper conduit and power systems.

D. Supply accessories and minor equipment items needed for a complete system, even if not specifically mentioned in these Specifications or on the associated Drawings, without claim for additional payment. The Installer is responsible for providing all components necessary for complete and operational system. Any system changes or revisions necessary to make the system conform to the building, walls, steel, electrical services etc, shall be included at time of bid and installed without claims for additional compensation.

E. The owner reserves the right to make reasonable device and equipment location changes prior to rough installation without claim for additional expense.

F. Notwithstanding any detailed information in the Contract Documents, it is the responsibility of this Installer to supply systems in full working order. Notify the Architect of any discrepancies in part numbers or quantities before bid. Failing to provide such notification requires this Installer to supply items and quantities according to the intent of the Specifications and associated Drawings without claim for additional payment.

G. Obtain permits necessary for the execution of any work pertaining to the installation, or any operation by the Owner including any associated charges or fees.

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H. Execute work in accordance with the National Electrical Code, the National Electrical Safety Code, and applicable State and Local codes, ordinances, and regulations. If a conflict develops between the contract document and the appropriate codes and is reported to the Architect prior to bid opening, the Architect will prepare the necessary clarification. Where a conflict is reported after contract award, propose a resolution of the conflict and, upon approval, perform work.

I. Coordinate exact location and installation of equipment, power, grounding, and raceway requirements with the Architect.

6. QUALITY ASSURANCE

A. Contractor's Qualifications: Firm experienced in the provision of systems similar in complexity to those required for this project; and meet the following:

1. No less than three years experience with equipment and systems of the specified types.
2. Experience with at least three comparable scale projects within the last two years.
3. Be a franchised dealer and service facility for the manufacturer's products furnished.

a. Replacement parts, equipment and components are required so that during failures the facility will not be disabled due to factory returns or replacements.

4. Provide manufacturer-certified installer for passive LAN components. Submit copies of certification.
5. Maintain a fully staffed and equipped service facility.
6. At the request of the Architect, demonstrate that:

a. Adequate plant and equipment is available to complete the work.
b. Adequate staff with commensurate technical experience is available.

B. Manufacturer's Qualifications: No less than 5 years continuous experience in the production of specified types of product. Production per applicable NEMA standards.

C. Work: Perform Work in compliance with the applicable standards listed herein and governing codes and regulations of the authorities having jurisdiction and the Contract Documents.

1. Drawings and specification requirements govern where they exceed Code and Regulation requirements.
2. Where requirements between governing Codes and Regulations vary, the more restrictive provision applies.
3. Nothing in the Contract Documents grants authority or permission to disregard or violate any legal requirements.

7. SUBMITTALS:

A. The submittal information required by the specification is to be presented complete. Cost for the Owner's consultant to review secondary and re-submittals due to the Installer's failure to include required submittal information, or rejection of incomplete or improperly prepared submittal information will be the responsibility of the Contractor.

B. Provide for approval not later than thirty (30) days after issuance of Notice to Proceed and prior to commencement of Work:

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1. A complete schedule of submittals.
2. A chronological schedule of Work in bar chart form. Revise and resubmit schedule as required to reflect construction progress.

C. Provide the following organized by section:

1. Section 1: Complete list of products to be incorporated within the Work
2. Section 2: Manufacturer's data sheets for each product.

    a. Provide original manufacturer's data sheets in order as they appear in the specification.

        1) Products that are not organized as specified will be returned un-reviewed and it will be the contractor's responsibility to organize the submittal and resubmit at no additional cost to the project. Any time delays experienced as a result of resubmissions will be borne by the contractor.
        2) These data sheets are submitted for each product in sufficient detail to facilitate proper evaluation to the product suitability for incorporation within the Work.

3. Section 3: Samples of wall plates, subassemblies, and connectors.

    a. Color selection chart must be provided for architectural review.

4. Section 4: Samples of cable types proposed with representative cable labeling.

    a. Each cable sample must have visible on the jacket its manufacturer and UL rating visible as well as product number.
    b. This will include each type of cable to be used in the project to include fiber & copper connectors.

D. Provide for approval no later than ninety (90) days after notice to proceed:

1. Provide drawings created with CAD software such as AutoCAD using standard industry graphic standards.
2. Provide installing drawings showing special details depicting methods and means specific to each product, assembly and each product manufacturer's recommended installation methods and means. Provide no less than:

    a. Headend floor plan with dimensioned equipment rack and elevated wall lining at no less than 3/8" scale, and
    b. Dimensioned elevation layout drawing of wall lining within each distribution room at no less than 3/8" scale.

3. Provide point-to-point schematic drawings detailing inter-component and intra-component, on contractor-assembled components, manufactured product connections or fabricated products, wiring and cabling diagram depicting cable types, designator, and color codes. Give each component a unique designator and use this designator consistently throughout the project. Provide no less than:

    a. Headend:
    b. Telecom Amplifier and Distribution Elevations indicating each component:
    c. All equipment devices and locations are to be identified.

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1) This is to include all headend & distribution components such as drop taps, multi-taps, amplifiers, splitters, encoders, modulators, combiners, fiber transmitters & receivers, etc.

d. Show signal levels at entry and exit of each piece of equipment both active and passive.

1) This will include the signal levels of each piece of equipment in the headend rack, fiber equipment, NODEs, multi-tap ports, transceivers, amplifiers etc.
2) Signal levels must be shown for each drop service outlet.
3) Cable lengths of each cable, fiber & copper must be provided.

4. Provide equipment drawings showing location of equipment in racks, or consoles, with dimensions; wire routing and cabling within housings; AC power outlet and terminal strip locations.

a. All power distribution within racks must include coordinated electrical panel and circuit identification numbers located on the distribution strips and receptacles.

5. Provide in submittal shop drawings calculations and documentation for the following:

a. DTV signal bandwidth is to be 5MHz to 1000MHz. Indicate levels at the inputs and outputs of active components, multi-taps, multi-tap port levels and each drop outlet measured at the TV location. Indicate physical location (e.g., room number, column line, etc.) of each component and drop location

6. Floor Plan drawings, including all walls, doors, and rooms, showing exact locations of devices and equipment.
7. Floor Plan drawings, including all walls, doors, and rooms, showing exact power requirements and conduit routing for each system with the location of all junction boxes.
8. Patch Panel Drawings. Provide detailed drawing of patch panel layouts and designation (labeling) strips, including color schemes.
9. Custom Enclosures and Millwork Drawings. Provide full fabrication detail drawings indicating size, material, finish, and openings for equipment.
10. Fabricated Plates and Panels Drawings. Provide complete drawings on custom fabricated plates or panels. Drawings to include dimensioned locations of components, component types, engraving information, plate material and color, and bill of material.
11. Provide representative equipment and cabling labeling scheme. Include font sizes and styles, explanation of scheme, and descriptor and designator schedule.
12. Provide detail drawings depicting any unique installation methods specific to each product.
13. Any other pertinent data generated which is necessary to provide the Work.

E. Submittal Format:

1. Each submittal shall be bound in a three-ring D style binder sized for 150% of the material with a maximum size being a three-inch spine. Use multiple volumes if necessary.
2. Provide each submittal with a unique number and be numbered in consecutive order.
3. Provide each submittal binder with a cover and a spine reflecting the project title and submittal number.
4. Provide each submittal with a complete table of contents with the following information:

a. Project title and number.

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b. Submittal number. In the case of a re-submittal, use the original submittal number immediately followed by the suffix “R” immediately followed by a unique number and be numbered in consecutive order.
c. Date of submission.
d. Referenced addendum or change-order number as applicable.
e. Referenced specification Section, Part, Article, Paragraph, and page number or drawing reference as applicable.
f. Index Product Data sheets by manufacturer and model or part number.

5. Separate major grouping with labeled binder tabs.
6. Each submission page stamped with Contractor’s certification stamp, initialed or signed certifying:

a. Review, approval, and acceptance of submission.
b. Certification of product compliance to specification.
c. Verification product may be incorporated within the work.

7. Arrange product data list in alphanumeric order by manufacturer and model or part number. Follow list by manufacturer’s data sheets, arranged in the same order. If a data sheet shows more than one product, indicate the model being proposed with an arrow or other appropriate symbol.
8. Drawings executed at an appropriate scale, not smaller than 3/8"=1'.

F. Submittal Copies:

1. These requirements represent minimum project requirements; a project’s general conditions may require additional copies for project distribution.
2. Submit one (1) unbound reproducible drawing set and two (2) bound prints of all drawings. The processed reproducible shall be returned to Contractor. Additional prints will not be reviewed they will be returned un-marked.
3. Submit four binders of bound materials (e.g., product submittals).
4. Submit three copies of product or sample finishes as required within this specification.

G. Resubmission Requirements:

1. Make any requested corrections or change in submittals required. Resubmit for review until no exceptions are taken.
2. Indicate any changes that have been made other than those requested.

8. PROJECT RECORD MANUAL

A. Submit three bound original sets (this is a minimum of two for the Owner and one for the Architect’s consultant; additional copies may be required by the project’s general conditions) after substantial completion and prior to final inspection.

B. The Project Record Manual shall be segregated into three separate bindings as follows:

1. Operations Manual:

a. Product Data: Product actually incorporated within the Work:

1) Manufacturer's data for each type of product conforming to the scheme above. The list shall include manufacturer’s serial numbers.
2) Each products Owner/Instruction Manual.

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3) For custom circuits or modifications, a description of the purpose, capabilities, and operation of each item.
4) Manufacturer's wiring diagram for each type of product actually incorporated.
5) Separately bound list by manufacturer and model or part number of all products incorporated within the Work arranged in alphanumeric order.

b. Record drawings: Final rendition of that specified depicting what is actually incorporated within the Work.
c. Test Reports: Recorded findings of testing specification of this specification.
d. System Operation and Instructions: Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity.

1) This procedure should describe the operation of all system capabilities.
2) Assume the intended reader of the manual to be technically experienced but unfamiliar with the components and the facility.

2. Service & Maintenance Manual:

a. Provide an original copy of the service manual on every piece of equipment for which the manufacturer offers a service manual. Arrange manuals in the same order as the operations manual.
b. Manufacturer’s maintenance and care instructions.
c. Maintenance Instructions, including maintenance phone number(s) and hours; maintenance schedule; description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.

3. Warranty Manual:

a. Manufacturer's warranty statements on each product.
b. Date of substantial completion and ending dates for warranties for each group of products.
c. Software registration and licenses.

C. Include any other pertinent data generated during the Project or required for future service.

1. Appropriately duplicate data within the separate bindings when it will reasonably clarify procedures, e.g., operational data in maintenance binding.

9. DELIVERY, STORAGE, AND HANDLING

A. Ship product in its original container, to prevent damaging or entrance of foreign matter.

B. Handling and shipping in accordance with manufacturer’s recommendation.

C. Provide protective covering during construction, to prevent damaging or entrance of foreign matter.

D. Replace at no expense to Owner, product damaged during storage, handling, or the course of construction.

10. PROJECT CONDITIONS

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A. Verify conditions on the job site applicable to this work. Notify Architect in writing of discrepancies, conflicts, or omissions promptly upon discovery.

B. The Drawings diagrammatically show cabling and arrangements of equipment fitting the space available without interference. If conditions exist which make it impossible to install work as shown, recommend solutions and/or submit drawings to the Architect for approval, showing how the work may be installed.

11. FINAL INSPECTION AND TEST

A. Upon completion of installation, initial adjustments, tests, and measurements specified in Part 3, and submission and review of the results, a final inspection and test will be observed by the Architect no earlier than two weeks after receipt of the written results.

B. Provide a minimum of one (1) person for inspection and two (2) persons for testing familiar with aspects of the System to assist the Owner.

C. The process of testing the System may necessitate moving and adjusting certain components such as antennas or signal processors.

D. Testing includes operation of each major system and any other components deemed necessary. Perform tests and provide required test equipment, tools and material required to make any necessary repairs, corrections, or adjustments.

E. The following procedures will be performed on each System:

1. Inspection of the methods and means employed to incorporate the System within the facility.
2. Verification of proper operation, from controlling devices to controlled devices.
3. Verification of proper adjustment, balance, and alignment of equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for each level control, and appropriately record these settings within the Record Documents.
4. Other tests on equipment or systems deemed appropriate.

F. In the event the need for further adjustment or work becomes evident during testing, the Contractor is to continue his work until the System is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications and any extension of the inspection and testing period is required, the contract price will be reduced for the additional time and expenses of the Owner, at the standard rate in effect at that time.

12. WARRANTY

A. Warrant labor and product for one (1) year following the date of substantial completion to be free of defects and deficiencies, and to conform to the drawings and specifications as to kind, quality, function, and characteristics. Repair or replace defects occurring in labor or product within the Warranty period without charge.

B. This warranty is in addition to any specific warranties issued by manufacturers for greater periods of time.

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C. Within the warranty period, answer service calls within eight hours, and correct the deficiency within twenty-four hours.

13. INSTRUCTION OF OWNER PERSONNEL

A. Training and Event Attendance Submittals:

1. All Operations and Maintenance manuals, as well as as-built drawings must be on site for all sessions of training.
2. Training and Event Attendance shall be submitted to Owner. Submittal shall:

a. Include a separate page/entry for every training session.
b. Indicate date, time, and approximate length of training session.
c. Indicate person(s) conducting training.
d. Indicate whether training will be video & audio recorded.
e. Intended curriculum and most appropriate attendees (e.g., engineer, operations, IT, etc.)
f. Include signature and title lines for

1) Owner acknowledging and accepting training schedule. Include both an accepted and rejected box. An alternate schedule time should be suggested by the Owner in the event the schedule is rejected.
2) Countersigning by trainer indicating that training actually occurred.
3) All persons attending training. Where attendees do not stay for the entire session, this should be noted on the form and initialed by Owner's representative attending training.
4) Owner's representative attending training at the end of the session shall initial that:

g. Training Occurred.
h. Training Materials were provided and left with owner
i. Training was not interrupted or shortened by equipment or system troubleshooting. It if is, then there should be a line where Owner and Contractor can indicate when make-up training will be provided and how long it should be.
j. Training was generally sufficient for the proposed curriculum.
k. Include notes section for Owner and Contractor to note any issues during training (areas requiring further development, etc.)

14. ALTERNATES

A. None.

2.PRODUCTS

1. ACCEPTABLE MANUFACTURERS

A. Model numbers and manufacturers included in this specification are listed to establish a standard of product quality.

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B. Other qualified manufacturers will be considered subject to prior approval of complete technical data, samples, and, if requested, results of independent testing laboratory tests of proposed equipment.

C. If proposed System includes equipment other than specified model numbers, submit a list of major items and their quantities, with a one-line schematic diagram for review.

D. Include a list of previously installed projects using proposed equipment that are similar in nature to specified System.

2. GENERAL

A. Product: New, free from defects and listed by UL or other acceptable testing agencies acceptable to local authorities with jurisdiction. Provide product of a given type from one manufacturer.

B. Regardless of the length or completeness of the descriptive paragraph herein, provide product complying with the specified manufacturer's published specifications.

C. Equipment supply voltage: 120 VAC, 60 Hz.

D. Equipment temperature limits: 0 to 40 degrees Centigrade.

E. Provide product not specifically specified commensurate with the quality and standards established by the specified product.

3. HEADEND

A. DTV Platform (DVP Type 1):

1. Modular platform with twelve (12) card slots .
2. NVX Chassis:

    a. One (1) Master controller (MC):
    b. Two (2) Power Supplies

3. SDI Encoder (SDI-ENC):

    a. Four (4) SDI inputs
    b. Up to 1080p 60 Resolution

4. HDMI Encoder (HDMI-ENC):

    a. Four (4) HDMI inputs
    b. Up to 1080p 60 Resolution

5. QAM Input Module (QAM-IM):

    a. Supports CableCARD Decryption
    b. Supports 24 Programs

6. QAM Output Module (QAM-OM):

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a. 32 QAM Output Channels
b. Supports PSIP Information

7. Acceptable Product:

a. Blonder Tongue NXG-System Kit 6799 with redundant power supply including the following:

1) NXG SDI-4HD Encoder
2) NXG HDMI4 Encoder
3) NXG-CCQD-24 QAM Input Module
4) NXG-32CH-QM QAM Output Module

B. Trunk Fiber Optic Transmitters (FO-TX Type 1):

1. Frequency range: 47 to 1,218MHz
2. Center Wavelength: 1310nm
3. Optical Launch Power: +6, +10, +13.5 & +15 dBm
4. Provide APC Fiber connectors for connections.
5. 1RU Rack Mountable
6. Acceptable product:

a. Blonder Tongue FIBT-1310 Series
b. Approved Equal

C. Fiber Optic Splitter (FO-SPL Type 1):

1. Center Wavelengths: 1310/1550nm
2. Bandpass: -40 to +40 nm
3. Split Ratios (1xN): 2, 4, 8, & 16
4. Provide APC Fiber connectors for connections
5. 1RU Rack Mountable
6. Acceptable Product:

a. Blonder Tongue FOC Series
b. Approved Equal

D. Video Monitor/Receiver (MON Type 1):

1. Provide EIA rack mounted 22" LCD color, cable ready unit with escutcheon and mount.
2. Mount TV on
3. Acceptable product:

a. LG Electronics 22LF454B-PU with Peerless Industries SA740P Articulating VESA Mount custom mounted to black Middle Atlantic steel folded edge rack panel.
b. Approved Equal

E. Custom Encoder Patch Panel:

1. Provide custom arrangement of connectors for use with the electronic equipment indicated on the drawings. Tielines between areas are to be handled by standard video & audio patch panel.
2. Acceptable product:

a. AVP Insulated Bulkhead system with appropriate connectors.

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4. DISTRIBUTION

A. Fiber Optic NODE Receiver (DTV NODE Type 1):

1. Provider fiber NODE receiver for the reception and conversion of fiber optic signals to coax for distribution.
2. Center Wavelength: 1310nm
3. Output +44 dBmV
4. Provide APC Fiber connectors for connections.
5. Provide with manufacturer recommended power supply.
6. Acceptable product:

a. Blonder Tongue FTTB-1218-L1W
b. Approved Equal

B. Wall Mount Fiber Optic Splice Enclosure (FO-SE):

1. Provide interconnect/termination box for fiber optic cabling.
2. Interconnect box to be wall mount.
3. Box to have internal cable-tie anchors, dust-proofing grommets, fiber management clips, and facilities to maintain proper cable bend radius.
4. Size box to allow for 50% spare capacity.
5. Provide APC adapter bezels for termination of dark fiber.
6. Provide factory made pigtail cable compatible with APC connectors.
7. Provide blank bezels for unused ports.
8. Acceptable product:

a. Interconnect Box: Panduit FWME12EBL Series
b. APC Adapter Panel: Panduit FAP6W APC series
c. APC fusion splice fiber pigtail
d. Approved Equal

5. SPLITTERS, COMBINERS AND PASSIVE DEVICES

A. The distribution components listed below cover 1000 MHz, Use is dependent on location within the system. Splitters & couplers are utilized in headend, local channel insertion and racks, multi-taps are utilized in NODE closets for distribution to drop taps.

B. Drop Outlet:

1. Provide self-terminating feed through type.
2. Housing: radiation proof.
3. Provide cover plate to match service receptacles and data network plates. Coordinate color and finish with architect.
4. Provide blanks in unused ports.
5. Provide connector assembly mounted on a 106 Duplex Module Frame sub plate.
6. Coordinate color of with architect.
7. Acceptable product:

a. Panduit CF1064 series frame
b. Panduit CMFSRxx self-terminating F-connector
c. Face Plate to match project power receptacles
d. Approved Equal

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C. Fixed Attenuator (PAD):

1. Provide as necessary to meet performance requirements.
2. Provide 10 spares of 3, 6, 10 and 20 dB values.
3. Acceptable product:

    a. Blonder Tongue FAM Series
    b. Approved Equal

D. DTV NODE Multi-Taps:

1. Modular multi-tap assembly.
2. Provide eight (8) port 1000 MHz directional taps.
3. Provide three (3) or six (6) tap plate capacity housings.
4. Tap value from 26 to 11.5 dB.
5. Terminate unused taps with 75 ohm terminator.
6. Acceptable product:

    a. Toner TXMT108-** Total Tap
    b. Toner TMXT-3H or TMXT-6H Housing
    c. Approved Equal

E. DTV Housing Terminator:

1. Provide at last multi-tap in each NODE.
2. Acceptable product:

    a. Toner GTR-KS-M
    b. Approved Equal

F. Fiber Attenuators:

1. Provide Fiber attenuators to match levels as required.
2. Provide each of the following dB values.

    a. 3, 6, 9, & 12 db.

3. Provide SC/APC connectors that match equipment, and as recommended by the manufacturer.
4. Acceptable product:

    a. Blonder Tongue FOPD-SC
    b. Approved Equal

6. STREAMING MEDIA

A. Streaming and Recording Appliance (SRA Type 1):

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1. Video Inputs: HDMI & SDI
2. Audio Inputs: HDMI Embedded, SDI Embedded & 2-Channel Analog
3. Video Codec: H.264/MPEG-4 Encoder
4. Video Formats: HD 720p, 1080i, 1080p & 2K
5. Video Encoding: 100 Kbps to 20 Mbps
6. Audio Encoding: 32 Kbps to 256 Kbps
7. Storage: USB & SD Card
8. Network Interface: 10/100/1000 Ethernet
9. Standard of Performance:

    a. AJA HELO
    b. Approved Equal

7. EQUIPMENT HOUSING AND ACCESSORIES

A. Equipment Rack:

1. Provide equipment rack constructed of 14 gauge cold-rolled steel.
2. Size: Racks to be standard EIA width, with 44 rack mounting units and 33” deep.
3. Door: Rack rear to have locking solid door. The front of the rack is to have NO door.
4. Provide end, top, and side panels as required to have an enclosed rack bank.
5. Color: Flat black.
6. Lighting: Provide a gooseneck LED work light per rack in a locally switchable fixture mounted in the top rear of each rack. The light is to have a 16” gooseneck and magnetic base.
7. Provide a minimum of one rack mounted multiple duplex 120vac receptacle front mounted power strip centrally located in the rack group for service and portable equipment power. Power strip is to have a power on and off switch available from the front. A minimum of one shall be provided.
8. Quantity: as shown on drawings and as required to house specified equipment.
9. It will be the responsibility of the RF television provider to coordinate with the broadcast replay provider to coordinate the exact style and model of equipment racks. These racks are installed in the same location and are interconnected.
10. Provide horizontal cable management tie-off bars to prevent cable sag as required.
11. Provide with rear mounting rails.
12. Acceptable products:

    a. Rack: Middle Atlantic Custom depth WRK-44-32
    b. Top Panel: Middle Atlantic Four unit top panel for fans
    c. Fan: Middle Atlantic Fan 4 ½ “. Provide 4 fans per cabinet
    d. Fan Guard: Middle Atlantic Guard for 4 ½” fan
    e. Side Panel: Middle Atlantic Custom side panels for 36” deep rack
    f. Door: Solid rear Middle Atlantic
    g. Riser Base: Middle Atlantic RIB-*
    h. Magnetic LED Work Light: Middle Atlantic LT-GN-WL
    i. Front Rack Mounted Power Strip: Tripp Lite RS 12-15-20
    j. Horizontal Tie-off bars: Middle Atlantic LBP1R4
    k. Heavy Duty Sliding Shelves: Middle Atlantic SS.
    l. Storage Drawer: Middle Atlantic UD-3
    m. Provide vertical tie-off bars.
    n. Approved Equal

B. Closure and Vent Panels:

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1. Provide EIA 19 inch wide panel constructed of 16-gauge cold-rolled steel with formed top and bottom.
2. Panel color to be a smooth finish semi-gloss black.
3. Acceptable product:

    a. Middle Atlantic VTF series vents & EB series blanks
    b. Approved Equal

C. Custom and/or Engraved Panels:

1. Provide EIA 19 inch wide panel constructed of 1/8 inch aluminum.
2. Finish: black anodize
3. Acceptable product:

    a. RCI AVD series
    b. Pro-Co Sound Products
    c. Approved Equal

D. Internal Electrical Rack Distribution:

1. Provide isolated ground 20amp receptacles.
2. Provide receptacles mounted in wire way for multiple circuits.
3. Provide junction box sized appropriately for service entrance and termination.
4. Provide quantity and lengths as required coordinated with rack size.
5. Provide with NEMA –20R (IG) outlets.
6. Acceptable product:

    a. Middle Atlantic PD-1020J-IG
    b. Approved Equal

8. CABLING AND ACCESSORIES

A. Drop Cable

1. Provide compliant with NEC type DTV.
2. Black jacket color, F6 Series type with copper clad center conductor.
3. Acceptable product;

    a. Belden 1189AP (plenum)
    b. Belden 1189A (non-plenum)
    c. Approved Equal

B. Head-end Cable

1. Provide compliant with NEC type DTV rating.
2. Black jacketed F59 Series with copper clad aluminum center conductor.
3. Velocity of propagation: at least 65 percent nominal.
4. Frequency attenuation at 60° F: less than 10.5 dB per 100 feet at 1000 MHz.
5. Acceptable product;

    a. CommScope F59 HEC-2 or equal
    b. Approved Equal

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C. Video Cable

1. Provide compliant with NEC type CM or CMP rating as applicable.
2. Blue jacketed with copper clad aluminum center conductor.
3. Velocity of propagation: at least 80 percent nominal
4. Provide Return Air Plenum cable when run outside of equipment racks in ceilings.
5. Frequency attenuation at 60° F: less than 1.0 dB per 100 feet at 10 MHz.
6. Acceptable product;

    a. Belden 1694A
    b. Approved Equal

D. Audio Cable

1. Provide compliant with NEC type CM rating.
2. Red jacketed, shielded twisted pair for line circuits.
3. Conductors: minimum 20 AWG tinned copper
4. Capacitance: less than 30 Pico farads per 100 feet
5. Provide Return Air Plenum cable when run outside of equipment racks in ceilings where required by NEC.
6. Acceptable product;

    a. West Penn 2454
    b. Belden.1266A
    c. Approved Equal

E. Control Cable

1. Provide compliant with NEC type CMP rating as applicable.
2. DC power cable: 12 AWG jacketed.
3. Control cables to be 18 AWG with overall shield and appropriate number of conductors and pairs required by manufacturer.
4. Acceptable product:

    a. Belden or equal
    b. West Penn.
    c. Approved Equal

F. DC Power Cable

1. Provide compliant with NEC rating for CL3P or CL2P plenum rating.
2. Jacketed, one pair unshielded for control power circuits.
3. Provide for extended distance.
4. Conductors; minimum 12 AWG & 14 AWG stranded copper
5. Larger cable shall be provided as required depending on distance and equipment requirements.
6. Acceptable product;

    a. West Penn 25227 and 25226 series
    b. Belden
    c. Approved Equal

G. Single-Mode Optical Fiber Cable: (For ceiling & areas not underground)

1. Provide compliant with NEC type OFNR and ONFP ratings as applicable.

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2. 9/125 single-mode compliant with Corning SMF-28.
3. Yellow jacket color.
4. Provide 6 strand multiple optical fiber cable runs to each NODE.
5. Armored Jacket
6. Acceptable product:

    a. CommScope P-006-0Z-8W-YL
    b. Approved Equal

H. Single-Mode Optical Fiber Cable: (For underground)

1. Provide compliant with NEC type ONFP ratings as applicable.
2. 9/125 single-mode compliant with Corning SMF-28.
3. Yellow jacket color.
4. Provide 6 strand multiple optical fiber cable runs to each NODE.
5. Armored Jacket
6. Acceptable product:

    a. CommScope P-006-OZ-8W-F-S-U-B-K
    b. Approved Equal

I. Fiber Optic Cable Inner Duct:

1. Provide duct compliant with NEC type OFNP rating where applicable.
2. Color orange.
3. Provide interconnect boxes and junction boxes as required for branch runs.
4. Trade Size: as required.
5. Acceptable product:

    a. Carlon
    b. Approved Equal

J. Fiber Optic Connector:

1. Provide commercial style APC, connections compatible with fiber equipment and where indicated on the plans.
2. Provide connectors recommended by the manufacturer for compatibility with equipment and mounting panels and sub plates.
3. Acceptable product.

    a. Belden
    b. Approved Equal

K. Fiber Optic Rack Mount Enclosure:

1. Provide interconnect/termination box for fiber optic cabling.
2. Interconnect box to be rack mounted.
3. Box to have internal cable-tie anchors, dust-proofing grommets, fiber management clips, and facilities to maintain proper cable bend radius.
4. Provide label designators for interconnect box.
5. Size box to allow for 50% spare capacity.
6. Provide APC adapter bezels for termination of fiber.
7. Provide blank bezels for unused ports.
8. Terminate and test all Fibers
9. Provide required patch cables to interconnect Fiber Transmitter.

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10. Acceptable product:

    a. Interconnect Box: Panduit FRME12EBL Series
    b. Adapter Panel: Panduit FAP6Wxx/APC
    c. Approved Equal

L. F Connector:

1. Provide commercial style gold plated connector with integral sleeve for F6 Series, F11 Series, and F59 Headend cable.
2. Provide seal ring in all moisture intensive environments.
3. Install with manufacturer recommended compression tool.
4. Provide weatherized boots and seal covers for all antenna connections.
5. Verify connector cable type, size, and construction with manufacturer.
6. Acceptable product:

    a. Gilbert Engineering GF-US-6Q series, GF-US-11Q, and GF-US-59Q series respectively
    b. Gilbert Engineering Seal ring: G-SR-1/2
    c. Approved Equal

M. BNC Connector:

1. Provide commercial style gold plated connector dual crimp type with 75 ohm impedance the complete length of the connector for video cable.
2. Body: nickel plated.
3. Acceptable product:

    a. ADC BNC series
    b. Kings 2065 series
    c. Approved Equal

N. XLR Connector:

1. Provide gold plated connector incorporating metal shells and bodies as required on audio cable.
2. Acceptable product:

    a. Neutrik NC Series
    b. Approved Equal

O. Adapters:

1. Provide commercial style KS adapter for multiple directional taps.
2. Acceptable product:

    a. Gilbert Engineering G-KS-KS-MG
    b. Approved Equal

P. Ground Block:

1. Provide commercial style F and KS ground block per NEC Articles 810 and 820 with no less than #12 AWG grounding conductor.
2. Acceptable product:

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a. Gilbert Engineering GGB-4U and G-SPB-GLU
b. Approved Equal

Q. Terminator:

1. Provide 75-ohm termination at unused ports.
2. Provide four spare “KS” type.
3. Provide 50 spare “F” type.
4. Acceptable product:

a. Gilbert Engineering GTR-M and GTR-59-DCB
b. Approved Equal

R. Tubing:

1. Provide heat shrink tubing on outdoor connectors
2. Acceptable product:

a. Gilbert Engineering GC-HST series
b. Approved Equal

3.EXECUTION

1. GENERAL

A. Coordinate incorporation of the Work specified herein with other project work so as to facilitate a cohesive final product.

B. The installation recommendations contained within ASDI and TDMM are mandatory minimum standards and requirements.

C. Mount equipment and enclosures plumb and level.

D. Permanently installed equipment to be firmly and safely held in place. Design equipment supports to support loads imposed with a safety factor of at least five.

2. INSTALLATION OF CABLE AND WIRING

A. Cabling and Wiring:

1. Provide cabling for audio, video and RF connections utilizing distinctive jacket color coding.
2. Bend radius and rigging calculations and restrictions.
3. Provide appropriate support at all horizontal-to-vertical transitions in order to keep the weight of the cable from degrading at the point of transition.
4. Provide splice free wiring and cabling from origination to destination.
5. Make joints and connections with rosin-core solder or with mechanical connectors approved by the Architect; where spade lugs are used, crimp properly with ratchet type tool.
6. Take precaution to prevent and guard against electromagnetic and electrostatic hum. For line-level audio signal, float cable shield at the output of source device. Shield not

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connected to be folded back over cable jacket and covered with heat-shrink tubing. Do not cut off unused shield.

7. Isolate cables and wires of different signals or different levels; and separate, organize, and route to restrict channel cross talk or feedback oscillation in compliance with ASDI article 12.3.
8. Cover edges of cable and wire pass-through holes in chassis, housings, boxes, etc., with rubber grommets or Brady GRNY nylon grommetting.
9. Install cable so that a radius bend of no less than ten times the cables OD is maintained.

B. Housing Cabling and Wiring:

1. Cabling and wiring entering equipment housings should connect via connector termination or terminal block equal to Cinch 140 -142 series.
2. Install terminal block fully exposed, labeled, and mounted on 3/4-inch plywood board painted flat black with fire retarding paint.
3. Install cable and wire neatly tied in manageable bundles with cable lengths cut to minimize excess cable slack but still allow for service and testing. Provide horizontal support bars if cable bundles sag.
4. Neatly bundle excess AC power cable from housing mounted equipment with plastic cable ties.
5. Provide plastic cable ties or lacing twine to bundle cabling and wiring. Electrical tape and adhesive backed cable tie anchors are not acceptable.
6. Install with connections completely visible and labeled.
7. Provide termination resistors of 5 per cent tolerance; fully visible and not concealed.

3. INSTALLATION OF CONNECTORS, PLATES & PANELS

A. Install panel mounted connectors rigidly attached to panels, plumb and level.

B. Custom rack panels shall be 1/8 inch thick aluminum, standard EIA sizes, brushed black anodized finish (brushed in direction of aluminum grain only), unless otherwise noted.

C. Custom connector plates are typically stainless steel, unless otherwise noted or specified. However, it is the Installer’s responsibility to verify plate finish with the Architect.

D. Install F-type connectors as recommended by manufacturer. Ensure the following: the connector is attached securely to cable, no strands of the braid are touching the center conductor, and the center conductor extends beyond the end of the connector approximately 1/8 inch.

E. Install XLR type connectors in accordance with IEC-268 standard, with a wiring scheme of pin 2 hot (high), pin 3 (low), and pin 1 screen (shield).

F. Patch panels wired so that signal “sources” (output from devices) appear on the upper row of a row pair and all “loads” (inputs to devices) appear on the lower row of a row pair.

4. INSTALLATION POWER AND GROUNDING

A. Coordinate final connection of power and ground wiring to housings.

B. Hardwire power wiring directly to internal AC receptacles to ensure uninterrupted operation.

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C. Provide 3-conductor, isolated ground, 120 VAC outlets as required within each housing plus two spare outlets.

D. Provide a copper ground buss top to bottom in each housing, insulated from the housing. Ground equipment chassis not having a three wire power cord to these busses using 6/32 nuts, bolts, and lock-washers with No. 12 wire. Connect green ground wire from each AC outlet in housing to this buss bar.

5. INSTALLATION OF ELECTRONIC EQUIPMENT

A. Take appropriate precautions against electrostatic discharge (ESD). Establish a personal ground before handling electronic equipment through the use of a grounded wrist wrap and/or an anti-static floor pad.

B. Take appropriate precautions to protect the equipment from damage during installation. Equipment to be installed free of damages, scratches, dents, etc.

C. Mount trim potentiometers, custom circuit cards, relays, and transformers (except large 70V units) in shielded enclosures and mark their function and connections with engraved lamicoid labels.

D. Mount equipment plumb and level, firmly and safely held in place.

6. INSTALLATION OF EQUIPMENT HOUSING

A. Equipment housing includes all equipment racks, turrets, and boxes etc.

B. Install equipment in housings, fully wire and test before delivery to job site.

C. Install mounted equipment with black number 10 button head machine screws with Allen drive.

D. Provide rear support for housing mounted equipment greater than 15 inches deep.

E. Provide blank panels or vents (as appropriate) to fill unused panel space within the equipment housing. These panels and/or vents are to be painted to match housing.

F. Key door locks for each housing type alike.

G. Looking at the racks and turrets from the rear, install AC power and ground on the left; and audio, video wiring on the right.

H. Do not block access to any front mounted components when mounting product on rear housing rails.

I. Provide shaft locks or security covers on non-user operated equipment having front panel controls. These panels are to be installed at the conclusion of testing.

7. LABELING OF EQUIPMENT

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A. Provide engraved lamicoid label adjacent to the front and rear of equipment mounted in housing and immediately adjacent to wall lining mounted components. Install in a plumb, level, and permanent manner. Provide rear mounted labels on equipment mounted in furniture console.

B. Provide typed label on each patch panel designating port signal. If patch panel is does not have labels provided, then provide on 80 pound paper stock utilizing 10 point block sans serif font.

C. Provide engraved label over each user-operated control that describes the function or purpose of the control. Adjust label size to fit available space.

D. Provide each terminal strip with a unique descriptor and a numerical designator for each terminal. Show terminal strip descriptor and designator on System schematic drawing.

E. Provide legible cable and wiring label permanently affixed for easy identification per the Cable Numbering Plan.

1. Labels on cables to be adhesive strip type covered with clear heat-shrink tubing. Factory stamped heat shrink tubing may be used in lieu of the adhesive strip style
2. Wiring designator to be an alpha-numeric code unique for each cable.
3. Locate the cable designator at the origination and destination of each circuit within 3 inches of the point of termination or connection. Provide cable designator on circuits with intermediate splice points with an additional suffix to indicate each segment.

8. ENGRAVING

A. Text font: 1/8 inch block sans serif characters unless noted otherwise.

B. On dark materials, provide white characters; on stainless steel or brushed natural aluminum plates, or light-colored materials, provide black characters.

C. Provide at least two lines of text with first line listing the general device name, e.g., amplifier. Second line to include schematic reference of the device, e.g., amp-1.

D. Equipment label: black with white characters except where indicated.

9. CONTRACTOR COMMISSIONING

A. Prior to energizing or testing the System ensure the following:

1. Products are installed in proper and safe manner according to manufacturer’s instructions.
2. Insulation and shrink tubing are present.
3. Dusts, debris, solder splatter, etc. is removed.
4. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
5. Labeling has been provided.
6. Temporary facilities and utilities have been properly disconnected, removed, and disposed of off-site.
7. Products are neat, clean, and unmarred and parts securely attached.
8. Broken work, including glass, raised flooring and supports, ceiling tiles and supports, walls, doors, etc. have been replaced or properly repaired, and debris cleaned up and discarded.

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B. Prior to energizing the System verify and perform the following tests and adjustments in compliance with applicable EIA standards.

1. Electronic devices are properly grounded.
2. Powered devices have AC power from the proper circuit and hot, neutral, and ground conductors are connected correctly.
3. Grounding System Tests:

    a. Measure and record the DC resistance between the technical ground in any equipment rack or console and the main building ground. Resistance should be at least 0.15 ohms or less.
    b. Temporarily lift the technical ground from the main electrical ground, measure and record the DC resistance between them. Resistance should be at least 1000 ohms.

4. Systems, equipment, and devices are in full and proper adjustment and operation, and properly labeled and identified.
5. Store extra materials, portable equipment, and spares at the premises as directed by the Architect.

C. Perform the following Headend tests and adjustments in compliance with NCTA Recommended Practices for Measurements on Cable Television Systems. Correct any technical deficiencies until the NCTA preferred performance objectives are accomplished.

1. Adjust, measure and record carrier frequencies for channels assigned utilizing the spectrum analyzer method. Provide ATSC (convention) channel number, QAM carrier frequency, digital sub-channel number, and virtual channel number.
2. Adjust the gain of each active device to provide optimum signal to noise ratio per the manufacturer's instruction.
3. QAM Measurements:

    a. Spectrum & digital average power level of each carrier
    b. Modulation Error Rate - MER
    c. Constellation display analysis - 256 QAM
    d. Gain Compression
    e. System Noise
    f. Phase Noise
    g. Coherent Interference Signal to noise ratio - SNR
    h. Carrier to noise ratio - CNR
    i. Bit Error rate - BER
    j. Tilt
    k. QAM Ingress (Ingress under the carrier)

4. Coherent Disturbance
5. Composite Second Order - CSO
6. Composite Triple Beat - CBT
7. Measure, record and correct any undesired disturbances utilizing a QAM signal level meter and spectrum analyzer. Include a written explanation within the report as to the nature of any uncorrected disturbance.
8. Measure and record any spurious signals.
9. Measure and record the audio and video input/output of each encoder/demodulator at the patch panel.
10. Perform a subjective evaluation of each channels picture quality with an HD television receiver connected to headend test outlet. Provide a system with no visible picture impairments.

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D. Perform the following distribution system tests and adjustments in compliance with NCTA Recommended Practices for Measurements on Cable Television Systems. Correct any technical deficiencies until the NCTA preferred performance objectives are accomplished.

1. Adjust the gain of each active device to provide optimum signal to noise ratio per the manufacturer's instruction.
2. Measure and record the third order distortion utilizing the CW carrier method at the output of any RF amplifier.
3. Measure and record the frequency response utilizing the standard broadband or slow sweep method at the headend source, multitaps, amplifiers of any NODE and each drop-service outlet. A NODE is a fiber optic receiver or distribution amplifier.
4. Measure and record the aural and visual carrier levels at the output of each amplifier and one television outlet of any multitap. Measure at channels 2 (54 MHz), 44 (342 MHz) and 117 (750 MHz). Temporary set three of the modulators to these channels and provide, simultaneously, an audio and video test signal.
5. Perform leakage test utilizing the spectrum analyzer method.
6. Measure and record the aural and visual carrier levels and temperature every four hours three times within the same day. Make this measurement at the last multitap of each fiber optic receiver or distribution amplifier.
7. Perform a subjective evaluation of the picture quality with a standard television receiver connected to each System outlet. Provide a System with no visible components of cross modulation, ghosting, or beat interference when the receiver is tuned to each of the distributed channels.
8. Measure and record the sub-band aural and visual carrier levels from the truck dock and from the portable system at the headend. Measure with signal originating at electrically the furthest and nearest drop outlet on each level of the building.

10. TEST EQUIPMENT

A. Equipment listed by manufacturer and model number establishes a standard of quality; other approved equal equipment will be acceptable.

B. Thirty days prior to start of testing, provide a list to the Architect of test equipment make, model numbers and calibration dates that will be used.

C. Furnish the following equipment. Equipment to be available for the entire test period through final System testing.

1. Signal level meter: Blonder Tongue BT-QAM-PRO
2. Multi-Meter: Fluke 87V
3. Variable Attenuator: JFW Industries 75TA-006 F
4. 75 ohm, 1 percent terminating resistors, impedance matching pads, traps, connection adapters, test cabling, etc., as required.
5. Ladders and scaffolding necessary to inspect multi-taps in cable trays and ceiling mounted junction boxes.

D. Provide two portable VHF or UHF business band radios for use during acceptance testing with transmission range sufficient to cover entire project.

1. Include rechargeable batteries and re-charger along with "holster" for wearing on belt.
2. Radios to be available for duration of testing process, including any follow-up visits required prior to final acceptance.

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END OF SECTION 271343

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SECTION 274116 – INTEGRATED AUDIO-VIDEO SYSTEMS AND EQUIPMENT

1.GENERAL

1. RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections apply to work of this section.

2. SUMMARY

A. The systems shall be called the “Sound System” and the installer, the “Sound System Installer”. Sound system equipment and installation including but not limited to:

1. Audio Mixers, Equalizers, Amplifiers, Program Sources, and other audio signal processing equipment.
2. Loudspeakers, custom enclosures and speaker mounting or support hardware.
3. Equipment Racks and portable cabinets.
4. Control Equipment.
5. Cables, connectors, plates and wiring.

B. Products Furnished but Not Installed Under This Section:

1. Loudspeaker backboxes - Installation provided under Division 16 - ELECTRICAL.

C. RELATED SECTIONS

1. Division 1.
2. Division ** - ELECTRICAL.

3. REFERENCES

A. Published specification standards, tests or recommended methods of trade, industry or governmental organizations apply to Work in this section where cited below:

1. National Electric Code (NEC).
2. National Electrical Manufacturer’s Association (NEMA).
3. American National Safety Institute (ANSI).
4. Underwriters Laboratories (UL).
5. American Society of Testing and Materials (ASTM).
6. Electronics Industries Association (E.I.A).
7. Davis and Davis, Sound System Engineering (3rd Edition), Howard W. Sams, 2006.
8. Giddings, Audio System - Design and Installation, (ASDI) Howard W. Sams, 1990.
9. ANSI/TIA/EIA-568-A-Commercial Building Telecommunications Cabling Standard. (October 1995).
10. Building Industry Consulting Service International (BICSI).
11. ANSI S4.48-1992.

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4. SYSTEM DESCRIPTION

A. Seating Bowl Speaker System

1. The loudspeaker system is expected to have a maximum sound level of 95 - 97 dBA, with a uniformity of coverage of ±2 dBA across the fixed seating. The frequency response of the system is expected to be at least 80 Hz to 12,000 Hz, ±3 dB.
2. The speaker system will consist of a group of speakers mounted at the front edge of the Canopy. These speakers will provide sound to the seating area from the field wall back toward the Concourse. An additional group of speakers is used to provide sound to the seating areas under the Suite Level. Speakers mounted on the outfield light poles provide sound to the “berm” seating.

B. Private Suites

1. The Private Suites will include a speaker to provide sound to the outdoor seating. This speaker will provide Stadium Program only.

C. Working Press Area

1. The working press area will be provided sound from standard 6-inch ceiling speakers. The volume level of these speakers will be controlled from a wall mounted panel in the press box. The Press Announcer position will allow announcements to the press area only. The microphone for the Press Announcer will be mounted on a desk stand and have a push to talk switch. An LED will illuminate when the microphone is active.

D. Audio Control Room

1. The audio control room is located on the press level and serves as the operational center of the audio system. The control room will be composed of an announcer's position and an operator's position. The operator will have a minimum 32-input digital mixing console to control the level of microphone inputs, and other program sources, such as digital media and audio feeds from game broadcasters.
2. A field panel will be surface mounted on the side wall of the Home Team dugout. This panel will allow the use of wired microphones, line level (i.e.; cassette deck) inputs sources and on-field monitor speakers. The field panel will be in an outdoor rated junction box with a hinged cover and snap latch.
3. The PA Announce microphone is a headset or boom arm microphone that includes a hand operated switch to unmute the microphone.

E. Broadcast Booths

1. Each of the broadcast booths will have a ceiling speaker and wall mounted volume control. This speaker will allow audio signals from the Working Press to be heard in the broadcast booth. Each booth will also have a panel with a line level output of the house sound system signal, as well as a tie line jack to allow the broadcasters' audio to be routed into the control room patch panel. An additional jack will allow access to the signal from a crowd microphone mounted under the canopy.

F. Equipment Room

1. The main amplifier racks shall be located in the Sound Equipment Room behind the Scoreboard Control Room. Equipment located in these racks will not require operator adjustment during events.

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5. SUBMITTALS

A. Provide submittals in accordance with Conditions of the Contract and Division 1, Submittal Procedures section unless otherwise indicated.

B. Supplementary submittal requirements:

1. Provide the following in one submission for approval within ninety days of issuance of Notice to Proceed (NTP) and prior to commencement of Work:

a. Complete schedule of submittals.
b. Chronological schedule of Work in bar chart form.
c. Manufacturer's Data Sheets:
d. Submissions that do not follow the format and configuration described will be returned without review.
e. Provide a complete table of contents with the following information:

1) Project title.
2) Submittal number. In the case of a resubmittal, use the original submittal number immediately followed by the suffix "R" immediately followed by a unique number and be numbered in consecutive order.
3) Date of submission.
4) Provide a list of and Manufacturer's data sheets on products to be incorporated with the Work. Arrange data sheets in the same order they appear in this specification. Where a data sheet shows more than one product, indicate the model being proposed with an arrow or other appropriate symbol.
5) Submit manufacturer's product literature for each type of firestop material to be used. Literature shall include documentation of UL classifications or approved third party testing. Manufacturer's name and number for each part shall be included. Submit drawings of through penetrations, which include the system to be utilized for the firestopping application. Drawing shall indicate construction of wall or floor assembly; size, number and material of penetrating items; firestop system designation; required F-rating, T-rating and remarks.
6) Provide high quality copies with all text legible and illustrations of adequate resolution and sharpness for review. Internet web pages, faxed copies or copies with portions of the information missing or smeared not acceptable.

f. Shop Drawings:
g. Schematic: Detailed wiring diagrams showing interconnection of components and products, wiring and cabling diagrams depicting cable types and cable designators, and device designators. Provide connector designations and terminal strip identification, along with color codes for cables connecting to these devices. Give each component a unique designator and use this designator consistently throughout the project.
h. Coordination Drawings:
i. Prepare and submit a set of coordination drawings showing major elements, components, and devices of the sound system in relationship with other building components. Prepare drawings to an accurate scale of 1/8"=1'-0" or larger on suitable sized media.
j. Prepare floor plans, reflected ceiling plans, elevations, sections, and details to conclusively coordinate and integrate all equipment. Indicate locations where space is limited, and where sequencing and coordination of installations is of

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importance to the efficient flow of the work including but not necessarily limited to the following:

1) Equipment housings
2) Ceiling and wall mounted devices
3) Raceways
4) Cabling

k. Equipment housing: Location of equipment in racks including electrical circuit distribution, consoles position on tables or counters. Details to include dimensions; wire routing and cabling within housings; electrical power outlet and terminal strip locations.
l. Patch panel layouts and labeling strips, including color schemes.
m. Full fabrication details of custom enclosure and millwork indicating size, material, finish and openings required for equipment and enclosures.
n. Structural rigging and mounting details:
o. Structural rigging and mounting details of all loudspeakers suspended from or mounted to the building structure: These drawings will identify all types of hardware, fittings and materials to be used. Detail the product manufacture, part numbers and load capacity of the hardware, fittings and materials selected. All loudspeaker structural rigging and mounting detail drawings shall be signed and sealed by a professional engineer licensed to practice in the State of Florida and will include a copy of the design calculations.
p. The signed and sealed drawings noted above to include the following:

1) Attachment method to building structure for suspended loudspeakers or mounting brackets.
2) Any secondary steel required for attachment to the building structure.
3) All fittings, hardware, materials, and cable used for suspended loudspeakers.
4) All custom brackets, mounts, suspension grids or trusses and loudspeaker cabinet frames or brackets not supplied by the manufacturer of the specific loudspeaker to be mounted or suspended.

q. Fabricated Plates and Panels: Provide complete drawings on custom fabricated plates or panels. Drawings shall include dimensioned locations of components, component types, engraving information, plate material and color, and bill of material. Provide samples of plate color options for Architect review and selection.
r. Labeling: Equipment and cabling labeling scheme. Include font sizes and styles, explanation of scheme, and designator schedule.
s. Schedules: Wiring schedule showing source and destination of wiring and indicating which wiring is in conduit. Junction box schedule showing type of box, size, mounting and location. Include this information with remainder of wiring diagrams.

C. Submittal format:

1. Consultant’s project documents in electronic format will not be supplied to the Contractor for their use as part of submittals.
2. Standards:

a. Floor plan drawings executed at an appropriate scale, not less than 1/8” = 1’-0”.
b. Detail drawings executed at an appropriate scale, not less than 3/8” = 1’-0”.
c. Plate and panel drawings executed at an appropriate scale, not less than 1/2” = 1”.

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d. Rack, enclosure, and millwork detail drawings executed at an appropriate scale, not less than 1” = 1’-0”.

3. Electronic Submittals: Submit in non-proprietary PDF format. Combine product literature into a single file for each Part 2 sub heading (ie: 2.3 Microphones and Accessories, 2.4 Input Sources, etc.). Shop drawings may be combined into logical sections such as legend, floor plan, section, detail, functional, etc.
4. Hardcopy Submittals: Bind submittal in titled three ring D style binders sized for 150 percent of the material. Maximum size: three inch spine. Use multiple volumes as required. Separate major grouping with labeled binder tabs.

D. Resubmission requirements:

1. Resubmissions to follow original submission number scheme with the additional suffix of –R001, -R002, etc.
2. Make all requested corrections or changes in submittals required. Resubmit for review until no exceptions are taken.
3. Indicate all drawing changes that have been made by clouding and noted with a revision marker. Drawing title block to track all revisions.
4. Also indicate all changes that have been made other than those requested.

6. QUALITY ASSURANCE

A. The Contractor shall be experienced in the provision of systems similar in complexity to those required for this project and meet the following requirements:

1. The primary business of contractor shall be the installation of sound and video systems.
2. No less than five years of experience with equipment and systems of the specified types.
3. Demonstrate experience with at least two projects of this type comparable scale within the last three years involving large scale audio / video systems.
4. Be a franchised dealer and service facility for the major products furnished.
5. Maintain a fully staffed and equipped service facility with full time field technicians. It is recommended that the installation team members have following Infocomm International certifications.

a. Project Manager: Certified Technology Specialist (CTS).
b. Project Engineer: Certified Technology Specialist-Design (CTS-D).
c. Field Supervisor: Certified Technology Specialist-Installation (CTS-I).

6. At the request of the Owner, the Contractor shall demonstrate:

a. Adequate plant and equipment to complete the work.
b. Adequate staff with commensurate technical experience.

B. Any other contractor who intends to bid this work as the prime contractor and does not meet the required qualifications shall employ the services of a single "Sound System Contractor" who does meet the requirements noted above and is approved by the Owner. This "Sound System Contractor" shall:

1. Furnish the equipment.
2. Shop fabricate the equipment racks and subassemblies.
3. Make audio, speaker and control connections to equipment racks, each piece of equipment, and connection panels.

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4. Provide continuous supervision of the installation and connections of cable and equipment.

C. Work shall be in compliance with the applicable standards listed above and all governing codes and regulations of the authorities having jurisdiction and the Contract Documents.

1. Drawings and specification requirements shall govern where they exceed Code and Regulation requirements.
2. Where requirements between governing Codes and Regulations vary, the more restrictive provision shall apply.
3. Nothing in the Contract Documents shall be construed as authority or permission to disregard or violate legal requirements.

D. Coordinate exact location and installation of equipment, power, conduit, and raceway systems with the Owner.

E. Manufacturer's Qualifications: At least 5 years' experience in production of specified products.

F. Installer's Qualifications: Firm experienced in installation of systems similar in complexity to those required for this project; and meet the following:

1. At least five years' experience with equipment and systems specified.
2. Experience with large scale sound reinforcement projects for arenas and stadiums within the last five years.
3. Be a franchised dealer and authorized service center for the major products specified. If the installer is not an authorized dealer for a major component, submit documents describing how equipment will be acquired, how warranty repair work will be provided and what arrangements have been made to provide replacement parts.
4. Maintain fully staffed and equipped service facility.
5. Provide evidence of experience in similar rigging projects or qualifications of proposed rigging subcontractor with appropriate experience.
6. Installer's firm shall be engaged in the full-time installation of permanent sound systems and shall derive at least 60 per cent of their revenue from these types of projects.
7. Current membership in National Systems Contractors Association.
8. Provide with bid, the name and relevant experience of the proposed project manager. Also provide the name and qualifications of the lead installer.
9. At the request of the Architect, the Installer shall demonstrate that he has:

    a. Adequate plant and equipment to complete the work within the agreed timetable.
    b. Adequate staff with commensurate technical experience.
    c. Suitable financial status to meet the obligations of the work.
    d. Completed current version of AIA Contractor's Qualification form.

G. Any other installer who intends to bid this work as prime contractor and does not meet the above qualifications, shall employ the services of a single "Sound & AV system installer" who does meet the requirements noted above. The "Sound & AV system contractor" shall:

1. Furnish the equipment.
2. Shop fabricate the equipment racks and subassemblies.
3. Make audio, speaker, AV and control connections to equipment racks, each piece of equipment, and connection panels.
4. Continuously supervise the installation and connections of cable and equipment.

7. DELIVERY, HANDLING AND STORAGE

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A. Delivery: Deliver products in original unopened packaging with legible manufacturer's identification.

B. Storage and Protection: Comply with manufacturer's recommendations.

1. Store in cool, dry place out of direct sunlight.
2. Protect from damage by elements and construction process.
3. Store at room temperature.

C. Provide protective covering during installation to prevent damage or entrance of foreign material.

8. WARRANTY

A. Contractor shall warrant equipment to be free of defects in materials and workmanship for two years following the date of the first regular season NFL game, trouble free operation, or substantial completion, whichever is later.

B. The system to be free of defects and deficiencies, and to conform to the drawings and specifications as to kind, quality, function, and characteristics. Repair or replace defects occurring in labor or materials within the Warranty period without charge.

C. Within the Warranty period, answer service calls within eight hours, and correct the problem within twenty-four hours.

D. This warranty shall not void specific warranties issued by manufacturers for greater periods of time, nor shall it void any rights guaranteed to the Owner by law.

E. Installing contractor to provide Owner with the name and telephone number of the person to call for service. This information to be part of Project Record Drawings.

F. Thirty days prior to the end of the warranty period provide a complete checkout of all system components. Repair or replace any defective equipment or transducers discovered during the testing. Correct any defects in wiring or other functional problems reported by Owner. Warranty replacement and service of equipment shall not apply to Owner furnished equipment. Coordinate inspection visit with the Owner.

G. Outdoor mounted speakers shall be warranted by the manufacturer or contractor to withstand the rigors of the environment and perform to the published specifications for at least five years after date of Substantial Completion.

2.PRODUCTS

1. ACCEPTABLE MANUFACTURERS

A. Model numbers and manufacturers included in this specification are listed as a standard of quality.

B. Other qualified manufacturers will be considered subject to approval of complete technical data, samples, and results of independent testing laboratory tests of proposed equipment, submitted in accordance with Project General Conditions.

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1. If proposed system includes equipment other than specified model numbers, submit a list of major items and their quantities, with a one-line schematic diagram for review.
2. Include a list of previously installed projects similar in nature to specified system.

2. GENERAL

A. Provide new equipment and materials which conform with applicable UL, CSA, or ANSI provisions. Take care during installation to prevent scratches, dents, chips, etc.

B. Equipment and materials shall be new and conform to applicable UL or ANSI provisions. Take care during installation to prevent scratches, dents, chips, etc.

C. Regardless of the length or completeness of the descriptive paragraph, each device shall meet published manufacturer's specifications. Verify performance as required.

D. Install rack mounted equipment with black 10-32 Phillips head machine screws.

E. All loudspeaker finishes are to be factory applied. Ceiling and wall mounted speaker grilles and enclosures to match the surrounding ceiling or wall color as directed by Architect.

F. Provide shaft locks or security covers on non-user operated equipment having front panel controls. Install covers at conclusion of Acceptance Testing.

G. Fabricate custom rack panels using 0.125-inch-thick aluminum, standard EIA sizes, brushed black anodized finish unless noted. (Brush in direction of aluminum grain only.) Custom connector plates (speaker, microphone, etc.) are typically stainless steel; however, Installer is responsible to verify plate finish with Architect. Plastic plates are not acceptable.

H. Engrave panel, plate and label engraving with 0.125-inch block sans serif character unless noted. On dark panels or pushbuttons, use white letters; use black letters on stainless steel or brushed natural aluminum.

I. For custom plates and panels or cable terminations use audio XLR type connectors with gold plated contacts.

J. Remove manufacturer's names, logos, or other symbols from speakers or other objects placed in public view. Protect speaker cones with silicone based moisture resistant treatment applied either at factory or at time of installation. Apply according to manufacturer's directions.

3. MICROPHONES AND ACCESSORIES

A. Page Microphone

1. Acceptable product:

   a. Astatic 631L (Quantity: 1).
   b. Shure 514B (Quantity: 1).

B. Crowd Microphone

1. "Parabolic" type microphone provided to pick up crowd and game noise.
2. Permanently mount microphone to suite level.

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a. Crystal Partners, Inc. Model BE4 (contact number 800-244-3277) (Quantity: 1).

C. Voice Microphones

1. Acceptable product:

a. AKG D7 (Quantity: 6).
b. Beyer TG-X 80 (Quantity: 6).

D. Announcer Microphone:

1. Desktop dynamic cardioid pattern
2. Acceptable Product:

a. ElectroVoice RE-27N/D w/ 309A shock mount
b. Approved Equivalent

E. Announcer Microphone Headset

1. Headset style dynamic microphone
2. Acceptable Product:

a. AKG HSC 271
b. Beyer DT280

F. Announcer Microphone Switch

1. Use as PTT for announcer microphone.
2. Acceptable Product:

a. Studio Technologies Model 210
b. Approved Equivalent.

G. Vocal Microphone: (Type 1)

1. Handheld dynamic cardioid pattern
2. Acceptable Product:

a. Audix OM6
b. Shure Beta58a
c. Approved Equivalent

H. Quad Wireless Microphone System (WRLS Type 4)

1. Receiver Type: Digital Wireless System with automatic switching diversity reception with XLR type audio output connectors.
2. Indicators: LED signal strength meters for battery, RF and audio levels.
3. Frequency: Coordinate with FCC and local requirements.
4. Antennas: Rear mount passive antennas for the frequency spectrum chosen.
5. 1-RU Rack mountable.
6. Acceptable product to include:

a. Shure: ULXD4Q Diversity Receiver
b. Shure: SBC800-US Battery Charger Base

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c. Shure: SB900 Lithium Ion Battery (Quantity: 4)
d. Shure: ULXD2/58 Handheld Transmitter (Quantity: 4)

I. Wireless Microphone Antenna (ANT-M)

1. Directional paddle style
2. Acceptable Product:

a. Shure UA874US

J. In Ear Monitors (IEM)

1. 72 MHz wide tuning range.
2. Networkable control from PC & Wireless Workbench.
3. Balanced audio inputs.
4. Switchable output power mW.
5. Include sound isolating earphones
6. Include Wireless bodypack receiver
7. Approved product:
8. Shure P9TRA425CL and the following:

a. Shure SB900 Battery (Quantity 4)
b. Shure PA421A antenna combiner

K. Microphone Stands

1. Reference loose equipment schedules for quantities
2. Provide the following items:

a. TYPE 1: Tripod-base floor stands, Black

1) Atlas T1930 w / PB11XEB
2) Approved Equivalent

b. TYPE 2: Boom Arm Long, Black

1) AtlasPB21XEB
2) Approved Equivalent

c. TYPE 3: Table Top stand, Black

1) Atlas SMS2B
2) Approved Equivalent

d. TYPE 4: Studio Boom Arm

1) Rode PSA1 Studio Boom Arm
2) Approved Equivalent

4. INPUT SOURCES

A. Media Player (MDP Type 1)

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1. Analog and outputs: RCA unbalanced.
2. Digital input and output: S/PDIF.
3. Frequency response: 20Hz to 20kHz ±1dB.
4. Converters: 24-bit A/D and D/A.
5. Sampling frequency: 44.1kHz.
6. Sample Rate Conversion: 32kHz – 48kHz.
7. 1-U Rack Mountable.
8. Bluetooth Receiver
9. USB & Aux input
10. Wireless Remote Control.
11. Acceptable product:

    a. Tascam CD-200SB
    b. Approved Equivalent

B. Media Recorder (MDR Type 1)

1. Analog inputs and outputs: RCA unbalanced, Balanced XLR
2. Digital input and output: S/PDIF, AES/EBU, Dante.
3. Media Format: SD, USB, CD
4. File Formats: CD, MP3, WAV
5. Stereo Record and Playback
6. Ethernet connectivity
7. 2-U Rack Mountable.
8. Wired Remote Control.
9. Acceptable product:

    a. Tascam SS-CDR250N to include the following:

        1) Tascam RC-SS150
        2) Tascam IF-DA2

    b. Approved Equivalent

C. HD AM-FM Tuner (TUNER)

1. HD radio reception capable
2. RF Tuning Range:

    a. AM: 520kHz to 1720kHz in 10kHz increments
    b. FM: 87.9MHz to 108.1 MHz in 200kHz increments

3. RF Useable Sensitivity:

    a. AM: 5dBf (0.9μV) 20dB SNR at 30% modulation
    b. FM: 5dBf (0.9μV) 30dB SNR at 100% modulation

4. RF Useable Input Range: 15μV to 30KμV, AM or FM
5. IF Rejection:

    a. AM: Greater than 100dB for 20dB SNR
    b. FM: Greater than 100dB for 30dB SNR

6. AF Bandwidth:

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a. AM: + 1dB 40Hz to 15kHz
b. FM: + 1dB 20Hz to 20kHz

7. AF THD+N: < 0.005% (digital audio)
8. Stereo Channel Separation: > 90dB (digital audio)
9. Provide antenna and all antenna distribution hardware, band separator, power supply, and cabling required
10. Acceptable product:

    a. DaySequerra M4.2Si with Pixel Model AFHD-4 Antenna Kit System
    b. Approved Equivalent

D. USB Sound Card (USB AUDIO)

1. Minimum 2 Chanel in/out
2. Operating System Level driver
3. Rackmount kit
4. Balanced in/out
5. Acceptable Product:

    a. Henry Engineering USB MatchBox II
    b. Approved Equivalent

E. Mono DI Box

1. Inputs for unbalanced line sources
2. Inputs shall be via ¼” receptacles
3. Line and mic level outputs
4. Ground lift switch
5. Acceptable Product:

    a. Whirlwind DIRECTOR
    b. Radial ProDI
    c. Approved Equivalent

F. Stereo DI Box

1. Inputs for stereo/dual mono unbalanced line sources
2. Inputs shall be via ¼”, RCA, 3.5mm receptacles
3. Line and mic level outputs
4. Ground lift switch
5. Acceptable Product:

    a. Whirlwind DIRECT2
    b. Radial ProAV2
    c. Approved Equivalent

G. Bluetooth Receiver Box

1. Receives Bluetooth audio
2. Outputs balanced stereo audio
3. Acceptable Product:

    a. Radial BT-PRO
    b. Approved Equivalent

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H. Bluetooth: (BT) (BT TX) (BT RX)

1. Bluetooth receiver
2. Customizable naming
3. Remote pairing activation
4. Bluetooth extension via CAT-5 cabling
5. Acceptable Product:

   a. QSC BT1
   b. Approved Equivalent

I. Message Repeater (MSG REPEATER):

1. Provided for recording and playing back of promotional messages and public service announcements.
2. Resolution: 24bit, 48 kHz Linear Recording.
3. S/N Ratio: 90dB.
4. 1000+ independent messages with instantaneous, random access of messages
5. Media Storage: PCMCIA or Flash memory cards with adapter.
6. Line and microphone inputs and line and speaker outputs.
7. Ethernet IP or Serial (RS-232) control, setup and audio file transfer.
8. Synchronization relay for sequencing applications.
9. Front mount LED indicators and manual controls for convenience in rack applications.
10. Acceptable product to include the following:

    a. Roland AR-3000SD
    b. SanDisk 8GB Ultra II SD Card

5. SIGNAL PROCESSING AND MIXING

A. Reinforcement Console (MIXER Type 1)

1. Digital audio mixing surface
2. Customizable motorized faders
3. Touch screen LCD
4. Local Analog and Digital IO
5. Digital Audio Network compatibility
6. Expansion Card Slots
7. Acceptable Product:

   a. Allen & Heath SQ6

      1) Dust Cover

   b. Soundcraft Vi1

      1) Dust Cover

   c. Yamaha QL-3

      1) Dust Cover
      2) Yamaha LA1L

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d. Approved Equivalent

6. DIGITAL SIGNAL PROCESSING (DSP) SYSTEM

A. Signal processing shall be performed by computer-based system.

B. The DSP system shall be fully operational 30 days prior to the first use of the installed system.

C. The system shall have the following capabilities:

1. Digital Signal Processing Unit: (DSP Type 1)

a. Unit to be at least eight in and eight out digital processing unit.
b. Interior configuration of signal flow and routing to be fully user configurable.
c. Unit to permit hardwire connection of external switches for recalling presets.
d. Unit to be able to be networked together for common computer control.
e. Unit to have no external user adjustable controls.
f. Provide fiber converters as shown on drawings for long runs between units.
g. Acceptable product:

1) QSC Q-SYS with analog Volume/Select Panels.
2) Biamp TESIRA with analog Volume/ Select Panels.
3) BSS SoundWeb with analog Volume/Select Panels.

2. Digital Signal Processing Unit: (DSP Type 2)

a. Unit to be configured for 4 inputs / 4 outputs
b. Ethernet connectivity
c. Proprietary digital audio transport
d. Acceptable product:

1) QSC Q-SYS IO8-FLEX
2) Biamp FORTE DAN VT4
3) BSS BLU-50

3. Digital Signal Processing Unit: (DSP Type 3)

a. Unit configured for analog control input
b. Acceptable Product:

1) QSC Q-SYS
2) Biamp
3) BSS BLU-GPX

D. Digital Signal Processing System Computer

1. The system shall have the following capabilities:

a. CPU: 4.0 GHz Intel® Core i7 processor.
b. Operating System: Microsoft Windows 10 Professional, 64-bit.
c. Enclosure/Case: 2-RU Rack Mountable.
d. Power supply: 400 watt.
e. Memory: 16 GB, DDR3 1600MHz.

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f. Internal Hard Disk 1: 500 GB. 7200RPM, SATA.
g. Internal Hard Disk 2: 500 GB. 7200RPM, SATA, fully redundant, mirrored, RAID 1.
h. Networking: Dual 10/100/1000 Mbps.
i. Blu-ray: Minimum of 12x recording speed. Include disc recording software.
j. Video: Dual Intel HD Graphics with DVI outputs.
k. Software to be included:

1) License all software to the owner.
2) Dante Controller (Dante systems only).
3) Dante Via (Dante systems only).
4) Dante Domain Manager Platinum (Dante systems only).

l. Warranty: Three-Year Onsite Warranty with 24/7 Phone and Next Business Day Service.
m. Computer system shall be completely tested by manufacturer prior to delivery.
n. Acceptable product:

1) Super Logics SL-2U-H81M-GD-DB (custom configured as above).

2. Software Setup:

a. Provide site specific programming of the DSP software.
b. Coordinate user interface, software functionality, and menu screens with Consultant.
c. Provide ongoing software upgrades and maintenance for 12 months from date of final acceptance.

1) Concourse/Restroom Systems:

a) The Restroom system is to provide sound to restroom facilities.
b) The Concourse system provides sound in the concourses.
c) The system is to typically play radio broadcast of game, but audio operator to be able to substitute alternate programs.
d) Program the system to use presets to allow rapid setup of standard configurations.

2) Press Level System:

a) The system is to provide sound to writing press seating on the press level.
b) The system is to typically be the writing press PA feed, but audio operator to be able to substitute alternate programs.
c) Program the system to use presets to allow rapid setup of standard configurations.

3) Priority Page:

a) To supplement the building fire alarm, the seating bowl system will be able to accept an audio and control signal from the alarm system.
b) Upon activation of the control signal, normal audio to all areas outside the seating bowl to be muted.
c) The seating bowl system will switch from the normal audio program to the special audio signal provided by the alarm system.
d) The sound system is to remain in this state until the control signal is restored to its normal state.

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e) While in the priority mode, an indicator light in the audio control room should provide a distinctive indication that normal programming has been overridden.

4) Club Systems

a) Provide playback of local music or remote audio feeds in addition to sound reinforcement from microphone receptacles in selected clubs.
b) The system will permit selection of any of the local or remote sources. Clubs with local microphone capability to have microphone and line inputs always “on” with only one remote or local program source to be selected at a time.
c) Provide approved and final DSP configuration files to Control System Vendor for use in developing final control system programming. Coordinate delivery schedule of files with Control System Vendor so as not to impact completion of Control system programming.
d) The system will respond to an alarm override closure from the alarm system and mute all of the audio outputs. At the completion of alarm override, the system will revert to previous operating mode and configuration.

d. Control Screens:

1) Each control screen is to be logically arranged for ease of operation. The basic graphical appearance should remain the same for all screens. Consistent terminology should be employed throughout. Utilize color backgrounds and other techniques to group similar functions. Include bitmap graphical elements where it will provide enhanced clarity. Screen functions described below may be combined when doing so will not create confusion or complexity.
2) Restroom System:

a) Provide for selection of one of four standard programs with system defaulting to radio.
b) Provide for volume adjustment with visual meter indication of volume.
c) Provide for saving and recalling of four stored configurations.

3) Pressbox System:

a) Provide for selection of one of four standard programs with system defaulting to PA.
b) Provide for volume adjustment with visual meter indication of volume.
c) Provide for saving and recalling of four stored configurations.

4) Miscellaneous Areas:

a) Provide for selection of one of four standard programs with the system defaulting to radio.
b) Provide for volume adjustment with visual meter indication of volume.
c) Provide for saving and recalling of four stored configurations.

5) Security:

a) Provide supervisor or higher password protection to all configuration screens not intended to be manipulated by regular operators.

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b) Each normal user must to have distinct password for logging system usage.

E. Keyboard/Video Monitor/Mouse (KVM)

1. 17” LCD screen, 1080p
2. 1 RU
3. HDMI/DVI inputs, HDCP Compliant
4. Touch pad pointing device
5. Full QWERTY Keyboard
6. Acceptable Product:

a. Middle Atlantic RM-KB-LCD17HD
b. Approved Equivalent

F. Volume/Select Panel (VS)

1. Analog volume and source select panel
2. Decora inserts
3. Color: White
4. Acceptable Product:

a. QSC Axon C1
b. BSS AC-V & AC-5S

7. AMPLIFIERS

A. General:

1. Two, Four, or Eight channel power amplifier with the EIA standard RS-490 power rating at 1% THD into 70-volt constant voltage load or 8-ohm load as applicable.
2. Provide protection of circuit components in the event of input over-drive, output overload, or short circuits.
3. Frequency response: ±1 dB, 20 Hz to 20 kHz with less than 1 per cent THD at rated output.
4. Input impedance: 10k ohm balanced.
5. Output regulation: 2 dB from no load to full load conditions.
6. Noise generation: at least 85 dB below rated output with input shorted.

B. Acceptable Products:

1. Type 1:

a. QSC CX-Q 2K4
b. Crown DCI 300 Series
c. Approved Equivalent

1) LEA
2) Linea
3) Lab Gruppen
4) Ashly
5) Yamaha

2. Type 2:

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a. QSC CX-Q 4K8 series
b. Crown DCI 600 Series
c. Approved Equivalent

1) LEA
2) Linea
3) Lab Gruppen
4) Ashly
5) Yamaha

3. Type 3:

a. QSC CX-Q 4K4 & 8K8 series
b. Crown DCI 1200 Series
c. Approved Equivalent

1) LEA
2) Linea
3) Lab Gruppen
4) Ashly
5) Yamaha

4. Type 4:

a. QSC CX-Q 8K4
b. Crown DCI 2400N Series
c. Approved Equivalent

1) LEA
2) Linea
3) Lab Gruppen
4) Ashly
5) Yamaha

8. POWER CONDITIONING

A. Power Protection:

1. Provide surge protection device to maintain clean power to the following equipment:

a. All DSP analog to digital converters.
b. All Fiber Transport system components.
c. All low level (mic or line) processing equipment with internal microprocessor or DSP chips.
d. All uninterruptible power supplies.

2. Acceptable product:

a. New Frontier Electronics Surge-X

B. Backup Power:

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1. Provide UPS systems to maintain power to all computer CPU's and associated video monitors.
2. Provide UPS systems to maintain power to all DSP units and DSP hubs.
3. UPS's shall be on-line style with sufficient battery reserve to operate for 15 minutes. Size each UPS unit for 25percent additional capacity.
4. Acceptable product:

    a. Powerware Series

9. POWER SEQUENCING SYSTEM

A. Provide system to sequentially power up or down the sound system mixing and processing equipment. System to be operated from the control room and to interface with equipment such as the console power supply, program sources, DA's, and non-DSP based signal processing equipment.

B. System to send a control signal to the main digital signal processing equipment to mute all outputs in the power down mode and to unmute outputs during power on mode. Initiate muting on DSP units prior to powering down the remainder of the sound system equipment. DSP units to unmute after all other sound equipment is powered up.

C. Powered speakers and power amplifiers used by ancillary systems to remain on when remainder of system is off.

D. A contact closure from the fire command station shall enable both systems if they are in a disabled state.

E. Insure that a power failure does not violate the provisions stated above.

F. Audible pops or clicks from the sound system in response to the power sequencing procedure or in the event of a power failure is not acceptable.

G. The computer monitors are not on a power sequencing system.

H. Coordinate installation of power sequencing system with Division 16.

I. Power sequencing equipment must maintain isolated ground system and be listed by a recognized safety testing agency.

J. Acceptable product manufacturers:

    1. Lowell.
    2. Middle Atlantic

10. SPEAKERS

11. LOUDSPEAKER RIGGING

A. Provide evidence of previous rigging experience of similar systems.

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B. Loudspeaker loads to be dead hung from structure/ light poles using a rigid mounting method. Use of wire rope/ cable is not acceptable.

C. Attachments to stadium structure to be approved by project Structural Engineer.

D. Rigging requirements: Safety factor employed in design to be not less than 5:1 except where noted.

1. Equipment shall be manufactured, installed, operated, and maintained in such a way that its safety and function is assured.
2. Equipment shall be inspected before the initial use, after any alterations to the operation or design of the system, and at regular intervals. Specialists in rigging equipment and installation shall conduct these inspections.
3. Operation, maintenance and repair work on rigging equipment shall be done by those persons having proper training and qualifications.
4. If rigging equipment is found to have defects which may result in personal injury or property damage, the equipment shall be declared unsafe, and rendered inoperative, until such time as the defect(s) have been corrected. Defect(s) in engineering or manufacturing shall be reported to the manufacturer who, in turn shall take corrective action.
5. Persons charged with operation of the rigging system shall be thoroughly instructed in the following and sign a statement indicating they have received instruction in the safe operation of the system:

    a. Operation and function of the equipment.
    b. Safe recommended use of the equipment.
    c. Necessary routine maintenance work for safe operation.
    d. Possible dangers during potential normal operation as well as increased danger potential during improper operation.
    e. Procedures during accidents and malfunctions.

6. A manufacturer's label or name shall be conspicuously and permanently attached to each piece of rigging equipment and hardware.

E. Contractor to retain services of Tennessee registered Structural Engineer to review and approve the rigging design. Cluster rigging submittals, including rigging/suspension elements, to include stamp of registered Structural Engineer, licensed to practice in the State of Tennessee.

1.02 LOOSE CABLES

A. Microphone/Instrument Cables:

1. Cable properties:

    a. Quad 24 gauge stranded with braided shield, flexible hard service jacket.
    b. Color: Black

2. Each cable to be provided with a Velcro style tie wrap.

    a. Minimum 5/8" width
    b. Length appropriate to wrap minimum 1.5 times around a cable loop of 14-inch diameter.
    c. Standard of performance:

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1) Rip-Tie CABLEWRAP

3. Microphone Cable:

a. Type 03 – 3 foot, with Brown collar on male connector
b. Type 06 – 6 foot, with White collar on male connector
c. Type 10 – 10 foot, with Red collar on male connector
d. Type 15 – 15 foot, with Orange collar on male connector
e. Type 20 – 20 foot, with Yellow collar on male connector
f. Type 25 – 25 foot, with Green collar on male connector
g. Type 30 – 30 foot, with Blue collar on male connector
h. Type 50 – 50 foot, with Violet collar on male connector
i. Type 100 – 100 foot, with Grey collar on male connector

4. Instrument Cable

a. Type 6 - 6 foot, 1/4-1/4
b. Type 10 – 10 foot, 1/4-1/4

5. Acceptable cable:

a. Whirlwind MKQ series
b. Canare StarQuad
c. ProCo AmeriQuad

B. Microphone Snake (Type 1):

6. 6 Channel
7. Male to Female XLR connectors
8. Acceptable Product:

a. WhirlwindUSA MS-6-0-NR-075
b. Approved Equivalent

C. Intercom Cables ETH:

9. Cable properties:

a. Color: Black
b. Neutrik Ethercon Connector
c. Rugged Tactical Jacket

10. Each cable to be provided with a Velcro style tie wrap.

a. Minimum 5/8” width
b. Length appropriate to wrap minimum 1.5 times around a cable loop of 14-inch diameter.
c. Standard of performance:

1) Rip-Tie CABLEWRAP

11. Intercom Cable:

a. Type 03 – 3 foot, with Brown collar on male connector

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b. Type 06 – 6 foot, with White collar on male connector
c. Type 10 – 10 foot, with Red collar on male connector
d. Type 15 – 15 foot, with Orange collar on male connector
e. Type 20 – 20 foot, with Yellow collar on male connector
f. Type 25 – 25 foot, with Green collar on male connector
g. Type 30 – 30 foot, with Blue collar on male connector
h. Type 50 – 50 foot, with Violet collar on male connector
i. Type 100 – 100 foot, with Grey collar on male connector

12. Acceptable cable:

a. ProCo ProCat
b. Approved Equivalent

D. Speaker Cables:

13. Cable properties:

a. Color: Black,
b. Connector: NL4 to NL4 or NL8 to NL8
c. Wire: 12 gauge stranded, SJ jacket.

14. Each cable to be provided with a Velcro style tie wrap.

a. Minimum 1” width
b. Length appropriate to wrap minimum 1.5 times around a cable loop of 14-18 inch diameter.
c. Standard of performance:

1) Rip-Tie CABLEWRAP

15. Speaker Cable:

a. Type 03 – 3 foot, with Brown collar on male connector
b. Type 06 – 6 foot, with White collar on male connector
c. Type 10 – 10 foot, with Red collar on male connector
d. Type 15 – 15 foot, with Orange collar on male connector
e. Type 20 – 20 foot, with Yellow collar on male connector
f. Type 25 – 25 foot, with Green collar on male connector
g. Type 30 – 30 foot, with Blue collar on male connector
h. Type 50 – 50 foot, with Violet collar on male connector
i. Type 100 – 100 foot, with Grey collar on male connector

16. Acceptable cable:

a. Whirlwind SK5 series
b. Approved Equivalent

E. Ethernet Audio Cables:

17. Cable properties:

a. Color: Black
b. Neutrik Ethercon Connector
c. Rugged Tactical Jacket

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18. Each cable to be provided with a Velcro style tie wrap.

    a. Minimum 5/8” width
    b. Length appropriate to wrap minimum 1.5 times around a cable loop of 14-inch diameter.
    c. Standard of performance:

        1) Rip-Tie CABLEWRAP

19. Ethernet Cable:

    a. Type 03 – 3 foot, with Brown collar on male connector
    b. Type 06 – 6 foot, with White collar on male connector
    c. Type 10 – 10 foot, with Red collar on male connector
    d. Type 15 – 15 foot, with Orange collar on male connector
    e. Type 20 – 20 foot, with Yellow collar on male connector
    f. Type 25 – 25 foot, with Green collar on male connector
    g. Type 30 – 30 foot, with Blue collar on male connector
    h. Type 50 – 50 foot, with Violet collar on male connector
    i. Type 100 – 100 foot, with Grey collar on male connector

20. Acceptable cable:

    a. ProCo ProCat
    b. Approved Equivalent

F. Power Extension Cables:

21. Cable properties:

    a. Color: Black
    b. 12-gauge, 3 conductor, stranded, flexible hard service jacket.

22. Each cable to be provided with a Velcro style tie wrap.

    a. Minimum 1” width
    b. Length appropriate to wrap minimum 1.5 times around a cable loop of 14-18 inch diameter.
    c. Standard of performance:

        1) Rip-Tie CABLEWRAP

23. Power Extension Cable:

    a. Type 06 – 6 foot
    b. Type 12 – 12 foot
    c. Type 25 – 25 foot
    d. Type 50 – 50 foot
    e. Type 100 – 100 foot

24. Acceptable cable:

    a. ProCo E-Cords series
    b. Approved Equivalent

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1.03 INSTALLED CABLING & WIRING

A. General

25. All electrical conductors installed under this contract, except where otherwise specified, shall be soft drawn annealed stranded copper having a conductivity of not less than 98% of pure copper, and meet appropriate ratings (e.g. CMR, CMP, etc.)
26. Cable shall carry appropriate fire rating (e.g. CMR, CMP, OFNR, OFNP, etc.) on jacket of cable.
27. Where cables are routed through cable tray, provide tray rated cable of equal specification.
28. Where speaker cables are run exposed through a return air plenum, provide plenum rated cable of equal specification.
29. Shielded cables located in raceways shall have aluminum foil shield with drain wire.
30. The Belden cables listed below are approved for use on this project and are listed to set the acceptable standard of performance. If field conditions or actual cable pathway requires tray or plenum cable, provide version of cable that meets required rating. Cables from West Penn, Windy City Wire, Liberty, Commscope and Gepco are also acceptable provided they meet the performance specifications of the approved listed cables.

B. Microphone/Line Level Wire

31. Provide shielded 22 AWG cable.
32. Cable to be PVC jacketed.
33. Jacket color: black.
34. Acceptable Product:

    a. Belden 9451

C. Production Intercom Wire

35. 18 AWG shielded
36. Cable capacitance to be less than 17 pF/ft
37. Acceptable Product:

    a. Belden 6340FT

D. Speaker Level Wire

38. For applications less than 600W and/or 600 feet
39. Provide 14 AWG cable.
40. Cable to be CL3R or CL2P rated.
41. Jacket color: gray.
42. Acceptable Product:

    a. Belden 5100UE

E. Speaker Level Wire

43. For applications less than 2400W and/or 1000 feet
44. Provide 12 AWG cable.
45. Cable to be CL3R or CL2P rated.
46. Jacket color: gray.
47. Acceptable Product:

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a. Belden 5000UE

F. Speaker Level Wire

48. For applications more than 2400W and/or 1000 feet
49. Provide 10 AWG cable.
50. Cable to be CL3R or CL2P rated.
51. Acceptable Product:

a. Belden 5T00UP

G. Category Cable

52. 23-gauge solid cable
53. Category 6+ Enhanced
54. 4 pair, UTP
55. Acceptable Product

a. Belden 2412F

H. Relay/Control Level Wire

56. Provide unshielded 22 AWG cable.
57. Cable to be CMR or CMP rated.
58. Provide number of conductors where required.
59. Acceptable Product:

a. Belden Cable

I. Wireless /Assisted Listening Antenna Cable

60. For applications less than 100 feet
61. 16-gauge, stranded center conductor
62. RG8/X
63. 95% braided shield
64. Acceptable Product:

a. Belden 9258

J. Wireless /Assisted Listening Antenna Cable

65. For applications between 100 and 400 feet
66. 10-gauge, stranded center conductor
67. RG8/U
68. 90% braided shield
69. Acceptable Product:

a. Belden 9913

K. HDMI Cable

70. Provide pre-molded cables in lengths as required
71. Acceptable Product:

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a. Extron Ultra Series HDMI Cable
b. Comprehensive Microflex Pro AV/IT 18Gbps

L. Digital Media Cable:

a. Acceptable Product:

1) Crestron DM-CBL-ULTRA-PC
2) Crestron DM-CBL-ULTRA-NP
3) Crestron DM-CBL-ULTRA-P (where necessary)

M. Fiber Uplink Cable:

72. Reefer to Division 27 10 00 specs.

12. PLATES AND PANELS

N. General

1. Provide plates and panels and as described in Drawings. Engrave as shown on Drawings. Other Plates and Panels may be required to satisfy the requirements of the Work.
2. Custom panels shall be 1/8-inch thick aluminum, standard EIA sizes, brushed, anodized finish unless otherwise noted. Brush in direction of aluminum grain only.
3. Plate finish shall be coordinated with the Owner. Plastic plates are not acceptable.
4. Panel, plate and label engraving shall be 1/8-inch block sans serif characters unless noted otherwise. On dark panels or pushbuttons, letters shall be white; on stainless steel or brushed natural aluminum pushbuttons, letters shall be black.

O. Custom and/or Engraved Panels:

5. Custom panels constructed of 1/8 inch brushed aluminum
6. Coordinate finishes with Owner
7. Acceptable Manufacturers:

a. PanelCrafters
b. EMG
c. RCI Custom
d. ProCo
e. Radial Engineering

B. Potentiometer:

1. Mount in plate as shown on Drawings.
2. Acceptable manufacturers:

a. Bourns.
b. Clarostat.

C. Autoformer:

1. Acceptable product:

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a. Atlas Soundolier AT-10, AT-35, or AT-100.

D. Knobs

1. Acceptable product:

a. Knob: Rogan PT-6-P with 1/4-inch brass bushing and set screw.

E. Wire Duct

1. Acceptable product:

a. Wiremold Series G4000.

F. Power Supply

1. Provided for lamp illumination and relay operation.
2. Type: 24-volt DC regulated.
3. Current rating: 2.5 amps.
4. Acceptable products:

a. FSR DC-24R-2.5.
b. Lambda LOS-X-24.
c. Power-Mate EMA-18/24CC.

G. Switches

1. Type 1: Illuminated alternate action:

a. Accepted product: EAO series 31 low level with multi chip LED light source.

2. Type 2: Illuminated momentary action:

a. Accepted product: EAO Series 31 snap action with multi chip LED light source.

3. Type 3: DPDT Toggle Switch with security cover.
4. Type 4: DP3T Toggle Switch (center off).
5. Type 5: 5-position, two pole rotary switch:

a. Acceptable product: CRL PA7023.

6. Type 6: 6-position, one pole rotary switch:

a. Acceptable product: CRL PA7007.

7. Type 7: 2-position, rotary switch, maintained:

a. Acceptable product: EAO Series 61.

H. Receptacles

1. Acceptable product:

a. Type XLR-3M:

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1) Neutrik NC3MD-L-1-B.

b. Type XLR-3F:

1) Neutrik NC3FD-L-1-B.

c. Type XLR-5M:

1) Neutrik NC5MD-L-1-B.

d. Type XLR-6M:

1) Neutrik NC6MD-L-1-B.

e. Type 1/4inch Phone:

1) Neutrik NJ3FP6C.

f. Type SPEAKON:

1) Neutrik NL4MP.

g. Type 1/4-inch Speaker:

1) Switchcraft Z15J.

h. Type BNC:

1) Canare BCJ-JRU.

i. Type NCJ:

1) Neutrik NCJ6FI-S.

j. Type RCA:

1) Switchcraft 3501FR with S-1028 and S-1029 insulating washers.

I. Plugs:

1. Accepted product:

a. Type XLR-3MP: Neutrik NC3MX-B.
b. Type XLR-3FP: Neutrik NC3FX-B.
c. Type TRS: Neutrik NP3C-B.
d. Type 1/4 inch: Neutrik NP2C-B.

J. Patch Panels:

1. Mount in Auxiliary Equipment rack.
2. Provide patch points as shown on functional diagrams.
3. Identification strips to be engraved lamacoid of assorted color for each major signal group.
4. Coordinate “normals” with Owner’s representative.

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5. Non-terminated inputs to be shorted through normalling contacts.
6. Provide one punch down tool and one replacement tip.
7. Acceptable product:

    a. ADC PPA3-14MKIV-N.O. and ADC impact tool and replacement tip.

K. Patch Cords:

1. Patch cords: 2 or 3 feet long with 2-conductor shielded plugs.
2. Provide different color cords for each cable length.
3. Provide patch cord holder.
4. Acceptable product:

    a. ADC R2 (Quantity: 12) and ADC G3 (Quantity: 12) and Audio Accessories 1/4-inch patch cord holder (Quantity: 1).

13. HEARING ASSISTANCE SYSTEM

A. Transmitter (ALT):

1. System to be used in Seating bowl area.
2. Frequency modulation type with maximum 80 millivolts per meter at 3 meters.
3. Input: balanced bridging, nominal level 10 millivolts to 1 volt, P-P maximum.
4. Displays: LED power indicator and LED VU meter.
5. Frequency response: 50 Hz to 15k Hz.
6. Controls: power on-off and individual mic and line level.
7. System to include receivers, earpiece, charger, antenna, placard.
8. Acceptable product:

    a. Listen Technologies LS-71-216.
    b. Approved Equivalent

B. Receiver:

1. Configuration: Single channel.
2. Frequency: 216 MHz.
3. Frequency agile to adjust various systems.
4. Receivers to be frequency adjustable for use in all venues.
5. Include an individual price for owner to purchase additional receivers.
6. Acceptable product:

    a. Listen LR-4200-216 Receiver (include each of the following):

        1) Listen LA-401 Ear Speaker
        2) Listen LA-402 Headset
        3) Listen LA-430 Neck Loop

14. MISCELLANEOUS EQUIPMENT

A. Floor Box (FB):

1. Minimum of 6 gang openings

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2. High Voltage divider
3. Acceptable Products

    a. Legrand Wiremold EFB6S
    b. FSR FL-500P
    c. Approved Equivalent

B. Equipment Racks: (ER-A, ER-AB)

1. Type: frame and panel with locking rear door.
2. Size: 30 inches deep with 77 inches of panel space.
3. Construction: factory assembled 16-gauge cold-rolled steel frames with all corners welded.
4. Top to be capable of mounting up to four 4-1/2” fans.
5. Mount racks on wood riser to isolate rack from floor.
6. Fill unused spaces with blank panels or vent panels.
7. Acceptable products:

    a. Middle Atlantic Products WRK-44-32 with SPN-44-312 side panels and MW-4FT top panel.
    b. Approved Equivalent

C. Equipment Racks: (ER-A, ER-AB)

1. Type: frame and panel with locking rear door.
2. Size: 27 inches deep with 41 RU of panel space.
3. Construction: factory assembled 16-gauge cold-rolled steel frames with all corners welded.
4. Top to be capable of mounting up to four 4-1/2” fans.
5. Mount racks on caster base to facilitate service in closet.
6. Fill unused spaces with blank panels or vent panels.
7. Acceptable products:

    a. Middle Atlantic Products BGR-41SA-27LRD.
    b. Approved Equivalent

D. Wall Mounted Equipment Rack: (ER-BC)

1. Constructed of 16-gauge cold-rolled steel.
2. Corners welded for rigidity.
3. Top to be capable of mounting up to four 4-1/2” fans.
4. Fill unused spaces with blank panels or vent panels.
5. Provide lockable front door.
6. Acceptable products:

    a. Middle Atlantic Products DWR-10-17 with lockable, perforated front door.
    b. Raxxess SWR-10-17 with lockable, perforated front door.

E. Ethernet Switch:

1. Multiple ports and transceiver slots for optional modules.
2. Auto sensing 10/100/1000 Base TX.
3. DANTE Compatible.
4. SNMP remote monitoring capability.
5. VLAN, spanning tree and meshing protocol capable.

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6. Hot swappable modules.
7. Provide 1000 BaseT fiber transceiver.
8. Acceptable product:

    a. Cisco SG300 Series.
    b. Approved Equivalent

F. Headphones:

1. Purpose: for private monitoring of console outputs and program sources.
2. Type: circumaural dynamic style with dual muffs.
3. Frequency response: 40 Hz to 20 kHz.
4. Impedance: 600 ohms.
5. Provide one pair of headphones.
6. Acceptable products:

    a. Beyer DT-250.
    b. Sony HDR-7506.

G. Transformers:

1. Frequency response ±0.25 dB, 20-20,000 Hz.
2. Maximum input level +18 dBv at 30 Hz and higher frequencies.
3. Magnetic and Faraday shield.
4. Acceptable products:

    a. 600:600 ohm: Bauer RE-11SSP-6M.
    b. 10k:600 ohm: Bauer RE-10KB-C.

3. EXECUTION

1. GENERAL

A. Coordinate work with other trades to avoid causing delays in construction schedule.

B. Mount equipment and enclosures plumb and square. Permanently installed equipment to be firmly and safely held in place. Design equipment supports to support loads imposed with a safety factor of at least three (five to one for loudspeaker mountings).

C. The process of acceptance testing the System may necessitate moving and adjusting certain component parts - e.g., loudspeakers. Provide for +5 degrees of adjustability from initial aiming angle and perform such adjustments without claim for additional payment.

D. Cover edges of cable pass-through holes in chassis, racks, boxes, etc., with rubber grommets or Brady GRNY nylon grommetting.

E. Speakers mounting in acoustical tile ceilings to be properly supported with tile bridges or other similar structural bracing.

F. AC Power and Grounding

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1. Coordinate final connection of power and ground wiring to racks. Hardwire power wiring directly to power contactors or internal AC receptacles to ensure uninterrupted operation.
2. Install 3-conductor, isolated ground, 120 VAC outlets in each rack. Provide a minimum of two spare outlets in each rack. Label each outlet as to which AC circuit is feeding it and provide the same information in the circuit breaker panel.
3. Install a 1 inch by 1/4-inch copper ground buss bar top to bottom in each rack, insulated from the rack. Ground equipment chassis not having a three-wire power cord to these busses using 6/32 nuts, bolts and lockwashers with No. 12 wire. Connect green ground wire from each AC outlet in rack to this buss bar.

G. Equipment Racks

1. Mount equipment in racks and consoles and fully wire and test before delivery to job site. If field conditions prevent prior assembly of racks, notify Consultant in writing that racks will be fabricated on site and the reasons for the change. Racks located on concrete floors in equipment rooms or non-finished spaces to mount on a 4-inch wood or concrete riser.
2. Provide ventilation adequate to keep temperature within the rack below 100 degrees Fahrenheit. Provide whisper type ventilation fan in each rack if temperature in rack rises above 100 degrees with power on for five continuous hours.
3. Looking at the rack from the rear, locate AC power, digital control, DC control, and speaker wiring on the left; microphone, line level audio, and video wiring on the right. Panels or equipment mounted near the rear of the rack shall not block access to any components or controls.

H. System Wiring

1. Take precautions to prevent and guard against electromagnetic and electrostatic hum. For line level audio signals, float cable shield at one end only. Maintain consistent shield connection for the entire project. Shields not connected to be folded back over cable jacket and covered with heat-shrink tubing. Do not cut off unused shields.
2. Exercise care in wiring; damaged cables or equipment will not be accepted. Isolate cables of different signals or different levels; and separate, organize, and route to restrict channel crosstalk or feedback oscillation in any amplifier section. Keep wiring separated into groups for microphone and line level circuits, loudspeaker circuits, and power circuits.
3. Make joints and connections with rosin-core solder or with mechanical connectors approved by the Architect; where spade lugs are used, crimp properly with ratchet type tool. Spade lugs mounted on 22 gauge or smaller cable to be soldered after crimping.
4. Speaker level wiring entering equipment racks should connect via terminal blocks (Cinch 140 - 142 Series); terminal blocks shall be fully exposed, labeled, and mounted on 3/4-inch plywood board painted flat black. If quantity of terminals is too numerous to fit in rack, terminal blocks may be located on wall mounted plywood terminal board adjacent to rack. Mounting boards to be 3/4-inch A/C grade or hardwood plywood painted flat black. Terminal board wiring to meet the same requirements as internal rack wiring described below.
5. Route unbroken microphone, audio line, and control wiring from receptacle plate/chassis to patch panel/rack. Remove spliced cables and replace without additional charge to the Owner.
6. Connect cable to active components through screw terminal connections and spade lugs whenever available. Make connections to speaker transformers with properly sized closed end connectors crimped with factory approved ratchet type tool. Wire nut or "Scotchlock" connectors are not acceptable. Do not wrap audio cable splices or connections with adhesive backed tape.

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7. Execute wiring in strict adherence to "standard broadcast practices," as excerpted from "Recommended Wiring Practices," Broadcast Audio Equipment for AM, FM, Television (5th Edition), Radio Corporation of America (RCA), Camden, N.J. 1962, and Appendix II, "Recommended Wiring Practices", Sound System Engineering, (2nd Edition), D. Davis, and performed in accordance with standard professional practice.
8. Run vertical wiring inside rack in properly sized plastic raceway with snap-on covers (Panduit Type E series). Mount raceways on full length 3/4-inch plywood backboards attached to rack sides. Horizontal wiring in rack to be neatly tied in manageable bundles with cable lengths cut to minimize excess cable slack but still allow for service and testing. Provide horizontal support bars if cable bundles sag. Neatly bundle excess AC power cable from rack mounted equipment with plastic cable ties. Rack wiring to be bundled with plastic cable ties or lacing twine. Electrical tape and adhesive backed cable tie anchors are not acceptable.
9. Connect loudspeakers electrically in phase, using the same wire color code for speaker wiring throughout the project.
10. Wiring and connections shall be completely visible and labeled in rack. Termination resistors shall be 1/2 watt 5 per cent tolerance; fully visible and not concealed within equipment or connectors.

I. Equipment and Cable Labeling

1. Provide engraved lamicoid labels on the front and rear of active equipment mounted in racks. Mount labels in a neat, plumb and permanent manner. Embossed labels are not acceptable. Equipment labels to have at least three lines of engraving with the first line listing the general name of the device, i.e., POWER AMPLIFIER or EQUALIZER. The second line to include the schematic reference of the device, i.e., PA-29A or EQ-3. The bottom line to indicate what other devices or areas this equipment controls, i.e., FEEDS HF-3&4 or FEEDS XOVER-3.
2. Provide an engraved label over each user-operated control that describes the function or purpose of the control. Label size to be adjusted to fit available space.
3. Engraved labels to have 1/8-inch-high characters typical. Labels to be black with white characters except where indicated.
4. Cables and wiring to be logically, legibly and permanently labeled for easy identification. Labels on cables to be adhesive strip type covered with clear heat-shrink tubing. Factory stamped heat shrink tubing may be used in lieu of the adhesive strip style label. Hand-written or self-laminating type labels not acceptable.
5. Wiring designations to be an alpha-numeric code that is unique for each cable. Locate the cable designation at the start and end of each cable run and within 3 inches of the point of termination or connection. For cable runs that have intermediate splice points at riser junction boxes, the cable shall have the same designation throughout with an additional suffix to indicate each segment of the run. Actual cable designation assignments to be determined by Contractor. Add cable designation codes to system schematic drawings included with Project Record Drawings.
6. Label each terminal strip with a unique identification code in addition to a numerical label (Cinch MS series) for each terminal. Show terminal strip codes on system schematic drawings included with Project Record Drawings.
7. Provide adhesive labels on the rear of equipment where cables attach to indicate the designation of the cable connected at that point.

J. Outdoor Mounting of Equipment

1. Objects mounted outdoors shall be properly treated for exposure to moisture and temperature extremes.
2. Use non-corrosive mounting hardware.

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3. Structural supports for speakers or other equipment to have inherent corrosion resistance or covered with a corrosion inhibiting layer.
4. Speaker components mounted in exterior environments to be rigidly connected to the structure to prevent movement caused by wind gusts.
5. Speaker enclosures to include grille capable of breaking up direct water sprays or rain.
6. Seal all electrical connections on speaker enclosure with waterproof sealant.
7. Treat paper cones of speakers with silicone based moisture repellent.
8. Provide screened cover over all openings in horn type speakers to keep out birds, insects, or small animals. Screened covering to be stretched taut with no visible wrinkles.

2. CONTRACTOR'S TESTS, SETUPS AND ADJUSTMENTS

A. Verify the following before beginning actual tests and adjustments on the system:

1. Electronic devices are properly grounded.
2. Powered devices have AC power from the proper circuit and hot, neutral, and ground conductors are connected correctly.
3. Insulation, and shrink tubing are present where required.
4. Dust, debris, solder splatter, etc. is removed.
5. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.

B. Grounding System Tests:

1. Measure and record the DC resistance between the technical ground in any equipment rack or console and the main building ground. Resistance should be at least 0.15 ohms or less.
2. Temporarily lift the technical ground from the main electrical ground, measure and record the DC resistance between them. Resistance should be at least 1000 ohms.

3. CONTRACTOR TESTING

A. Prior to energizing or testing the system, ensure the following:

1. All product is installed in a proper and safe manner per the manufacturer's instructions.
2. Insulation and shrink tubing are present where required.
3. Dust, debris, solder splatter, etc. is removed.
4. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
5. All labeling has been provided.
6. Temporary facilities and utilities have been properly disconnected, removed and disposed off-site.
7. All products are neat, clean and unmarred and parts securely attached.
8. All broken work, including glass, raised flooring and supports, ceiling tiles and supports, walls, doors, etc. have been replaced or properly repaired, and debris cleaned up and discarded.
9. Electronic devices are properly grounded.

B. Prior to energizing the system, perform the following tests in compliance with applicable EIA standards. Record the results of each test in the Project Record Manual and have a copy available for the Architect during inspection.

1. Test each AC power receptacle with a circuit checker for proper hot, neutral and ground connections.

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2. Measure and record the DC resistance between the technical ground in any equipment rack or console and the main building ground. Resistance should be 0.15 ohms or less.
3. Temporarily lift the technical ground from the main electrical ground, measure and record the DC resistance between them. Resistance should be 1000 ohms or greater.
4. Measure the impedance of each speaker line leaving the equipment racks. For full range devices, use a frequency of 1000 Hz, for band limited devices, use a frequency appropriate for the operating range of the transducer. When documenting the results of these tests, include the calculated impedances based on number of units on a line and the size and distance of the run. Correct any field readings that differ more than 20 per cent from the calculated impedances.

C. Speaker Circuit Verification Test

1. Provide a low level, distinctive test tone to each amplifier input.
2. Turn on one channel of Amplifier #1 and verify that the correct speaker or group of speakers is operating. Correct any wiring or other problems found.
3. In a similar manner, check each channel of all remaining amplifiers and their respective speaker circuits.
4. Include the results of the tests in the Project Record Manual.

D. 70 Volt Speaker Test

1. Play music, pink noise or other distinctive audio signal through each group of 70-volt speakers. Only one amplifier channel should be on at a time.
2. Walk the area covered by the speakers.
3. Verify that each speaker is operating and that there are no significant changes in volume level from one speaker to the next.
4. Verify that the extent of coverage is consistent with the areas indicated on the drawings.

E. Speaker Polarity Verification Test

1. Use an electronic polarity checker, SMAART PRO, SIM II, TEF machine or other similar device to test each reinforcement speaker. All speakers should have the same relative polarity.
2. Follow manufacturer’s recommendations in conducting the tests.
3. In a similar manner, check all distributed speakers to ensure they have the same polarity.
4. Include the results of the tests in the Project Record Manual.

F. System Gain Adjustment

1. Adjust each active device to have unity gain from the console output to the input of the crossover.
2. With all amplifiers turned off, connect a sine wave or pink noise generator to the input of the console. Using a RMS AC voltmeter with a dB scale, adjust the console to an output between -10 and 0 dBu. Once the level has been established, it should remain unchanged throughout the test. All equalizers should be set flat for this test.
3. Follow the signal flow from the console to each subsequent component. Measure the input level and output level of each device at the point of connection to the device. The input level reading should differ no more than 0.25 dB from the level recorded for the preceding device. Diagnose and correct the wiring or equipment when any readings that exceed this range.
4. Adjust the output of each component to match the reference level coming from the console. Output level should differ no more than 0.5 dB from the console output level.
5. Record the output levels of each device on the Project Record Drawings.

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G. Signal Delay Adjustment

1. Adjust the delay to each subsystem to ensure proper synchronization between the main speakers and the local, delayed speakers.
2. Using SMAART PRO, SIM II, TEF 20 or other acceptable time-based measurement system, measure the arrival time of the distant signal and then measure the arrival of the local signal.
3. Based on the arrival times measured, adjust the delay applied to the local speakers to synchronize them with the distant speakers. Repeat the test to verify the delay has been set to within 1 ms of the arrival of the distant signal.
4. Continue to test and adjust each separate subsystem with a dedicated delay channel.
5. Provide hard-copy printout of each delay adjustment showing first the arrival times with no delay set and then the result after the delay has been adjusted. Record the settings of each delay in the Project Record Manual.

H. Speaker Driver Alignment

1. Adjust the delay to each speaker cabinet component to ensure proper synchronization between speaker cabinet components.
2. Using SMAART PRO, SIM II, TEF 20 or other acceptable time-based measurement system, measure the arrival time of each speaker component.
3. Based on the arrival times measured, adjust the delay applied to each speaker component to synchronize them. Repeat the test to verify the delay has been set to within 1 ms of the arrival.
4. Provide hard-copy printout of each delay adjustment showing first the arrival times with no delay set and then the result after the delay has been adjusted. Record the settings of each delay in the Project Record Manual.

I. Amplifier Level Adjustment - Main Reinforcement System

1. Adjust the gain of each amplifier to provide a consistent and appropriate volume level throughout the facility.
2. Begin by connecting a pink noise source to one input of the mixing console. Adjust the console output to -10 dB on the VU meter.
3. Using one or a small group of upper level reinforcement speakers, adjust the appropriate amplifiers to achieve 85 dBA in the area covered by the speakers. Use a calibrated sound level meter to make the measurement.
4. If the test group of speakers employs an active crossover, use a Ivie IE-30, TEF 20, SMAART PRO or SIM II to balance the spectrum by adjusting the amplifier for each band.
5. Once the initial speakers have been properly adjusted, begin adding the speakers in each adjacent area and repeating the same adjustments.
6. When a given area or seating level has been completed, move to the next lower area and repeat the tests and adjustments for that area.
7. Amplifier settings for speakers covering similar seating areas should have the same gain settings. Investigate and correct any occurrences where an amplifier deviates more than 2 dB from the average.
8. Amplifiers should be set to provide an average of 85 dBA ±1.5 dB throughout each seating section. Coverage at 4 kHz should be no more than ±2 dB.
9. Record the setting of each amplifier in the Project Record Manual and keep backup copies of the data file on disk.

J. Amplifier Level Adjustment - 70 Volt Systems

1. Adjust the level of exterior suite speakers to match the rest of the reinforcement system.

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2. Adjust the level of the individual concourses which are open to the reinforcement system to a maximum 90 dBA when the mixing console is operating at 0 VU. Volume controls and compressors should be bypassed for this setup.
3. Adjust the level of individual concourses which are not open to the reinforcement system to a maximum level of 80 dBA when the mixing console is operating at 0 VU. Volume controls and compressors should be bypassed for this setup.
4. Adjust the level of other 70-volt systems to achieve a volume level appropriate for their location and intended use.
5. After setting the amplifier level for each system, play a pink noise signal over the speakers and walk through each area. Using a sound level meter, identify any areas where the SPL changes by more than 3 dB. Identify the cause of the change and where it is due to mounting height or architectural differences, adjust the transformer taps of the affected speakers to bring the sound level within range.

K. Headroom Verification Test

1. Once the preceding tests and adjustments have been completed, play a variety of musical programs through the system.
2. Adjust the console gain to achieve peak output levels of +6 VU on the console meters.
3. Observe if any of the components indicate clipping or less than 3 dB of headroom.
4. Replace the musical program with a steady 1000 Hz sine wave. Connect an oscilloscope or similar device to selected amplifiers in each portion of the reinforcement system.
5. Increase the output level of the console until the signal displayed on the oscilloscope begins to show distortion. Record the dB level of the signal from the console and which component in the chain is creating the distortion in the Project Record Manual.

L. Remote Input Verification Test

1. Using a microphone or portable signal generator, connect to each microphone receptacle throughout the facility.
2. Verify that the receptacle under test appears at the correct position on the patch bay and is operating properly.
3. In a similar manner, check all remote tielines and media related lines for correct wiring and labeling.

M. Emergency Bypass Test

1. Coordinate test with Fire Alarm System installer.
2. Simulate a fire alarm override signal from the fire control panel.
3. Verify that all necessary mixers and related components have recognized the signal and switched to their bypassed mode.
4. Verify that the computer control system recognizes the fire alarm signal and provides the appropriate commands to the amplifiers and other related components.
5. Verify that all locally controlled volume controls have either been bypassed or switched to their minimum attenuation mode.
6. Verify that the audio input line assigned to the fire alarm system does play throughout all designated portions of the sound system.
7. Verify that the emergency page microphone in the security room will override the program from the mixing console, but the fire alarm signal will override the security microphone.
8. Verify that all indicators associated with the emergency bypass system correctly display the current status of the system.

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N. When all the above tests have been completed and the system is ready for inspection, formally notify the Architect. Include in this notice copies of all data recorded, date each test was completed and the results of each test.

4. TEST EQUIPMENT

A. Provide the following equipment on site for final acceptance testing. Test equipment to be available for the entire period through final system acceptance unless noted. Prior to start of testing, provide a list to the Owner of test equipment make and model numbers that will be used.

1. Dual-trace oscilloscope - 100 MHz bandwidth, 1 mV/cm sensitivity.
2. Sound Level Meter: ANSI S1.4-1971 Type S1A with digital or analog display. Meter to provide ranges of 40 to 120 dBA.
3. Pink Noise Source - Equal energy per octave bandwidth 20 Hz to 20,000 Hz, +1 dB (long-term average) at 0 dBm output. Stability: +2 dB per day.
4. Impedance Meter - Capable of testing audio lines at three frequencies, minimum, between 250 Hz and 4k Hz. Measurement Range: 1 ohm to 100 kohms.
5. Multimeter - Measurement range, DC to 20k Hz, 100 mV to 300 V, 10 mA to 10 A.
6. Audio Oscillator: bandwidth 20 Hz to 20k Hz +1 dB at 0 dBm output. Output to be balanced. Oscillator to include adjustable output level.
7. Ladders and scaffolding necessary to inspect ceiling mounted speakers or clusters.
8. Twenty-five 620 ohm, 1/4 watt, 5 per cent resistors.

5. ACCEPTANCE

A. Acceptance testing will include operation of each major system and any other components deemed necessary. Contractor will assist in this testing and provide required test equipment. Contractor shall provide at least two technicians familiar with installation, available for the entire testing period (day and night), to assist in tests, adjustments, and final modifications. Tools and material required to make any necessary repairs, corrections, or adjustments shall be furnished by the Contractor.

B. Provide three portable VHF business band radios (Motorola HT600 type) for use during acceptance testing. Radios should have a transmission range sufficient to cover entire project. Radios to include rechargeable batteries and recharger along with "holster" for wearing on belt. Radios to be available for duration of testing process, including any follow-up visits required prior to final acceptance. Confirm that radio frequencies used are not in use elsewhere on project site.

C. Temporarily relocate the equalizer for each sub-system to the respective seating area controlled by the equalizer to permit adjustments to be made while listening to the speaker response. Extension cables to be terminated with 4.7k ohm resistors.

D. The following procedures will be performed by the Architect on each System:

1. Audio fidelity test: drive the system with pink noise and measure the frequency response in each 1/3 octave band from 40 Hz to 16k Hz. Use 2/3 Octave, 1/3 octave, or parametric filters to adjust the response of the system (s) to fit the requirements of the space.
2. Control functions shall be checked for proper operation, from controlling devices to controlled devices.

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3. Adjust, balance, and align equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for each level control, and record these settings, in the "System Operation and Maintenance Manual".
4. Installed and loose equipment will be inventoried for correct quantity.
5. Any other test on any piece of equipment or system deemed appropriate.

E. In the event the need for further adjustment or work becomes evident during equalization or acceptance testing, the Contractor will continue his work until the system is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications, the Contractor will pay for additional time and expenses of the Architect at the Architect's standard rate in effect at that time, during any extension of the acceptance testing period.

6. INSTRUCTION OF OWNER PERSONNEL

A. Provide six hours instruction to Owner designated personnel on the use and operation of the System, scheduled as two separate sessions, by an instructor fully knowledgeable and qualified in system operation. The System Reference Manuals should be complete and on site at the time of this instruction.

B. Be present at the first three formal uses of the system.

END SECTION 274116

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SECTION 274143 - INSTALLATION OF TELEVISION DISPLAYS & MOUNTS

1.GENERAL

1. SECTION INCLUDES

A. Coordination, provision, installation, commissioning, testing, instruction, and warranties for TV display systems. Provide plant, materials, equipment, transport, and labor necessary to accomplish this and have a complete and proper System.

B. Also includes:

1. Required licenses and permits including payment of charges and fees.
2. Verification of dimensions and conditions.
3. Provision of submissions.
4. Installation in accordance with the contract document, manufacturer's recommendation, and in conformity with applicable codes and authority having jurisdiction.
5. Distribution of electrical service, including ground, to the installed devices.

2. RELATED WORK

A. General Conditions:

1. As provided by the Owner as well as conditions contained in these technical documents.

B. Provision of electrical power and infrastructure per electrical documents.

3. REFERENCES

A. Published specification standards, tests or recommended methods of trade, industry or governmental organizations apply to Work in this section where cited below:

1. American with Disabilities Act (ADA)
2. American National Safety Institute (ANSI)
3. American Society of Testing and Materials (ASTM)
4. Building Industry Consulting Service International (BICSI)
5. BICSI’s Telecommunications Distribution Methods Manual (TDMM)
6. Electronics Industries Association (EIA)
7. Federal Communications Commission (FCC)
8. Institute of Electrical and Electronic Engineers (IEEE)
9. National Electrical Manufacturer’s Association (NEMA)
10. National Electrical Code (NEC)
11. Telecommunications Industries Association (TIA)
12. Underwriters Laboratories (UL)

4. DESCRIPTIONS AND REQUIREMENTS

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A. The following is intended to further describe the Work and clarify design and project intent and is not an exhaustive description of the television display system. Refer to the Electronic Systems ("AV" series) drawings and the TV Schedule for further information relating to this Section.

B. Displays and Mounts:

1. Install the displays and mounts specified within.
2. Confirm with the Owner and Architect that all display mounting conditions are ADA compliant. Where the specified mount is found to be non-ADA compliant provide recommendations for an alternate compliant mount.
3. For each display connected to the Distributed Television System provide:

   a. RG6 cable between the wall outlet the TV Display
   b. All cables must be kept concealed from view. Provide covering for mounts to conceal cable where possible.

4. Provide the manufacturer's remote control supplied with the display for control.

C. Owner Furnished Contractor Installed Equipment (OFCI):

1. The owner reserves the right to provide TV displays and mounts from existing stock and/or to provide on a direct basis.

D. Contractor Commissioning:

1. It is the intent that the Contractor provides a complete and working system free of defects. All systems and connections described must be verified to be in operational order as intended.

5. RESPONSIBILITY AND RELATED WORK

A. Coordinate exact location and installation of equipment and schedule work with other trades and stadium project managers.

B. Refer to the bid forms and contractual requirements listed in the bid package as provided by the Owner. The project will be priced in separate phases with individual pricing as well. The general conditions outlined in these technical documents are to be considered complimentary to those listed in the Owner documents. In the event of a conflict, the most stringent will apply.

C. Conduit, wire ways, pull boxes, junction boxes, and AC power circuits and ground wiring are defined elsewhere.

D. Supply accessories and minor equipment items needed for a complete system, even if not specifically mentioned in these Specifications, without claim for additional payment. The Contractor is responsible for providing all components necessary for complete and operational system. Any system changes or revisions necessary to make the system conform to the building, walls, steel, electrical services etc., shall be included at time of bid and installed without claims for additional compensation.

E. The Owner reserves the right to make reasonable device and equipment location changes prior to rough installation without claim for additional expense.

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F. Notwithstanding any detailed information in the Contract Documents, it is the responsibility of this Contractor to supply systems in full working order. Notify the appropriate design professionals and Owner of any discrepancies in part numbers or quantities before bid. Failing to provide such notification requires this Contractor to supply items and quantities according to the intent of the Specifications without claim for additional payment.

G. Obtain permits necessary for the execution of any work pertaining to the installation, or any operation by the Owner including any associated charges or fees.

H. Execute work in accordance with the National Electrical Code, the National Electrical Safety Code, and applicable State and Local codes, ordinances, and regulations. If a conflict develops between the contract document and the appropriate codes and is reported to the appropriate design professional and Owner representative prior to bid opening, the design professional and Owner representative will prepare the necessary clarification. Where a conflict is reported after contract award, propose a resolution of the conflict and, upon approval, perform work.

6. QUALITY ASSURANCE

A. Contractor’s Qualifications: Firm experienced in the provision of systems similar in complexity to those required for this project; and meet the following:

1. No less than three (3) years’ experience with equipment and systems of the specified types.
2. Experience with at least three (3) comparable scale projects within the last two years.
3. Be a franchised dealer and service facility for the manufacturer’s products furnished.
4. Maintain a fully staffed and equipped service facility.
5. At the request of the design professionals and Owner Representative, demonstrate that:

   a. Adequate plant and equipment is available to complete the work.
   b. Adequate staff with commensurate technical experience is available.

B. Manufacturer's Qualifications: No less than five (5) years continuous experience in the production of specified types of product. Production based on applicable NEMA standards.

C. Work: Perform Work in compliance with the applicable standards listed herein and governing codes and regulations of the authorities having jurisdiction and the Contract Documents.

1. Drawings and specification requirements govern where they exceed Code and Regulation requirements.
2. Where requirements between governing Codes and Regulations vary, the more restrictive provision applies.
3. Nothing in the Contract Documents grants authority or permission to disregard or violate any legal requirements.

7. SUBMITTALS

A. The submittal information required by the specification is to be presented complete. Cost for the Owner's consultant to review secondary and re-submittals due to the Contractor's failure to include required submittal information, or rejection of incomplete or improperly prepared submittal information will be the responsibility of the Contractor.

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1. Refer to the bid documents for project completion requirements. Due to the time frame of the project, it is important for the Contractor to be prepared to provide the required documentation and be prepared to proceed once approved by the Owner.

B. Provide for approval no later than fourteen (14) days after issuance of Notice to Proceed and prior to commencement of Work:

1. A complete schedule of submittals.

C. Provide for approval no later than twenty-one (21) days after issuance of Notice to Proceed and in accordance with previously submitted submittal schedule.

1. Section 1: Complete list of products to be incorporated within the Work.
2. Section 2: Manufacturer's data sheets for each product.

    a. Provide original manufacturer's data sheets in order as they appear in the specification. These data sheets are submitted for each product in sufficient detail to facilitate proper evaluation to the product suitability for incorporation within the Work.

3. Section 3: Samples of cable types proposed with representative labeling.

D. Provide for approval no later than fourteen (14) days after notice to proceed:

1. Provide drawings created with CAD software such as AutoCAD using standard industry graphic standards.
2. Provide installing drawings showing special details depicting methods and means specific to each product, assembly and each product manufacturer's recommended installation methods and means.
3. Provide point-to-point schematic drawings detailing inter-component and intra-component, on contractor-assembled components, manufactured product connections or fabricated products, wiring and cabling diagram depicting cable types, designator, and color codes.
4. Provide detail drawings depicting any unique installation methods specific to each product. Including any support backing.
5. Any other pertinent data generated which is necessary to provide the Work.

E. Submittal Format:

1. Each submittal shall be a combined electronic digital copy in specification order.
2. Provide each submittal with a unique number and be numbered in consecutive order.
3. Provide each submittal shall have a cover sheet reflecting the project title and submittal number.
4. Provide each submittal with a complete table of contents with the following information:

    a. Project title and number.
    b. Submittal number: In the case of a re-submittal, use the original submittal number immediately followed by the suffix "R" immediately followed by a unique number and be numbered in consecutive order.
    c. Date of submission.
    d. Referenced addendum or change-order number as applicable.
    e. Referenced specification Section, Part, Article, Paragraph, and page number or drawing reference as applicable.
    f. Index Product Data sheets by manufacturer and model or part number.

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5. Separate major grouping with labeled binder tabs.
6. Each submission page stamped with Contractor's certification stamp, initialed or signed certifying:

    a. Review, approval, and acceptance of submission.
    b. Certification of product compliance to specification.
    c. Verification product may be incorporated within the work.

7. Arrange product data list in alphanumeric order by manufacturer and model or part number. Follow list by manufacturer's data sheets, arranged in the same order. If a data sheet shows more than one product, indicate the model being proposed with an arrow or other appropriate symbol.
8. Drawings executed at an appropriate scale, not smaller than 3/8"=1'.

F. Resubmission Requirements:

1. Make any requested corrections or change in submittals required. Resubmit for review until no exceptions are taken.
2. Indicate any changes that have been made other than those requested.

8. PROJECT RECORD MANUAL

A. Submit combined electronic copy after substantial completion and prior to final inspection.

1. A cover sheet with a clickable table of contents will be included as the first sheet. This table of contents shall link you to each of the major sections listed below.
2. Each section shall contain a cover sheet with clickable table of contents.

B. The Project Record Manual shall be segregated into three separate sections as follows:

1. Operations Manual:

    a. Product Data: Product actually incorporated within the Work:

        1) Manufacturer's data for each type of product conforming to the scheme above. The list shall include manufacturer's serial numbers.
        2) Each products Owner/Instruction Manual.
        3) For custom circuits or modifications, a description of the purpose, capabilities, and operation of each item.
        4) Manufacturer's wiring diagram for each type of product actually incorporated.
        5) Separately bound list by manufacturer and model or part number of all products incorporated within the Work arranged in alphanumeric order.

    b. Record drawings: Final rendition of that specified depicting what is actually incorporated within the Work.

2. Service & Maintenance Manual:

    a. Provide an original copy of the service manual on every piece of equipment for which the manufacturer offers a service manual. Arrange manuals in the same order as the operations manual.
    b. Manufacturer's maintenance and care instructions.

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c. Maintenance Instructions, including maintenance phone number(s) and hours; maintenance schedule; description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.

C. Warranty Manual:

1. Manufacturer's warranty statements on each product.
2. Date of substantial completion and ending dates for warranties for each group of products.
3. Each piece of equipment must be logged with location, make and model and serial numbers.

9. PROJECT CONDITIONS

A. Verify conditions on the job site applicable to this work. Notify design professional and Owner representative in writing of discrepancies, conflicts, or omissions promptly upon discovery.

10. FINAL OBSERVATION AND TEST

A. Upon completion of installation, initial adjustments, tests and measurements specified in Part 3, and submission and review of the results, a final observation and test will be observed by the design professional and Owner representative no earlier than two weeks after receipt of the written results.

B. Provide a minimum of one (1) person familiar with all aspects of the System to assist the design professionals and Owner representatives.

C. Testing includes operation of each major system and any other components deemed necessary. Perform tests and provide required test equipment, tools and material required to make any necessary repairs, corrections, or adjustments.

D. The following procedures will be performed on each System:

1. It is not the intent to readjust all systems at the time of final observations. It is the contractor’s responsibility to have the systems ready and completely adjusted and documented prior to the final observations.
2. Inspection of the methods and means employed to incorporate the System within the facility.
3. Verification of proper operation, from controlling devices to controlled devices.
4. Verification of proper adjustment, balance, and alignment of equipment for optimum quality and to meet the manufacturer's published specifications. Other tests on equipment or systems deemed appropriate.

E. In the event the need for further adjustment or work becomes evident during testing, the Contractor is to continue his work until the System is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications and any extension of the inspection and testing period is required, the contract price will be reduced for the additional time and expenses of the Owner, at the standard rate in effect at that time.

11. WARRANTY

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A. Warrant labor and product for one (1) year following the date of substantial completion to be free of defects and deficiencies, and to conform to the drawings and specifications as to kind, quality, function, and characteristics. Repair or replace defects occurring in labor or product within the Warranty period without charge.

B. This warranty is in addition to any specific warranties issued by manufacturers for greater periods of time.

C. Within the warranty period, answer service calls within eight (8) hours, and correct the deficiency within twenty-four (24) hours.

1. The contractor must be prepared to install equipment replacements during this period so that the stadium does not loose operations or experience depredated signals.
2. Should existing equipment fail such as RF amplifiers, the contractor must be prepared to replace with equal product to the existing equipment.

2.PRODUCTS

1. ACCEPTABLE MANUFACTURERS

A. Model numbers and manufacturers included in this specification are listed to establish a standard of product quality. Provide the most up-to-date model number available from the manufacture.

B. Other qualified manufacturers will be considered subject to prior approval of complete technical data, samples, and, if requested, results of independent testing laboratory tests of proposed equipment.

C. If proposed system includes equipment other than specified model numbers, submit a list of major items and their quantities, with a one-line schematic diagram for review.

D. Include a list of previously installed projects using proposed equipment that are similar in nature to specified System.

2. GENERAL

A. Product: New, free from defects and listed by UL or other acceptable testing agencies acceptable to local authorities with jurisdiction. Provide product of a given type from one manufacturer.

B. Regardless of the length or completeness of the descriptive paragraph herein, provide product complying with the specified manufacturer's published specifications.

C. Equipment supply voltage: 120 VAC, 60 Hz.

D. Indoor equipment temperature limits

1. Operating Limits: 0 to 40 Degrees Centigrade
2. Non–Operating Limits: -15 to 50 Degrees Centigrade

E. Outdoor equipment temperature limits:

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1. Operating Limits: 0 to 50 Degrees Centigrade
2. Non–Operating Limits: -30 to 60 Degrees Centigrade

F. Provide product not specifically specified commensurate with the quality and standards established by the specified product.

G. Acceptable TV Display Manufactures:

1. LG Commercial Electronics http://www.lg.com/us/commercial/display
2. Samsung USA Business http://www.samsung.com/us/business
3. As Approved

H. Acceptable TV Display Mount Manufactures:

1. Chief http://www.chiefmfg.com
2. Peerless AV http://www.peerless-av.com
3. Premier Mounts http://www.mounts.com/
4. As Approved

3. TELEVISION DISPLAYS

A. 43” Display:

1. Provide Commercial Grade LCD UHD TV Display
2. Native Resolution 3040 x 2160
3. ATSC/Clear QAM TV Tuner
4. RS232C Control Input
5. Two (2) HDMI/HDCP Inputs
6. USB 2.0 Input with Cloning
7. VESA 200 x 200mm Standard Mount
8. Standard of Performance:

a. LG 43UT640S
b. Approved Equal

B. 49” Display:

1. Provide Commercial Grade LCD UHD TV Display
2. Native Resolution 3040 x 2160
3. ATSC/Clear QAM TV Tuner
4. RS232C Control Input
5. Two (2) HDMI/HDCP Inputs
6. USB 2.0 Input with Cloning
7. VESA 300 x 300mm Standard Mount
8. Standard of Performance:

a. LG 49UT640S
b. Approved Equal

C. 55” Display:

1. Provide Commercial Grade LCD UHD TV Display
2. Native Resolution 3040 x 2160

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3. ATSC/Clear QAM TV Tuner
4. RS232C Control Input
5. Two (2) HDMI/HDCP Inputs
6. USB 2.0 Input with Cloning
7. VESA 300 x 300mm Standard Mount
8. Standard of Performance:

    a. LG 55UT640S
    b. Approved Equal

D. 65” Display:

1. Provide Commercial Grade LCD UHD TV Display
2. Native Resolution 3840 x 2160
3. ATSC/Clear QAM TV Tuner
4. RS232C Control Input
5. Two (2) HDMI/HDCP Inputs
6. USB 2.0 Input with Cloning
7. VESA 300 x 300mm Standard Mount
8. Standard of Performance:

    a. LG 65UT640S
    b. Approved Equal

4. DISPLAY MOUNTS

A. 43” Low Profile Non-Tilt Wall Mount:

1. Provide for use with displays listed above
2. Final model number may vary
3. Provide bracket for digital media player
4. Standard of Performance:

    a. Chief MSTU
    b. Approved Equal

B. 49” to 55” Low Profile Non-Tilt Wall Mount:

1. Provide for use with displays listed above
2. Final model number may vary
3. Provide bracket for digital media player
4. Standard of Performance:

    a. Chief LSTU
    b. Approved Equal

C. 43” to 65” Display Wall Mount:

1. Provide for use with displays listed above
2. Final model number may vary
3. Provide bracket for digital media player
4. Standard of Performances:

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a. Chief LTM1U
b. Approved Equal

D. 43” to 65” Display Ceiling Mount

1. Provide for use with displays listed above
2. Final model number may vary
3. Provide bracket for digital media player
4. Standard of Performance:

a. Chief LCM1U w/CMA105/CMS Extension Column.

1) Chief FCA540 Power Outlet Box.
2) Chief CPA Ceiling Plates

b. Approved Equal

E. 43” to 65” Display Back-to-Back Ceiling Mount

1. Provide for use with displays listed above
2. Final model number may vary
3. Provide bracket for digital media player
4. Standard of Performance:

a. Chief LCB1U w/CPA Ceiling Plate and CPA Adjustable Column.

1) Chief FCA540 Power Outlet Box
2) Chief CPA Ceiling Plates

b. Approved Equal

F. 43” to 65” Articulating Wall Mount

1. Provide for use with displays listed above
2. Final model number may vary
3. Provide bracket for digital media player
4. Standard of Performance:

a. Chief TS325TU
b. Approved Equal

G. 49” to 65” Low Profile Non-Tilt Wall Mount:

1. Provide for use with displays listed above
2. Final model number may vary
3. Provide bracket for digital media player
4. Standard of Performance:

a. Chief LSTU.
b. Approved Equal

5. CABLING AND ACCESSORIES

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A. RF Tap to TV Jumper Cable:

1. Provide one (1) for every TV display
2. RG6 Quad Shield connectorized jumper cable
3. Black jacket color
4. Available in 12”, 36”, & 72” lengths
5. Standard of Performance:

a. Toner J12-6QB, J36-6QB, & JB72-6QB
b. Approved Equal

3.EXECUTION

1. GENERAL

A. Coordinate incorporation of the Work specified herein with other project work so as to facilitate a cohesive final product.

B. The installation recommendations contained within ASDI and TDMM are mandatory minimum standards and requirements.

C. Mount equipment and enclosures plumb and level.

D. Permanently installed equipment is to be firmly and safely held in place. Design equipment supports to support loads imposed with a safety factor of at least five.

2. INSTALLATION OF CABLE AND WIRING

A. Cabling and Wiring:

1. Provide cabling for RF connections utilizing black jacket color coding.
2. Provide appropriate support at all horizontal-to-vertical transitions in order to keep the weight of the cable from degrading at the point of transition.
3. Provide splice free wiring and cabling from origination to destination.
4. Install cable so that a radius bend of no less than ten times the cables OD is maintained.

3. INSTALLATION OF ELECTRONIC EQUIPMENT

A. Take appropriate precautions to protect the equipment from damage during installation. Equipment is to be installed free of damages, scratches, dents, etc.

B. Mount equipment plumb and level, firmly and safely held in place.

4. LABELING

A. Provide legible cable and wiring label permanently affixed for easy identification per the Cable Numbering Plan.

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1. Labels on cables to be adhesive strip type covered with clear heat-shrink tubing. Factory stamped heat shrink tubing may be used in lieu of the adhesive strip style
2. Wiring designator is to be an alpha-numeric code unique for each cable.
3. Locate the cable designator at the origination and destination of each circuit within 3 inches of the point of termination or connection. Provide cable designator on circuits with intermediate splice points with an additional suffix to indicate each segment.

5. CONTRACTOR COMISSIONING

A. Prior to energizing or testing the System ensures the following:

1. Products are installed in proper and safe manner according to manufacturer's instructions.
2. Cables are connected, dressed, routed, and labeled.
3. Products are neat, clean, and unmarred and parts securely attached.
4. Broken work, including glass, ceiling tiles and supports, walls, doors, etc. have been replaced or properly repaired, and debris cleaned up and discarded.

B. Prior to energizing the System verify and perform the following tests and adjustments in compliance with applicable EIA standards.

1. Electronic devices are properly grounded.
2. Powered devices have AC power from the proper circuit and hot, neutral, and ground conductors are connected correctly.
3. Systems, equipment, and devices are in full and proper adjustment and operation, and properly labeled and identified.
4. Store extra materials, portable equipment, and spares at the premises as directed by the Owner.

C. TV Display Performance Verification Test

1. Verify the following signals and functionality:

a. RF drop outlet to TV display RF input
b. Verify audio and set volume limits
c. IR Control

2. Disable the following:

a. Auto light level compensation
b. Motion detection for auto standby
c. Wi-Fi Hotspot

D. Final Inspection and Test:

1. It is the responsibility of the Contractor to be cognizant of the project schedule and execute their work to comply with the Project Schedule for Final Inspection and Test.
2. The Contractor must ensure that the project management and the Architect are made aware of any issues that may prevent the Contractor from completing their work prior to the scheduled final inspection timeframe.
3. Prior to the scheduled final inspection and test timeframe the contractor must have:

a. Complete the required installation, tests, and measurements.

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4. Submitted test results and as-built documentation at least three weeks prior to the final inspection and test timeframe.
5. Notified the Architect in writing of the date that they will be ready for final inspection and test.
6. No earlier than two weeks after receipt of the Contractor's notification the Architect's representative will schedule a final inspection and test

6. TEST EQUIPMENT

A. Furnish the following equipment as required:

1. HDMI Test Signal Generator: QVS VPGH
2. RF Signal Level Meter: Blonder Tongue QAM PRO

B. Equipment is to be available for the entire test period through final system testing.

C. Following final inspection and testing turn over the Blu-ray test disc to the owner.

D. Provide three portable VHF or UHF business band radios for use during acceptance testing with transmission range sufficient to cover entire project. Include rechargeable batteries and recharger along with holster for wearing on belt. Radios are to be available for duration of testing process, including any follow-up visits required prior to final acceptance.

END OF SECTION 27 41 43

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SECTION 280500 – COMMON WORK RESULTS FOR ELECTRONIC SECURITY

1.GENERAL

1. SUMMARY

A. See individual related documents for summary of work for each section.

B. Work will consist of providing and installing prescribed systems and equipment, in accordance with the Owner's directives and needs. Contractor will design, install and configure systems to provide the exact function described herein, when specified, and will be held to the operational criteria. Contractor will be responsible for providing and installing a complete and fully operational system, with the intended features and capabilities, whether or not all required parts, components, systems or accessories are specified in the construction documents. Contractor will provide all required parts, components, systems, materials, accessories, and programming needed for a complete and working system, without additional cost to Owner.

C. Although such work is not specifically indicated, provide, and install supplementary or miscellaneous items, appurtenances and devices incidental to, or necessary for, a sound, secure and complete installation.

2. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including all General and Supplementary Conditions and Division 1 Specification sections will apply to this section and will be considered as forming an integral part of this Work. These documents are referred to as the Project General Conditions in the remainder of these Specifications. Where the Project General Conditions conflict with the requirements defined herein, the more stringent of the requirements and the Project General Conditions will prevail.

B. This Specification Section incorporates general requirements for the following security sections.

1. 28 05 13 Conductors and Cables for Electronic Security
2. 28 10 00 Access Control
3. 28 20 00 Video Surveillance

3. RELATED WORK NOT IN THIS SECTION

A. General and specific provisions of these Specifications apply to the work specified in this Section, as well as:

1. Mockups
2. Division 07 Firestopping
3. Division 08 Door Hardware
4. Division 26 Electrical
5. Division 27 Structured Cabling

4. DEFINITIONS

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A. Owner's Representative: The representative or representatives appointed by the Owner responsible for project construction supervision.

B. Provide: To purchase, deliver to site and furnish all labor and material as necessary for a complete and operational system as specified herein.

C. Contractor: The Party contracted by the Owner or their designated representative to Provide Work specified herein.

D. Contract Documents: Documents used to specify the Work and govern the work of Contractor in their entirety or in part.

E. Work: The entire completed construction of the individual parts of the project as specified herein.

F. Local Authority Having Jurisdiction: The local governmental entity responsible for adopting and enforcing all code requirements at the location Work is being performed.

G. Project General Conditions: Include all relevant contractual requirements for the Project to include Division 1 General Conditions as well as Owner-provided and established contractual provisions.

H. Security Subsystem Specifications: Those specifications that apply to security subsystems for which these General Security Requirements apply.

I. The following are definitions utilized within this specification section:

1. (ACS).Access Control System.
2. (VMS).Video Management System.
3. (GUI).Graphical User Interface.
4. (IP).Internet Protocol.
5. (KVM).Keyboard Video Mouse.
6. (UI).User Interface.

5. SOFTWARE AND NETWORK

A. Custom Software Overview:

1. Integration of the Division 28 sections, including programming and development of any custom software that may be required of this section, is the responsibility of the contractor. It is the responsibility of the contractor(s) to work with the Owner and manufacturers to develop these integrations. When custom modules are required, it will be the responsibility of the contractor to coordinate with manufacturers for API's and SDK's in order to have the programs written.

a. Custom software programming must be contracted to the manufacturer to write; however, the expense of the development will be the responsibility of this section.
b. Any custom software developed for this project shall be maintained for changes to all systems integrated for a minimum of five years after completion of project.

6. REFERENCES

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A. American National Standards Institute (ANSI)

B. Electronic Industry Association (EIA)

C. National Electric Code (NEC)

D. Telecommunications Industry Association (TIA)

E. National Electrical Manufacturer's Association (NEMA)

F. Underwriters Laboratories (UL)

G. National Fire Protection Association (NFPA)

H. Federal Communications Commission (FCC)

I. Institute of Electrical and Electronics Engineers (IEEE)

J. Occupational and Safety Health Administration (OSHA)

K. Open Network Video Interface (ONVIF)

7. APPLICABLE CODES AND STANDARDS

A. The Contractor will ensure that all Work provided under this section will meet the minimum requirements of all applicable codes and standards, as determined by the LAHJ.

B. Where the requirements of this section exceed the minimum requirements of the LAHJ, this section will govern. Where codes conflict with the Contract Documents, codes will govern. Where any applicable codes and standards conflict between themselves, the more stringent will apply.

C. Nothing in this section will relieve Contractor from the responsibility for compliance with all applicable codes, standards or specifications which are generally recognized to be applicable to the Work specified herein.

D. Contractor will make application for, and obtain any and all permits required by federal, state, county, city or other LAHJ over the work. In the event that inspections are required, it will be the responsibility of Contractor to schedule and ensure the completion of said inspections and to ensure that all necessary certificates are issued, obtained, and delivered to the Owner.

E. Within this Section and the Security Subsystem Specifications, reference is made to United States-based standards, codes, and legislation. For projects outside the United States, the corresponding local codes, standards, and legislation will apply, except where local requirements are less stringent than those proscribed within the referenced United States requirements. In these cases, the referenced United States requirements will apply.

8. SUBMITTALS

1. Contractor is required to provide complete shop drawings and submittal packages.
2. Provide simultaneously the following for approval thirty days after issuance of notice to proceed and prior to commencement of work:

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a. Complete schedule of submittals.
b. Chronological schedule of work in bar chart form.

3. Submittal format:

a. Provide a unique control number in consecutive order.
b. Provide a complete table of contents with the following information:

1) Project title and number.
2) Submittal number. In the case of a re-submittal, use the original submittal number immediately followed by the suffix “R” immediately followed by a unique number and be numbered in consecutive order.

c. Date of submission.
d. Referenced addendum or change order number as applicable.
e. Referenced specification Section, Part, Article, Paragraph, and page number or drawing reference as applicable:

1) Index by the data in specification order, manufacturer and model or part number unless specified otherwise herein.

f. Each submission page stamped with Contractor’s certification stamp, initialed or signed certifying:

1) Review, approval, and acceptance of submission.
2) Certification of product compliance to specification.
3) Verification product may be incorporated within the work.

g. Arrange product data list in specification order when applicable followed by unspecified product arrange by manufacturer and model or part number. Follow list by manufacturer’s data sheets, arranged in the same order. Where a data sheet shows more than one product, indicate the model being proposed with an arrow or other appropriate symbol.
h. Drawings executed at an appropriate scale, but not smaller than 1/8 inch = 1’–0”. Provide one reproducible and two bound prints of which the processed reproducible will be returned to Contractor, additional prints will not be reviewed or returned.
i. Submittal documents shall be computer generated. Free-hand sketches or reproductions of Contract Documents will not be accepted, and contractor will be deemed nonresponsive.

B. Prefabrication as required within these specifications:

1. Prefabrication submittals will be submitted in English in addition to the local language. Submittals not translated to English will be rejected without review.
2. Prefabrication submittals will completely demonstrate the Contractor’s understanding and interpretation of the systems, equipment, devices, and components being installed. Prefabrication submittals will consist of shop drawings and product data as defined herein. Submittals will clearly show materials, dimensions, operational features, durability, technical limitations and requirements, and all other information required for a complete and thorough review.
3. Acceptance of prefabrication submittals by the Owner’s Representative will not relieve Contractor from any responsibility to Provide Work as defined in the Contract Documents.

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No portion of the Work will commence until the Owner's Representative has approved the prefabrication submittals in writing.

4. All prefabrication submittals will be submitted by Contractor in their complete form. Partial submittals will not be considered.

C. Action Submittal:

1. This submittal is intended to be used when a substitution is being requested.
2. Product Data:

   a. Provide a list of, and manufacturer's data sheets on product to be incorporated within the work:

      1) Manufacturer's product technical datasheet for each product in sufficient detail to facilitate proper evaluation to the product's suitability for incorporation within the work. Where multiple products are shown on the same datasheet, the product intended to be used shall be identified in a manner that can be photocopied in black and white.
      2) Manufacturer's wiring diagram for electrically actuated units in sufficient detail to facilitate proper evaluation to the products suitability for incorporation within the work.
      3) Organize the data sheets in the order of the specification.

3. Comparison Matrix:

   a. Provide a Matrix showing the features of the specified product in one column with the next column depicting how the proposed item's features compared.
   b. Highlight any item that does not exceed the specification or feature of the specified device.
   c. Provide documentation showing the device being substituted is on the approved devices list:

      1) If generic ONVIF driver is used the contractor will show that the substituted product will have the same quality and features as the native driver for the originally specified product.

4. Shop Drawings:

   a. See below

5. Samples if required by owner or architect.

D. Informative Submittal:

1. This submittal is intended to be used when using specified equipment.
2. Product Data:

   a. Provide a list of and the manufacturer's data sheets on product to be incorporated within the work:

      1) Manufacturer's product technical datasheet for each product in sufficient detail to facilitate proper evaluation to the products suitability for incorporation within the work. Where multiple products are shown on the

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same datasheet the product intended to be used shall be identified in a manner that can be photocopied in black and white.

2) Manufacturer's wiring diagram for electrically actuated units in sufficient detail to facilitate proper evaluation to the products suitability for incorporation within the work.

3) Organize the data sheets in the order of the specification.

3. Shop Drawings:

   a. See below.

4. Samples if required by owner or architect.

E. Shop drawings:

1. Shop drawings will be computer generated in AutoCAD® Revit. Coordinate version with owner's representative. Drawings will be precisely scaled. Free-hand sketches or reproductions of Contract Documents will not be accepted, and contractor will be deemed nonresponsive.
2. PDF prints will be produced of all sheets and organized following the architectural numbering format.
3. Coordinate with the Owner's Representative to obtain architectural model/backgrounds in electronic or hardcopy format for use in the shop drawings.
4. Shop drawings will consist, at a minimum, of the following:

   a. Original design effort provided by the Contractor indicating the proposed work to meet the specified systems.
   b. Floor plan drawings indicating the location of all security devices as well as all wire runs and designations.
   c. Plans, elevations, and details indicating dimensions, gauges, reinforcement, anchorage, and other installation details for each device as required.
   d. System point-to-point diagram indicating the inter-relationship of all security system peripheral devices, control panels, software / monitoring workstations, and other components as necessary for a complete and operational system.
   e. Typical wiring diagrams for each system peripheral device.
   f. Specific wiring diagrams for each system control panel, power supply, video recorder or other device or equipment that controls or communicates with multiple peripheral devices.
   g. Fabrication shop drawings for all custom equipment.
   h. Installation: Special details depicting methods and means specific to each product, assembly and each product manufacturer's recommended installation methods and means.
   i. Equipment: Location of equipment, with dimensions; wire routing and cabling within housings; AC power outlet and terminal strip locations. This will include equipment closet layouts, power inserters, camera power supplies etc.
   j. Camera mounting details for each camera position. Each mounting detail will contain sufficient scaled detail to indicate the entire coverage area and attachments.
   k. Control software screens. Provide color printouts of screen layout for camera, floor layouts and controls. This requirement is to be coordinated with the GUI development process.
   l. Fabricated plates and panels: Provide complete drawings on custom fabricated plates or panels. Drawings to include dimensioned locations of components,

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component types, engraving information, plate material and color, and bill of material.

m. Labeling: Representative equipment and cabling labeling scheme. Include font sizes and styles, explanation of scheme, and descriptor and designator schedule.

n. Any other pertinent data generated which is necessary to provide the Work.

o. Seek the services of a state licensed structural engineer to stamp and approve mounting details of cameras mounted on any location requiring a foundation, dedicated poles (such as outside locations), or where the objects are mounted over seating areas.

p. Copying contract documents and returning them as shop drawings will be considered as nonresponsive and will be rejected without review.

F. Record Documents:

1. Submit four bound originals of the following Project Record Manual information after substantial completion and prior to final inspection:

a. Product Data: Product incorporated within the Work:

1) Manufacturer's data for each type of product conforming to the scheme specified herein.
2) Include manufacturer’s serial numbers within the list of products.
3) All product data for the Project will be tabulated into a comprehensive list of equipment to be provided for the Project, including quantities, manufacturer names, model numbers, description, and any applicable options. The product data submittal will be of sufficient detail that the Owner’s Representative may readily identify the equipment and materials proposed.

b. Provide all product data in hard copy organized in three (3) ring binders as well as three (3) in electronic formats on CD or USB thumb drive. Bind Project Record Manual in titled three ring D style binders sized for 150 percent of the material in general conditions sections described previously as part of this specification. Maximum size: three-inch ring. Use multiple volumes if necessary:

1) Product data will consist, at a minimum, of the following:

a) Product data sheets for each piece of equipment included in the project identifying the following:

(1) Materials and Fabrication.
(2) Tolerances.
(3) Power and environmental / HVAC requirements.
(4) Special criteria related to particular systems and components.
(5) Specifically, and clearly, mark items submitted where multiple items and options occur on a sheet.

c. Identify all Parts and Components by name and manufacturer's number:

1) Manufacturers’ brochures for each of the system components included. Contractor will submit original brochures; copies will not be acceptable. Where information is in color, all copies will be provided in color.
2) Schedules will independently identify each piece of equipment, component and device provided for the project including project name/number

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reference, product name and number, installation location and conductor/cable identifications that devices are connected to.

d. Reference both manufacturer and construction document identification.
e. For information submitted in a schedule, include information independently in an organized and consistent format.
f. Provide programming point information within the schedules:

1) At the request of the Owner's Representative and as identified in Security Subsystem Specifications, submit color samples for specific pieces of equipment.
2) Where test data is required by the Security Subsystem Specifications or Project General Conditions, all tests must be specific to products supplied specific for this project.
3) Certificates and Testing Information:

a) Provide a manufacturer's certificate certifying that Products meet or exceed specified requirements.
b) Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency.

4) The Owner's Representative will have the right to request additional information as required for a proper review of the submittal information.
5) For custom circuits or modifications, a description of the purpose, capabilities, and operation of each item.
6) Manufacturer's wiring diagram for each type of product actually incorporated.
7) Manufacturer's maintenance and care instructions.

g. Record drawings: Final rendition of submission depicting what is actually incorporated within the Work.
h. Test Reports: Recorded findings of Contractor's Commissioning.
i. System Operation and Instructions: Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity.

1) This procedure should describe the operation of system capabilities.
2) Assume the intended reader of the manual to be technically inexperienced and unfamiliar with this facility.

j. Maintenance Instructions, including maintenance phone number(s) and hours; maintenance schedule; description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.
k. Any other pertinent data generated during the Project or required for future service.
l. Segregate documents within the three separate bindings containing data relevant to operational, maintenance and warranty issues. Appropriately duplicate data within the separate bindings when it will reasonably clarify procedures, e.g., operational data in maintenance binding.
m. Provide the same layout in PDF form within the electronic storage media listed above. The bindings would be electronic folders. All PDF files must be flattened so that any notes or comments are not able to be moved accidently when selected.

9. CLOSEOUT SUBMITTAL

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A. Copy of Maintenance contracts.

B. Operation and Maintenance Manual and Schedule.

C. Bonds.

D. Warranty Documentation.

E. Record Documentation.

F. Copy of software.

10. MAINTENANCE MATERIAL SUBMITTAL

A. Copy of Maintenance contracts.

B. Operation and Maintenance Manual and Schedule.

11. RESUBMITTAL

A. Resubmission Requirements:

1. Make any requested corrections or change in submittals required. Resubmit for review until no exceptions are taken.

a. Indicate any changes that have been made other than those requested. Identify each change or correction with the appropriate delta identifier and cloud the change.

B. Replace at no expense to Owner, product damaged during storage, handling, or the course of construction.

12. SITE DOCUMENTATION

A. Contractor will maintain up-to-date record drawings on site for inspection by the Owner's Representative. Each change to the original approved submittal data and deviation from the Contract Documents will be indicated on the record drawings. Contractor will ensure that the record drawings are protected against soiling, tears, or other damage or defacement. At the conclusion of the Project the Contractor will incorporate all changes on the record drawings into electronic format and will submit the completed set as As-built documentation as defined in the section titled "Record Documentation" herein.

13. PROJECT CONDITIONS

A. Contractor will have a minimum of five (5) years of experience in the design, installation, and commissioning of projects of a similar nature. Contractor will provide evidence of completion of at least two (2) projects of a similar size to that specified herein that have been in operation a minimum of one year.

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B. The Contractor will be equipped to support the Project from a local field office. The office will offer twenty-four (24) hour emergency service with a maximum response time of four (4) hours. The Contractor will have an in-depth understanding of all local codes and requirements for the area that the Project is located in.

C. Contractor will be an authorized dealer of each of the major access control, intrusion detection, and video product lines specified in the associated specification sections. Contractor will provide written proof of dealership status along with bid.

D. In addition to experience requirements stated, Owner's Representative reserves the right to require:

1. Site visit to at least two facilities where installations have occurred and are in use.
2. Owner approval.
3. Surety bond backed warranty.
4. Proof that contractor or bidder is familiar with installations to be made.
5. Background information on prior installations, including the following information:

a. Owner, Architect, and contractor contacts
b. Names
c. Phone numbers
d. Addresses

14. PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle products in accordance with manufacturer's recommendations, as to minimize the opportunity for damage, deterioration, or loss.

B. The Owner assumes no liability or responsibility for loss by theft, vandalism, burglary of material or equipment stored on site.

C. Deliver all equipment and material to the site in the manufacturer's original sealed packaging. Packaging is to provide factory identification of items contained within the packaging, and protection until the items or materials are installed. Inspect all equipment and material upon delivery to ensure that they are free from damage and in accordance with the Contract Documents.

D. Acceptance of the products constitutes the contractor's acknowledgment that products or materials are satisfactory for use.

E. Store products in their original packaging until installation. Protect from spoilage, moisture, all weather-related conditions, corrosion, breakage, or other damaging elements. Store in conditions that will ensure all required manufacturer's environmental criteria are maintained until use of material or products.

15. TECHNICAL SYSTEMS SOFTWARE LICENSE

A. Introduction:

1. All proprietary software provided for the Technical Systems will be subject to this software license agreement between the Contractor and the Owner as an essential

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element of the system as defined in the system specification and associated documents, drawings, and agreement.

2. Contractor will agree that 3rd party (e.g. manufacturer's) proprietary software provided with the system will be subject to this agreement.
3. Contractor and Owner agree that this software license is deemed to be part of, and subject to, the terms of the Agreement applicable to both parties; and will supersede any standard manufacturer or Contractor's standard license agreement.
4. Proprietary software will be defined to include, but not be limited to, device and system specific software and firmware designed to run on conventional computer based operating platforms as well as all micro-processor based hardware used to program, setup, or operate the system or its components.
5. For sake of this agreement, MS Windows® will not be considered "proprietary" software, unless a non-public version of Windows® or any of its components are critical to the operation of the system in which case it will be deemed proprietary.

B. License Grant and Ownership:

1. Contractor hereby grants to Owner a perpetual, non-exclusive, site license to all software for Customer's use in connection with the establishment, use, maintenance, and modification of the system implemented by Contractor. Software will mean executable object code of software programs and the patches, scripts, modifications, enhancements, designs, concepts or other materials that constitute the software programs necessary for the proper function and operation of the system as delivered by the Contractor and accepted by the Owner.
2. Except as expressly set forth in this paragraph, the Contractor will at all times own all intellectual property rights in the software. All licenses, product warranties or service contracts provided by third parties in connection with any software, hardware or other software or services provided in the system will be delivered to Owner for the sole benefit of Owner.
3. Owner may supply to Contractor or allow the Contractor to use certain proprietary information, including service marks, logos, graphics, software, documents, and business information and plans that have been authored or pre-owned by Contractor. All such intellectual property will remain the exclusive property of Owner and will not be used by Contractor for any purposes other than those associated with delivery of the system.
4. Contractor shall provide all licenses or modules to make the system fully functional system.

C. Copies, Modification and Use

1. Source code will be available to Owner for a period of not less than 10 years.
2. Owner may make copies of the software for archival purposes and as required for modifications to the system. All copies and distribution of the software will remain within the direct control of Owner and its representatives.
3. Owner may make modifications to the source code version of the software, if, and only if, the results of all such modifications are applied solely to the system. In no way does this Software License confer any right in Owner to license, sublicense, sell, or otherwise authorize the use of the software, whether in executable form, source code or otherwise, by any third parties.
4. All express or implied warranties relating to the software will be deemed null and void in case of any modification to the software made by any party other than Contractor.
5. During the life of the system (defined as a period of not less than 10 years and not more than 15 years), the Contractor will provide software updates in accordance with all necessary support requirements to maintain the system. This will include a commitment to provide appropriate patches, fixes, and interface updates as necessary to maintain the operability and security of the system at a level commensurate with the original system:

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a. In the event that computer and or processor hardware refinements and updates are necessary to support software updates 5 years after substantial completion, said hardware will be provided to Owner at negotiated terms between the Contractor and the Owner.
b. Labor will be in accordance with change order rates of the original contract, as adjusted for inflation in accordance with conditions and limitations of the general contractor or U.S. Bureau of Labor Statistics' Consumer Price Index (CPI).

6. All hardware supplied will support software updates for a period of not less than 5 years following substantial completion.

2.PRODUCTS

1. MATERIALS, EQUIPMENT, AND DEVICES

A. Herein and within the related Sections of Work identified herein, performance requirements and other specifications related to equipment to be provided as part of this Project are listed. Contractor will refer to the identified product or a known equal for acceptable manufacturers of equipment.

B. Or approved equal basis:

1. The products are listed or are on an approved equal basis. The known equals to the products specified are listed in each section.
2. Substitute products not listed in this section may be submitted for approval during the question-and-answer period of the bidding phase. See substitution requirements in this section.
3. Substitution approvals will be based on the complete functionality, integration, operation, and user interface as it compares to the specified product(s).

a. If a substitute product is approved, the Contractor is solely responsible for integrating it to meet the operational intent of the originally specified product.

4. Products not approved prior to the bidding phase will be deemed non-responsive.

C. Provide products of types, materials, sizes, capacities, and electrical characteristics as indicated. Products will meet the following requirements:

1. Design and construction will be as recommended by manufacturer and as required for installation.
2. Provide manufacture's standard product as indicated by published product information.

D. Where special power treatment is required, such as filtering or spike elimination that may be required for proper operation of the system, Contractor will provide as part of the system.

E. Acceptable product will be as indicated in each section. All products will meet the following requirements:

1. Manufacturer will have a minimum of 5 years' experience producing the specific types of products to be used.

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2. All like equipment, components and devices will be by one manufacturer where possible unless the major component manufacturer does not provide a specific device, (example; 180° or 360° camera).
3. Where different manufacturers must be provided, all products will be totally compatible.

F. Where specific model numbers are not provided for a specific manufacturer, information is provided to indicate the level of quality to be met by other approved manufacturers:

1. Systems provided are to be of factory designed, independently tested, published components; coordinated, designed, and interfaced to perform as one unitized system.
2. Include all required wire, cable, fittings, and miscellaneous accessories.
3. Unless specifically noted, components and system logic will be provided through microprocessors and pre-designed cards.
4. Provide low voltage components and devices where possible.
5. Provide only systems designed for continuous 24-hour 7 days a week operation.

2. FABRICATION

A. Electronic Equipment and Components:

1. To the greatest extent possible, provide standard equipment and components, designed to operate as complete coordinated systems capable of interfacing with all related systems required for the work.
2. Where custom fabricated and integrated systems or components, such as vehicular pedestals, are required or indicated, provide compatible components and complete system to attain performance and operational capabilities intended.

B. Factory finish all components:

1. Where selected color is not specifically identified in contract documents, submit sample materials finished with actual colors and textures. Contractor will submit for approval the full range of colors and textures for approval by the Owner's Representative.
2. See Security Subsystem Sections for specific finishes.

C. Provide factory-fabricated wire of the size, rating, material, and type as indicated for each service. Where not indicated, provide proper selection as required to comply with installation requirements and with local standards adopted by the LAHJ.

3.EXECUTION AND SCOPE

1. EXAMINATION AND SITE PREPARATION

A. Prior to bidding, examine the project (if under construction) for nature, scope, and intent of all work to be performed and notify Owner's Representative in writing of any conditions determined to be detrimental to proper completion of the Work.

B. Submission of a bid/proposal will constitute that examination has been made, and any difficulties foreseen identified and noted. Any claims for labor, work, materials, or equipment for difficulties encountered which should have been foreseen, will not be recognized; and will be taken care of by the contractor at no additional cost to the Owner.

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C. Do not proceed with Work until all unsatisfactory conditions have been corrected.

D. Prior to installation of systems components and devices, verify that all required preparations have properly occurred and that substrates are acceptable for installation:

1. Verify all rough-ins and field dimensions.
2. Report any discrepancies, unsatisfactory conditions and prevailing conditions that will adversely affect satisfactory execution of work for systems included under this specification section.

a. Do not proceed with work until unsatisfactory conditions have been corrected.
b. Owner's Representative reserves the right to review proposed methods of direction, reject proposed methods and have the installation done in a satisfactory method at the Contractor's cost.
c. Installation constitutes acceptance of responsibility for performance.

2. INSTALLATION

A. Install all system components in accordance with manufacturer's written instructions, in compliance with all applicable codes and standards and in accordance with recognized industry practices.

B. Ensure that all equipment is properly installed to avoid mechanical stresses, twisting or misalignment of equipment that may be exerted by clamps, supports and cabling.

C. Thoroughly clean all areas and spaces where work is performed or used as access to work. Completely remove all paints, mortars, oils or other residues and otherwise restore all surfaces to their original condition. Upon completion of the work, remove refuse and rubbish from and about areas of work. Repair any damage caused to the premises by the installation of systems at no cost to the Owner.

D. Grounding:

1. Provide equipment grounding connections for all systems as indicated herein and in the Contract Documents. Ensure and demonstrate that resistance to solid earth for signals is less than or equal to three (3) ohms.
2. In no event will the AC neutral conductor, either in a power panel or in receptacle outlets be used for a reference ground.
3. Ground all equipment in accordance with the manufacturers' requirements. Contractor will be responsible for diagnosis and correction of all problems related to improper grounding, including that which causes damage to equipment.

E. All equipment will be installed square and plumb. Ensure that all equipment is clean and free of paint and other foreign materials.

F. All installation practices will adhere to all applicable regulations, codes, ordinances, and standards as required by the LAHJ.

G. Clearly identify points of connection for wiring from building power system to work of this section, and requirements for connection to materials and equipment supplied under other Sections of Work.

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H. Provide all transformers, relays and other accessories as required for a complete and operational system as defined herein and as required by the Security Subsystem Specifications. Furnish and install all fastenings, plates and other incidental items required for complete and operational installation.

I. Contractor will ensure that all equipment installations and mounting are in strict accordance with requirements for applicable seismic classification.

J. Prior to installation, ensure that each installation area meets the following conditions:

1. All wet work is completed.
2. Area is dust free.
3. All work is completed in regard to painting.

K. Anchor components securely in place, plumb, level, and accurately aligned. Provide separators and isolators to prevent corrosion and electrolytic deterioration.

L. Protect installed equipment from damage and spoilage.

M. Touch up minor scratches and abrasions with manufacturer's touch-up paint as necessary.

N. Double-sided foam tape will not be used to secure any terminal boxes, relay bases or circuit boards, etc.

O. All device mounting will be of a permanent nature.

P. During installation, care will always be exercised to protect Owner property.

3. LABELING

A. Provide machine generated labels for each system associated with the Electronic Security System to include but not limited to the following:

1. Conduit pathways including:

a. Junction boxes
b. Pull boxes
c. Horizontal connection points
d. Conduit
e. Cable tray
f. Grounding busbars
g. Voltage protection equipment

B. Provide machine generated labels for each component associated with the Electronic Security System to include but not limited to the following:

1. Access Control Panels

a. Label shall include;

1) Panel name
2) Location
3) IP and MAC address

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4) Termination information for each port, input, output, and connection.

2. Cameras
3. Readers
4. Termination blocks
5. Patch panels
6. Equipment cabinets, racks, frames, and enclosures
7. Power distribution units, power strips

C. Provide machine generated labels for each cable associated with the Electronic Security System to include but not limited to the following:

1. Copper backbone cables
2. Fiber optic backbone cables
3. Horizontal premise cables
4. Grounding and bonding conductors
5. Inter- and Intra-equipment rack cables

D. Provide lamacoid type permanent labels for specified equipment.

E. Provide machine generated placards as specified for each security enclosure.

F. Provide labeling materials designed for a lifetime equal to the system, component or cable being identified.

G. Provide labels on enclosure interior door face of equipment enclosures.

4. COORDINATION

A. Coordinate all Work to be performed with the General Contractor as necessary for smooth and expedient completion. Ensure critical path to completion where Work specified herein in dependent upon completion of Work by other trades or by Owner. Coordinate with other trades to avoid conflicts where Work in a certain area requires exclusive use of the area for the duration of the Work.

B. Coordinate arrangement and quantity of security-related assemblies with ceiling space configuration and with other components occupying ceiling space, including structural members, ductwork, electrical raceways, lighting fixtures and other items.

C. Furnish any inserts required for building into concrete, masonry, and other work, to support and attach work of this section. Furnish in ample time to comply with schedule of work into which inserts are built.

5. SYSTEM STARTUP

A. Subsequent to installation, clean each system component of dirt, dust, oils and other residues incurred from project activities and prepare the system for activation by following each manufacturer's recommended procedures for adjustment, alignment and synchronization.

B. Program the system in accordance with the Owner's instructions and with the requirements of this Section.

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6. OWNER PERSONNEL TRAINING

A. Contractor will provide on-site training by factory personnel in the operation, setup, and administration of all systems and major components installed.

B. Provide a detailed training schedule to the Owner no later than 30 days prior to system completion or the date of Owner's beneficial use of system, whichever comes sooner.

C. Operator Training: Instruct operating staff in proper operation, including hands-on training. Operator training will meet the following requirements:

1. Will cover the operations for each system installed.
2. Training sessions will be provided to supervisors, staff utilizing systems and equipment provided under this section, maintenance personnel and any other personnel designated by the Owner. Contractor should prepare to provide operator training for up to ten (10) personnel.
3. Contractor will be prepared to provide training sessions on all work shifts, including day, evening, and night shifts.

D. Administrator Training: Instruct Owner-designated security system administrators for each system installed. Administrator training will cover all administrative and management functions, features and controls for each system.

E. Review in detail all information in the Operations and Maintenance Manuals for each system provided.

F. Prior to administering the above training, the Contractor(s) will prepare an outline of the training, identifying the goals and expectations of the course and detailing what attendees are expected to learn.

G. Contractor will provide follow-up training on all of the above subjects at the request of the Owner at additional cost.

H. At the option of the Owner, training courses will be videotaped for subsequent training use by the Owner.

I. In no case will the number of hours allocated toward training be a limiting factor to meeting the training requirements defined herein.

J. Training Submittals:

1. All Operations and Maintenance manuals, as well as as-built drawings must be on site for all sessions of training.
2. Following discussions with Owner, formally submit a Training and Event Attendance submittal two weeks prior to first training. Submittal will:

a. Include a separate page/entry for every training session.
b. Indicate date, time, and approximate length of training session.
c. Indicate person(s) conducting training.
d. Indicate whether training will be video-taped.
e. Intended curriculum and most appropriate attendees (e.g. engineer, operations, IT, etc.)
f. Include signature and title lines for:

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1) Owner acknowledging and accepting training schedule. Include both an accepted and rejected box. An alternate schedule time should be suggested by the Owner in the event the schedule is rejected.
2) Countersigning by trainer indicating that training actually occurred.
3) All persons attending training. Where attendees do not stay for the entire session, this should be noted on the form and initialed by Owner's representative attending training.
4) Owner's representative attending training at the end of the session will initial that:

a) Training Occurred.
b) Training Materials were provided and left with Owner.
c) Training was not interrupted or shortened by equipment or system troubleshooting. If it is, then there should be a line where Owner and Contractor can indicate when make-up training will be provided and how long it should be.
d) Training was generally sufficient for the proposed curriculum.

g. Include Notes section for Owner and Contractor to note any issues during training (areas requiring further development, etc.).

3. Following training occurrence, submit completed training records no later than 5 days following end of training. When training is conducted over a period of weeks, completed training submittals will be consolidated into a single submittal and submitted every 2 weeks.
4. Provide all training material on DVD in Adobe PDF format.

7. SYSTEM TEST AND VERIFICATIONS

A. Contractor will coordinate with Owner's Representative for final tests and inspections in the presence of the Owner and other representatives as the Owner's Representative deems appropriate.

B. Contractor will develop a Final Test and Acceptance (FTAA) Plan. The plan will include the following components:

1. Contractor will produce an item-by-item completion matrix indicating completion or incompletion for each item included in this Section and any additional direction, addenda, or bulletins issued by the Owner's Representative or other Owner representative. For each incomplete item, indicate the date of completion.
2. The FTAA Plan will incorporate Owner-provided startup checklists and will follow the Owner standards.
3. Contractor will perform a complete test of the systems installed to include visual inspections and operational tests of all components. Contractor will submit a report of the test to include system reports produced by the system software for each of the components tested and visual inspection reports for each component.
4. FTAA Plan will identify each component of the system, intent of test, method or methods of test and expected results. Each component listed in the plan will include space for test part signatures, brief comments, time of test and pass/fail check boxes.
5. The FTAA plan will be submitted to the Owner's Representative 30 days prior to the scheduled final test.

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C. Contractor will ensure that the system is on and fully operational prior to the start of the test. Contractor will provide a minimum of two employees to conduct the test, one of whom will operate software and other head-end equipment, while the other accompanies the Owner's Representative.

D. Owner's Representative will observe a complete and through demonstration of the systems for compliance and issue a final report. Once all items on the report deemed non-operational or non-compliant with the Specification have been corrected and verified by the Owner's Representative the systems will be deemed acceptable.

E. Provide manufacturer's supervision of final testing of each system.

F. Each system must test free from interference, opens, grounds, and short circuits.

G. Following completion of the Final Test, the system will undergo a thirty (30) day Operational Demonstration Test (ODT) or Burn-In period. This operational demonstration period will start when all specified systems and equipment have been installed and "Substantial Completion" is reached, with no more than a moderate number of punch list items remaining. During this period, the system will be operated under a normal facility traffic load for no less than 30 days. If any item or system fails during the ODT, the 30-day burn-in period will be suspended for that item until repaired or replaced. Once repaired or replaced, the burn-in period will recommence. Final system acceptance of the entire project will be withheld until after successful completion of this operational demonstration period for all systems and components.

8. RECORD DOCUMENTATION

A. Subsequent to completion, the Contractor will submit record documentation for the Project. Record documentation will consist of operation & maintenance manuals, as-built drawings, and a document deviation log. All record documentation will be submitted in digital and hard copy format. Record documentation will meet the following requirements:

1. Digital format: Provide computerized disks, USB drive or compact disks as desired by Owner.
2. Hard Copy: Provide a single copy, hard cover three ring binder for review purposes.
3. Provide three (3) final hard copies each in hard covered three ring binder.

B. Operations & Maintenance manuals will meet the following requirements:

1. Divide into sections for each system, clearly demarcated by a divider titled with the system:

   a. Provide each divider with a tab.
   b. Title each divider with machine print, no smaller than 12 point, to match tabs.

2. Each section will be sub-divided into consistent sub-sections of information:

   a. Provide each section with a table of contents.
   b. Follow each table of contents with contact person information including their name, responsibility, phone number, and address.
   c. Provide a section with a list of equipment, devices and components included in the section.
   d. Include in the list the manufacturer, parts number and contact person to call for questions on each item.

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e. Follow the list provided with technical information on each listed item, in the order of the list:

1) Product data sheets which include but are not limited to pictures, descriptions, dimensions, electrical diagrams, circuit board layouts, etc.
2) Product specifications including but not limited to power requirements, operational criteria, environmental requirements, optical descriptions, etc.

f. Provide information related to the operation of equipment, devices and components:

1) Information provided will be specific to the product models actually installed on the project.
2) Provide information as presented during the training sessions for each system provided for the facility.

g. Provide complete information required for care and maintenance of all equipment, devices and components installed on the project. Information will include but is not limited to:

1) Cleaning: Special procedures or use of special chemicals.
2) Maintaining: Maintenance schedules and tasks, application of products critical to proper operation, types of environmental conditions which need to be maintained or avoided.
3) Trouble Shooting: Instructions for how to proceed should a problem occur, method of determining the seriousness of the problem, repair instructions for minor problems.

h. Provide other Project Specific Information:

1) List of wires, color codes, description of type, tag identification reference.
2) As built drawings.

i. Provide Operations & Maintenance manuals in accordance with the Project General Conditions or as specified in this Section. Where there are conflicts between the Project General Conditions and this Section, provide in accordance with the stricter requirements between the Sections:

1) Where not addressed in other Sections provide per this specification Section.
2) See Security Subsystem Specifications for any additional requirements.

C. As-built drawings will meet the following requirements:

1. As-built drawings will consist of all information indicated under the section herein entitled “Shop drawings” but updated to include the actual conditions encountered during installation.
2. As-built drawings will indicate all cable pathways, termination box location and other information related to above-ceiling or concealed equipment locations.
3. Contractor will provide drawings showing all changes occurring related to documents provided on the project directly related to this section, and all Security Subsystem Specification sections.
4. Contractor will provide scaled drawings of the same formatted size as those originally issued as contract drawings.

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5. Changes will be indicated with referenced graphics that are properly noted:

    a. Clouding will be bold, but without interfering with or obscure documentation information.
    b. Notes will be alphabetically or numerically referenced.
    c. Notations will not interfere with other information on the documents.

6. Drawings will be completed in a digital format using AutoCAD® Software. Version of files provided to be determined by the Owner's Representative at the time that submittal of the information is required.

D. The document deviation log will meet the following requirements:

1. Contractor will provide a tracking log of changes made to the project that occurred that were in deviation of construction documents, and will be included:

    a. Notification date: Provide day that Owner's Representative was notified that a deviation was required or requested.
    b. Approval Date: Provide the day that approval was provided by the Owner's Representative.
    c. Reason that deviation was required or made.

2. Provide drawings and photographs of all custom details, and details originally in the contract drawings that were modified:

    a. Drawings to be submitted on 8 ½ inch x 11-inch sheets or larger.
    b. Provide photos that are 5-inch x 7-inch in size or larger. Photographs will be clear, focused and taken with the proper light:

        1) All details will be clearly visible.
        2) All text will be legible.

9. ACCEPTANCE

A. System Warranty will not start until Acceptance. Acceptance will be withheld until the following activities have been successfully completed:

1. Acceptance of all submittals.
2. Delivery of final documentation.
3. Successful final test and inspection.
4. Successful operational demonstration test.
5. Successful training and demonstration, including operation of systems using the manuals.

B. System contractor will be present at the first use of the facility. The contractor will be on site the day before the event in addition to the day of the event. The event will be decided by the operators as to which one the systems contractor should attend.

10. WARRANTY

A. In addition to all guarantees specified in the Project General Conditions, and specific Warranty requirements stated in the Security Subsystem Specifications, furnish the following warranty:

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1. Period: The Contractor will guarantee all labor, workmanship, and materials for a period of one (1) year from the date of Final Acceptance. Should failure occur within the first year to the system, the Contractor will provide all labor and materials necessary to restore the system to the condition required for the final test and acceptance at no cost to the Owner.
2. Tie-ins: During the Warranty period, additional components may be connected to the installed systems. New devices will be connected in the same manner as shown in the Contract Documents and the existence of the new connections will not void this guarantee. Where software is part of the system, new information will be entered in the database to extend operation of the system.

B. Contractor will/must respond to a request for assistance within 4 hours of receipt and have the repair completed or temporality repaired to the satisfaction of the Owner within 24-hours during the warranty period at no additional cost to the Owner. After-hours service will be available within the four (4) hour window whether or not the Owner elects to purchase a service contract from the Contractor.

C. Contractor's guarantee will include all costs related to troubleshooting, repair and replacement of defective Work, including costs of labor, transportation, materials, equipment and other costs as necessary to restore the system to a complete and operational state:

1. The Owner must not be without an operational system or component of the system should it require a return to the factory for repair or replacement. It will be the responsibility of the Contractor to replace the component during the 24-hour time period outlined above.

D. Contractor will provide local service by factory trained personnel from an authorized dealer of the equipment manufacturer. Contractor will provide written proof from the equipment manufacturer that said Contractor is duly authorized to sell, service and maintain the specified products. The dealer will have available stock of the manufacturer's standard parts for the primary system components and devices. The dealer will provide sufficient parts in inventory or readily available such that repair will be completed in no more than 24 hours. The inventory of spare parts requirement is assuming availability of components through a dealer network and/or obtained from respective manufacturers within the required time frame.

E. Contractor will correct any software or firmware defects identified during the Warranty period without additional cost to the Owner.

F. This warranty will be in addition to and not a limitation of other rights the Owner may have under the Contract Documents.

G. Contractor will warrant that all Work furnished in this project will be of good quality, free from faults and defects, and in conformance with the Contract Documents.

END OF SECTION 280500

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SECTION 280513 – CONDUCTORS AND CABLES FOR ELECTRONIC SECURITY

1.GENERAL

1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including all General and Supplementary Conditions and Division 1 Specification sections shall apply to this section and shall be considered as forming an integral part of this Work. These documents are referred to as the Project General Conditions in the remainder of these Specifications.

B. The Common Work Results for Electronic Security Specification Section shall apply to Work specified in this Section. Where similar requirements headings are listed herein, they are to augment the requirements indicated within the Common Work Results for Electronic Security Section. Nothing herein shall be construed as relieving Contractor from the requirements identified in the Common Work Results for Electronic Security Specification Section.

C. Not all cables shown within this section will be used on this project.

D. The following sections are related and have interaction between them:

1. 28 05 00 Common Work Results for Electronic Security
2. 28 10 00 Access Control
3. 28 20 00 Video Surveillance

E. Other related sections:

1. Division 07 Firestopping
2. Division 08 Door Hardware
3. Division 26 Electrical
4. Division 27 Structured Cabling and Pathways

2. DEFINITIONS

A. ACS – Access Control System

B. AWG - American Wire Gauge

C. SE – Security Enclosure

3. REFERENCES

A. National Electrical Code (NEC)

B. NFPA 70

C. UL 294 and UL 1076 as required where applicable

D. FCC Rules and Regulations

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E. Part 15 Class A or B as applicable

F. Applicable Federal, State, and Local laws, regulations, and other codes

G. CE mark, as and where applicable

H. C-Tick mark, as and where applicable

4. SUMMARY OF WORK

A. Work specified in this Section includes cables used for security systems.

5. SUBSTITUTION

A. See Section 28 05 00 Common Work Results for Electronic Security

6. SUBMITTALS

A. See Section 28 05 00 Common Work Results for Electronic Security

2.PRODUCTS

1. GENERAL

A. “Or approved equal” basis

1. The products are listed, or are on, an “approved equal” basis. The known equals to the products specified are listed in each section.
2. Substitute products not listed in this section may be submitted for approval during the question and answer period of the bidding phase. See substitution requirements in this section.
3. Substitution approvals will be based on the complete functionality, integration, operation, and user interface as it compares to the specified product(s).
4. Products not approved prior to the bidding phase will be deemed non-responsive.

B. Pathway shall follow structured cabling Division 27 standards.

C. Provide Wet Rated Cable as required due to project raceways/pathways.

2. MISCELLANEOUS EQUIPMENT

A. Demarcation Enclosure for Wet to Dry rated cabling

1. Provide a NEMA 3R rated enclosure with hinge, horizontally swinging lid, and cam lock.
2. Size the enclosure as needed for the contents.
3. Indicate locations on Shop Drawings.

B. Enclosure contents shall be:

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1. Phoenix Perforated NS 35/7,5 DIN rail to support DIN rail mounted items.
2. DIN rail mounted Phoenix universal screw terminal blocks model UT2,5 BU, quantity (as needed), end clamp model CLIPFIX 35-5 (as needed), Zack marker strips model ZB 5 (as needed), grounding block model UT 2,5 G for terminal connections (as needed).

    a. Contractor shall label each terminal block to indicate purpose and use.
    b. Provide quantities needed for one wire per terminal

3. CABLES AND WIRING

A. 18 AWG, 6 Conductor Stranded Overall Shield (Type A)

1. Provide Windy City Wire 442351 (Plenum).
2. Known equals:

    a. Superior Essex 2F-C4x-44
    b. Belden
    c. Bertek
    d. Commscope
    e. General Cable

3. Wet Rated Cable shall be

    a. Windy City Wire 714410VNQ
    b. Approved Equal

B. 18 AWG, 4 Conductor Stranded Unshielded (Type B)

1. Provide Windy City Wire442380 (Plenum).
2. Known equals:

    a. Superior Essex 2F-C32-31
    b. Belden
    c. Commscope
    d. General Cable

3. Wet Rated Cable shall be

    a. Windy City Wire 727310VNQ
    b. Approved Equal

C. 16 AWG, 2 Conductor Stranded Unshielded (Type C)

1. Provide Windy City Wire441360 (Plenum).
2. Known equals:

    a. Superior Essex 2F-C12-31.
    b. Belden
    c. Commscope
    d. General Cable

3. Wet Rated Cable shall be

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a. Windy City Wire 728110VNQ
b. Approved Equal

D. Network Communication Cable (Type D)

1. Provide UTP Category cable per Owner/Division 27 standards.

E. 18 AWG, 2 Conductor Stranded Shielded with drain: (Type E)

1. Provide Windy City Wire442320 (Plenum).
2. Known equals:

a. Superior Essex 2F-C12-32
b. Belden
c. Commscope
d. General Cable

3. Wet Rated Cable shall be

a. Windy City Wire 714110VNQ
b. Approved Equal

F. Composite Access Controlled Door Cable (Type F)

1. Provide Windy City Wire4461230 (Plenum).
2. Known equals:

a. Superior Essex AC-A1x-55
b. Belden 658AFJ
c. Commscope
d. General Cable 4EPL4S
e. West Penn AC251822B3PYEx
f. Honeywell 3196

3. Wet Rated Cable shall be

a. Windy City Wire 4461111WBT
b. Approved Equal

G. Network Communication Cable (Type G)

1. Provide UTP Category cable per Owner/Division 27 standards

H. Composite Copper Fiber

1. Provide Windy City Wire 441360 (Plenum)
2. Known Equals:

a. Superior Essex
b. Belden
c. Bertek
d. Commscope
e. General Cable
f. West Penn

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3. Wet Rated Cable shall be:

   a. Windy City Wire 728110VNQ
   b. Approved Equal

3.EXECUTION

1. LABELING

A. Provide labeling in accordance with TIA/EIA 606-A Level 2 numbering and ID format.

B. Mechanically print and install in accordance with manufacturer recommendations and drawing details.

C. Labels shall be single line, all capital letters, and bold font. Select font size and color that can be easily read on the applicable device or cable during installation, inspection, and for service maintenance.

D. Ensure all surfaces are clean prior to final placement of labeling products. Follow manufacturer recommendations for cleaning.

E. Handwritten labels are unacceptable.

2. DELIVERY, STORAGE, AND HANDLING

A. Cabling and related components shall be shipped to the jobsite in original manufacturer's shipping containers.

B. All shipping and handling costs shall be paid for by the Contractor at no additional cost to the Owner.

C. All equipment stored on the job site shall be secured in a locked storage area as designated by the General Contractor or Owner.

D. The contractor may receive a progress payment for the value of the equipment stored on site if adequate storage space is available.

3. TESTING AND COMMISSIONING

A. The Contractor shall be responsible for testing and commissioning the installation in accordance with all applicable documents in the Contract set.

B. Testing shall be comprehensive and sufficient to demonstrate compliance with each requirement.

C. A proposed test plan shall be submitted to the Contracting Officer or Owner's representative for approval before commencement of final test.

D. Final tests shall be conducted in the presence of the Contracting Officer or Owner's representative.

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4. WARRANTY

A. All equipment furnished under this contract shall be warranted for a period of twelve (12) months from the date of final Owner acceptance of the system.

B. Respond to service requests on-site, if required.

C. Replace or repair defective components as required.

5. COORDINATION

A. Coordinate custom ACS cable testing report requirements. Submit report templates to the Owner's Representative for review and acceptance.

END OF SECTION 280513

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SECTION 281000 – ACCESS CONTROL

1.GENERAL

1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including all General and Supplementary Conditions and Division 1 Specification sections shall apply to this section and shall be considered as forming an integral part of this Work. These documents are referred to as the Project General Conditions in the remainder of these Specifications.

B. The Common Work Results for Electronic Security Specification Section shall apply to Work specified in this Section. Where similar requirements headings are listed herein, they are to augment the requirements indicated within the Common Work Results for Electronic Security Section. Nothing herein shall be construed as relieving Contractor from the requirements identified in the Common Work Results for Electronic Security Specification Section.

C. This Specification Section incorporates general requirements for the following security sections.

1. 28 05 00 Common Work Results for Electronic Security
2. 28 05 13 Conductors and Cables for Electronic Security
3. 28 20 00 Video Surveillance

D. Other related sections

1. Division 07 Firestopping
2. Division 08 Door Hardware
3. Division 26 Electrical
4. Division 27 Structured Cabling and Pathways

2. DEFINITIONS

A. AC Alternating Current

B. ACS Access Control System

C. ACP Access Control Panel

D. ADA Americans with Disabilities Act

E. APGS Automated Parking Guidance System

F. API Application Programming Interface

G. ASCII American Standard Code for Information Interchange

H. AV Audio Visual

I. BACnet Building Automation and Control network

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J. BPI Bits Per Inch

K. BPS Bits Per Second

L. CCTV Closed Circuit Television

M. CE European Conformity

N. CPU Central Processing Unit

O. DMU Door Management Unit

P. DVR Digital Video Recorder

Q. FASC-N Federal Agency Smart Credential Number

R. FCC Federal Communications Commission

S. FDA Food and Drug Administration

T. FQRN Fully Qualified Reference Name

U. I/O Input/output

V. ID Identification

W. IDP Intrusion Detection Panel

X. IEC International Electrotechnical Commission

Y. IFC Intelligent Field Controller

Z. In-X-It Entry/Exit

AA. ISO International Organization for Standardization

BB. LDAP Lightweight Directory Access Protocol

CC. LAHJ Local Authority Having Jurisdiction

DD. LED Light Emitting Diode

EE. LPR License Plate Recognition

FF. MIS Management Information Systems

GG. MSEA Metasys System Extended Architecture

HH. NEC National Electrical Code

II. NEMA National Electrical Manufacturers Association

JJ. NFPA National Fire Protection Association

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KK. ODBC Open Database Connectivity

LL. OPC OLE for Process Control

MM. PARCS Parking Access And Revenue Control System

NN. PIAM Physical Identity Access Management

OO. PIN Personal Identification Number

PP. PSIM Physical Security Information Management System

QQ. RAM Random Access Memory

RR. RFQ Request for Quotation

SS. RPC Remote Procedure Call

TT. SDK Software Development Kit.

UU. SEIWG Security Equipment Integration Working Group

VV. SIA Security Industry Association

WW. SMS Security Management System

XX. SPDT Single Pole, Double Throw

YY. UDF User Defined Field

ZZ. UDP User Datagram Protocol

AAA. UL Underwriters Laboratories

BBB. URL Uniform Resource Location

CCC. VSS Video Surveillance System

DDD. WAMS Wireless Access Management Solutions

EEE. XML Extensible Markup Language

3. REFERENCES

A. National Electrical Code (NEC)

B. NFPA 70

C. UL 294 and UL 1076 as required where applicable

D. FCC Rules and Regulations

E. Part 15 Class A or B as applicable

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F. Applicable Federal, State, and Local laws, regulations Codes, and other standards

G. CE mark, as and where applicable

H. C-Tick mark, as and where applicable

I. Work specified herein shall comply with specific provisions of codes and standards adopted by the LAHJ as applies to electric locking devices and controlled egress.

J. Where the LAHJ has adopted a less stringent requirement than those required by the 2009 version of the International Building Code (IBC) for control of electric locking devices, the requirements of IBC 2009 shall govern.

4. SUMMARY OF WORK

A. Work specified in this Section includes systems used for authentication of credential-holders for physical access through associated portals as well as monitoring of intrusion and other alarm information.

B. Contractor will provide field access control equipment and software as necessary to install card, keypad, and/or biometric credential readers.

C. Credentials may be:

1. Access cards / readers
2. Keypads / codes
3. Biometric readers / data
4. Vehicle Tag Credential readers
5. Vehicle License Plate reader / camera

D. Systems shall consist of:

1. Software
2. Servers
3. Credential Management
4. Workstations
5. Alarm initiation / system ancillary devices
6. The ACS shall provide the following functions:

a. Access Control
b. Alarm Monitoring
c. Cardholder management
d. Badge creation and printing
e. System administration
f. Badge layout (template) creation
g. Screen/forms creation
h. Graphical map creation

5. SUBSTITUTION

A. See Section 28 05 00 Common Work Results for Electronic Security

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6. SUBMITTALS

A. See Section 28 05 00 Common Work Results for Electronic Security

7. RECORD DOCUMENTATION

A. See Section 28 05 00 Common Work Results for Electronic Security

2.PRODUCTS

1. GENERAL

A. Manufacturers

1. All access control hardware and software shall be of a single manufacturer including server system, controllers, workstations and input and output terminal modules. The system shall have a fully developed integration with the video surveillance, intrusion detection and intercommunication systems specified on this project.
2. Unless otherwise noted, all materials and equipment shall be new, of the type, capacity, and quality specified and free from defects. Material shall bear the label of, or be listed by, the appropriate local listing agency unless of a type for which label or listing service is not provided.
3. Where multiple items of a similar kind are provided, all shall be identical and of the same manufacturer.
4. The Contract Documents indicate major system components and may not show every component, connector, module, or other accessory that may be required for a complete and operational system. It is the Contractor's responsibility to identify and provide each component necessary for a complete and operational system in accordance with the Contract Documents.

B. "Or approved equal" basis:

1. The following products listed are on an "or approved equal" basis. The known equals to the products specified are listed in this section.
2. Substitute products not listed in this section may be submitted for approval during the question-and-answer period of the bidding phase.
3. Substitution approvals will be based on the complete functionality, integration, operation, and user interface as it compares to the specified product(s).
4. Products not approved prior to the bidding phase will be deemed non-responsive.

C. Access Control

1. Shall be Software House C-Cure 9000, the latest current released version.

a. Known equals

1) S2 Magic Monitor
2) Software House Victor Unified
3) Open Options, DNA Fusion
4) Avigilon Access Control Manager
5) AMAG Symmetry

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D. Known Systems Integration

1. The system will be an integration of products and workflows between VMS, ACS, and Intrusion detection systems.

E. Access Control Panel (ACP)

1. The access control panel will consist of the power supply and the field panel boards for the specific location:
2. Provide LifeSafety Power Enclosure

a. Field Panels for Mercury hardware FPO75/150-2F8-E8S

1) Network Interface

a) Provide Mercury Hardware LP1502

2) Inputs

a) Provide Mercury Hardware MR16IN
b) Or Approved Equal

3) Outputs

a) Provide Mercury hardware MR16OUT
b) Or Approved Equal

4) Card Reader Input Board

a) Provide Mercury hardware MR52
b) Or Approved Equal

3. Provide batteries for 4 hours of operation on loss of power to include lock power.

F. Card Reader System (CRS)

1. Card reader system includes the following;

a. Card Reader, wall mount - see below.
b. Lock specified in Door Hardware.
c. Request-to-Exit switch in door hardware.
d. Request-to-Exit motion detector (If not available in door hardware).
e. Door Position Switch.

G. Card Reader:

1. Provide HID Signo series readers with Bluetooth.

a. 20 - Mullion Mount.
b. 20K – Mullion Mount with Keypad (CRK)
c. 40 - Wall Mount.
d. 40K Wall Mount with Keypad. (CRK)

2. Known Equals

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a. Allegion AptiQ.

1) MT11 Mullion Mount.
2) MT15 Wall Mount.
3) MTK15 Wall Mount with Keypad. (CRK)

H. Badging Station/Credential Printer

1. Provide two (2) badging stations capable of dual side printing HID iClass SE PVC proximity cards.
2. Basis of Design

a. Fargo 70002 DTC1500XE Dual-Sided Printer

3. Provide digital camera for each badging station
4. Provide printer cartridges in sufficient quantity to print five hundred (500) credentials

I. Credentials

1. Provide five hundred (500) HID iClass SE PVC proximity cards with the 13.56 MHz technology in them.

a. These cards shall be printable on both sides.

J. Door Position Switch (D)

1. Provide GE Security Products DPDT 1076D

a. Switch color shall match door frame color.

K. Request to Exit Motion Detector

1. Coordinate with Division 087100 to provide REX motion for locations that do not include REX functions as an integral part of the door hardware.
2. Provide Bosch DS160.
3. Known Equal

a. Tyco Security Products - T.Rex.
b. Allegion Scan II.

L. Local Sounder (LS)

1. Provide White Wheelock MT Multi-tone horn 12/24 volts DC.

M. Local Door Alarm (AL)

1. Provide Designed Security Inc.

N. Remote Door Release (DR)

1. Door release shall be through security intercom master station where doors / gates are equipped with intercom door station.
2. Door locations not equipped with intercom door stations shall utilize United Security Products HUB-3B.

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a. Provide permanent machine produced label for each door controlled, calling out controlled door opening number as it appears in Close-out documents and ACS GUI.

O. Access Workstation (WS)

1. Refer to latest manufacturer specifications.
2. Confirm workstation configuration with manufacturer requirements.
3. Provide (3) 24” HD monitors connected to each station at the following locations;

a. Security Command Center

4. Provide (2) 55” HD monitor connected to each station at the following location;

a. Security Command Center

P. Fiber Optic Transceiver (FT)

1. Provide in locations where distance to IDF is greater than 300 feet cable length.
2. Provide Comnet CNMCSFPPOE with Comnet SFP3 for single mode fiber SFP2 for multimode fiber at each end of the cable run.

Q. Fiber Optic Transceiver Power Supply (PS2)

1. Provide Comnet PS-DRA240-48A (Adjusted voltage at field fiber optic transceiver to 48 VDC output 0.85A).
2. Must be provided when Fiber Optic Transceivers are used.

R. Above Door Junction Boxes

1. Provide above door junction boxes with covers and cam locks for the access control system to house the break-out of the combination cable and service loop.
2. Acceptable product:

a. Hoffman 8-inch X 8-inch X 6-inch.

2. CABLES AND WIRING

A. See 28 05 13 Conductors and Cables Electronic Security.

B. Pathway shall follow Structured Cabling Division 27.

3.EXECUTION

1. EXAMINATION

A. Ensure that relevant doors and door frames are properly prepared for electric locking hardware and door position switches.

B. Verify acceptance of each type of specified request-to-exit hardware for each application with the LAHJ.

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C. Verify fail-safe and fail-secure lock requirements with the Owner's Representative.

2. INSTALLATION

A. ACP

1. Wiring within the ACP panels shall not have more than 0.25" of exposed copper outside of the terminal.
2. High voltage (120 VAC) shall be separate from low voltage wiring within the panel.
3. Install the ACP in a readily accessible location as defined in Article 100 of the NEC 2014.
4. Connect field wiring to boards within the ACP in accordance with manufactures recommendations.

B. End of line supervision

1. Selected field wiring shall be supervised. Cutting, shorting, or altering connections of any wire listed as supervised below, shall be detected, and activate an alarm condition at system workstations. Provide wiring supervision for the following functions:

a. Door position switches.
b. Request-to-Exit devices.
c. Perimeter intrusion detection devices.
d. Any other device which reports a digital (on/off) condition back to the system ACP.

2. End of line supervision shall detect and annunciate four (4) states. Electrical open and short conditions shall not annunciate as any other condition than trouble or fault within the ACS software.

C. All access control system enclosures shall be provided with tamper switches and camlocks with keys.

D. Provide signs or labels on all tamper monitored enclosures warning that an alarm will sound if access is attempted and giving the telephone number of the security workstation operator.

E. Multiple Contractor user privilege levels will likely be established during the installation and testing periods of this Project. As a condition of system final acceptance, all Contractor user privileges shall be removed from the system, unless otherwise authorized in writing, by the Owner. Prior to removal of contractor access privileges, Contractor shall ensure that the Owner has been set up with a master password.

F. Configure the ACS such that devices can be connected to spare input points, output points and card reader inputs on the IFC without requiring reconfiguration of the ACS.

G. Card Readers: Wire card reader LEDs to indicate valid and invalid card reads, and door locked and unlocked conditions. All card reader LED indicators shall operate identically throughout the Project. The LED shall be red in the normal, secured state, and shall be green on valid card read and while the door is unlocked.

H. Electric Locking Mechanisms

1. Interface with electric locking mechanisms provided under a separate Door Hardware Section.

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2. Connections shall be wired fail secure except for those electric locking mechanisms the LAHJ has deemed necessary to fail safe. Contractor shall coordinate with Door Hardware Section to determine which doors are fail safe.

I. Auto-door Interface

1. Interface to auto-door / auto-assist door operators to permit door unlock and activation upon presentation of a valid access control credential.
2. Coordinate with Division 08 and Division 26 for all conduits and power requirements.
3. Provide relay modules as required.

J. Fire alarm interface

1. Connect (hard wire) fail-safe electric and time delay locking mechanisms to the building fire alarm system for fail-safe release upon any fire alarm.
2. Interface with a single low voltage / low current normally closed dry contact from the fire alarm system provided by the fire alarm contractor (coordinate exact locations). The contact shall open on any fire alarm condition.
3. Provide all additional UL listed fail-safe relays and power supplies necessary to interface to this contact and unlock all fail-safe doors.
4. Connect fail-safe relays and power supplies to standard building power. Connection of fail-safe devices to emergency or UPS power shall not be acceptable.
5. Reference the Drawings for fire alarm interface requirements.

K. Provide interface to uninterruptible power system (UPS) for all security head-end components, including those specified in other Security Subsystem Specifications.

L. Install signal in conduit provided as shown on the Electrical and this section drawings. If additional conduit/raceway/tray is required for systems, provide.

M. Conduit/raceway/tray/wire management not shown on these drawings but required for a complete system or by code is to be included in this scope of work. This section cabling exposed to public view is to be in conduit. This section's exterior junction boxes, conduit/raceway, terminations, etc. at, and those within, enclosures where enclosures are exposed to outdoor conditions are to meet NEMA ratings for outdoor electrical applications.

3. PROGRAMMING

A. Enter all data needed to make the Security System operational. Deliver the data to the Owner on data entry forms, utilizing data from the Contract Documents, Contractor's field surveys and all other pertinent information in the Contractor's possession required for complete installation of the database. Identify and request from the Owner any additional data needed to make the Security System fully operational and integrated. Provide the completed forms to the Owner for review and approval at least 30 days prior to the Contractor's scheduled need date.

B. Programming and setup data shall include, at a minimum, the following:

1. Graphical maps and icons:

a. Coordinate with the Owner's Representative to obtain AutoCAD architectural backgrounds for implementation as graphical maps. Import all AutoCAD background information provided by the Owner's Representative and produce a complete set of graphical maps depicting all ACS points.

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b. Partition and segregate graphical map displays between “Base Building” and “Tenant” as specified herein.

2. ACS card reader information:

a. Coordinate all card reader values and text, including descriptors, alarm messages, VSS camera call up, map call up and identification with the Owner’s Representative.
b. Certain card readers shall be designated for handicap access only. Coordinate special access privileges with the Owner’s Representative and program the ACS accordingly.

3. Input and output points for the ACS. Coordinate all input and output priorities and text, including descriptors, alarm messages, VMS Camera call up, and map call up and identification with the Owner’s Representative.
4. Initial system users, including levels of access. This shall include the designation of an Owner’s representative at the "Super User" level immediately upon ACS initialization.
5. Initial VMS camera call-up and alarm information for interface with VMS system.
6. Alarm monitoring and automatic shutdown information for the UPS interface.

C. Delivery, Storage, And Handling:

1. SMS components shall be shipped to the jobsite in original manufacturer’s shipping containers.
2. All shipping and handling costs shall be paid for by the Contractor at no additional cost to the Owner.
3. All equipment stored on the job site shall be secured in a locked storage area as designated by the General Contractor or Owner.
4. The contractor may receive a progress payment for the value of the equipment stored on site if adequate storage space is available.

D. Testing and Commissioning:

1. The Contractor shall be responsible for testing and commissioning the installation in accordance with all applicable documents in the Contract set.
2. Testing shall be comprehensive and sufficient to demonstrate compliance with each requirement.
3. A proposed test plan shall be submitted to the Contracting Officer or Owner’s representative for approval before commencement of final test.

E. Final tests shall be conducted in the presence of the Contracting Officer or Owner’s representative.

4. SERVICE CONTRACT

A. See 28 05 00 Common Work Results for Electronic Security

5. COORDINATION

A. Coordinate cylinder and master key requirements for LAAs and bypass key switches.

B. Coordinate custom ACS report requirements. Submit report templates to the Owner’s Representative for review and acceptance.

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C. Coordinate initial database partitioning and setup with the Owner prior to initial programming and cardholder data entry.

D. Coordinate door hardware for ACS doors with Division 08 to ensure the ACS will function properly.

E. Coordinate conduit/cable pathways within walls and door frames for routing of cabling to end-of-line devices with Division 26.

F. Coordinate IP addressing of all system components.

6. PREPARATION FOR SITE OBSERVATION

A. Prior to requesting final site observation of the ACS system, Contractor will submit test sheets for each ACS portal confirming final testing and commissioning has been completed.

1. Minimum data needed for the test sheets.

a. Project Name
b. Equipment Type
c. Equipment location
d. All components are tested
e. Wiring installed in conduit or raceway
f. Grounds installed as specified and tested
g. Equipment connections properly torqued
h. Batteries installed in control cabinets
i. Card Readers tested
j. Control cabinet wiring has been dressed
k. Equipment labeled
l. Control Panel programmed
m. Access database programing complete
n. Interface to elevator or fire system tested and complete
o. Network functional to allow head end connection
p. IP address
q. Subnet Mask
r. Controller
s. Sub Controller (If used)
t. Board
u. Point
v. Testing card results for:

1) Valid
2) Invalid by name
3) Invalid by permission
4) Invalid by no programming
5) Valid per floor

w. DC Voltage at Card Reader
x. Ohm Reading of device wiring from control panel (with resistor at EOL)
y. Card Reader within 300’ of nearest control panel
z. Document the system schedule that the card reader is assigned.

END OF SECTION 281000

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SECTION 282000 – VIDEO SURVEILLANCE

1.GENERAL

1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including all General and Supplementary Conditions and Division 1 Specification sections shall apply to this section and shall be considered as forming an integral part of this Work. These documents are referred to as the Project General Conditions in the remainder of these Specifications.

B. The Common Work Results for Electronic Security Specification Section shall apply to Work specified in this Section. Where similar requirements headings are listed herein, they are to augment the requirements indicated within the Common Work Results for Electronic Security Section. Nothing herein shall be construed as relieving Contractor from the requirements identified in the Common Work Results for Electronic Security Specification Section.

C. This Specification Section incorporates general requirements for the following security sections.

1. 28 05 00 Common Work Results for Electronic Security
2. 28 0513 Conductors and Cables for Electronic Security
3. 28 10 00 Access Control

D. Other related sections

1. Division 07 Firestopping
2. Division 26 Electrical
3. Division 27 Structured Cabling and Pathways

2. DEFINITIONS

A. ACAMS: Access Control Alarm Management System

B. APGS: Automated Parking Guidance System

C. CCD: Charged Coupled Device

D. HD: High Definition

E. IETF: Internet Engineering Task Force

F. IP: Internet Protocol

G. IPS: Images Per Second

H. ITU: International Telecommunications Union

I. LPR: License Plate Recognition

J. MP: Megapixel

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K. MPEG: Moving Picture Experts Group

L. NTSC: National Television System Committee

M. ONVIF: Open Network Video Interface Forum

N. PAL: Phase Alternating Line

O. PARCS: Parking Access And Revenue Control System

P. PTZ: Pan, Tilt and Zoom

Q. RWC: Regional Watch Center

R. SCC: Security Control Center

S. SD: Standard Definition

T. VMS: Video Management System

U. WAN: Wide Area Network

3. REFERENCES

A. Electronics Industry Association (EIA) RS-170a standard for analog video

B. NTSC broadcast video standard

C. ITU PAL-B broadcast video standard (Referred to herein as simply PAL)

D. ONVIF standards for IP video interoperability

E. MPEG standards for video encoding / decoding

F. ITU-T standards for video encoding / decoding

G. National Electrical Code (NEC)

H. NFPA 70

I. UL 294 and UL 1076 as required where applicable

J. FCC Rules and Regulations

K. Part 15 Class A or B as applicable

L. Applicable Federal, State, and Local laws, regulations and other codes

M. CE mark, as and where applicable

N. C-Tick mark, as and where applicable

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4. SUMMARY OF WORK

A. Work specified in this Section includes systems used for visual monitoring and recording of activities within the scene of view of attached cameras and associated features and functions, and equipment as necessary to support this capability.

B. Systems shall consist of:

1. Software
2. Recording servers
3. Management server
4. Recording storage
5. Client Workstations
6. Cameras
7. Network video encoders
8. Camera housings and mounts
9. Video analytics software / firmware
10. License plate recognition software / hardware / licensing

C. The VMS shall provide the following functions:

1. Video display as necessary for live monitoring and assessment of security incidents
2. Recording of, and retrieval from, video to digital storage media for historical record
3. Graphical map creation
4. System administration
5. Reports generation
6. License plate recognition systems integration to VMS / ACS

D. The VMS shall consist of a collection of devices by different manufacturers that are seamlessly managed by a single software package over an IP-based communications network. Video generated natively in digital IP format, as well as analog video digitized by an IP encoder shall both be supported by the VMS.

E. The VMS shall have the capability to integrate with intelligent video analysis products for monitoring of specific activities or behaviors that occur within the scene of view of the associated camera.

F. Multiple disparate video surveillance systems shall have the ability to be linked together in a centralized architecture, allowing cameras from any system to be viewed on any other system. The centralized architecture shall be configured and managed in a hierarchical manner.

G. The VMS shall incorporate security measures, including advanced authentication measures and encryption of data.

H. The VMS shall provide for redundancy of video storage using local storage at camera locations where critical or essential as indicated in the Construction Documents. Upon loss of recording server or network connectivity, the camera shall automatically buffer video to local storage, then automatically upload that video to the recording server upon restoral.

I. Components of the VMS that use proprietary digital technologies shall have an associated software developer's kit (SDK) that is published, regularly updated, and available for other manufacturers / software vendors to write to.

J. Contractor shall provide video analytics programming of no less than ten (10) rules for the system and shall include the camera programming and licenses to activate these analytics

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2.PRODUCTS

1. GENERAL

A. Unless otherwise noted, all materials and equipment shall be new, of the type, capacity, and quality specified and free from defects. Material shall bear the label of, or be listed by, the appropriate local listing agency unless of a type for which label or listing service is not provided.

B. Where multiple items of a similar kind are provided, all shall be identical and of the same manufacturer.

C. The Contract Documents indicate major system components and may not show every component, connector, module, or other accessory that may be required for a complete and operational system. It is the Contractor's responsibility to identify and provide each component necessary for a complete and operational system in accordance with the Contract Documents.

2. "OR APPROVED EQUAL" BASIS

A. The system is specified on a basis of design to indicate performance and workflow. Use of approved equal or proposed substitutions must meet the performance and workflow accommodations of the basis of design.

B. The following products listed are on an "or approved equal" basis. The known equals to the products specified are listed in this section.

C. Substitute products not listed in this section may be submitted for approval during the question-and-answer period of the bidding phase.

D. Substitution approvals will be based on the complete functionality, integration, operation, and user interface as it compares to the specified product(s).

E. Products not approved prior to the bidding phase will be deemed non-responsive.

3. MANUFACTURER

A. This project is to provide a new IP video surveillance system for the project. Contractor shall provide licenses for all devices and storage requirements for this project, plus five (5) extra licenses.

B. Video surveillance camera recording shall include the following areas;

1. Public Entrances
2. Concourses
3. Loading Dock
4. Site Perimeter to include Fence Line
5. Interior Public Spaces
6. Interior Corridors

C. Acceptable Product:

1. Shall be the Genetec Omnicast, the latest version.

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a. Known equals:

1) S2 VR2 with Magic Monitor
2) Software House Victor Unified
3) Milestone, X-Protect
4) Avigilon Access Control Center
5) Salient

D. Known Systems Integration

1. The system will be integrated between VMS and ACS systems to provide system administration and monitoring through one unified platform.

4. IP CAMERAS

A. All IP cameras shall be compatible with selected VMS.

B. In all cases the basis of design represents a standard of performance and the Contractor shall indicate, or submit as substitution, the most current version equivalent to the basis of design.

C. All IP cameras shall have the following mounting types:

1.

C	Ceiling Mount
G	Goose Neck/Parapet Mount
L	Pole Mount
R	Recessed/Flush Mount
S	Surface Mount
W	Wall Mount
P	Pendant Mount

2. Mounts shall be as recommended by the individual manufacture for each mounting type.

D. Type 1 Elevator Camera

1. Provide corner mount adapter.
2. Contractor shall provide 2N Telecommunications Model #9159014 2-Wire converter at both ends of the travel cable for the elevator camera.
3. Contractor shall coordinate with the elevator contractor for installation of the elevator security components.
4. Basis of Design

a. Axis Q9216-SLV metal

5. Known equals

a. Hanwha Techwin QNV-6082R
b. Bosch NCN-90022-F1

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E. Type 3 Fixed 3MP/1080P Dome with IR

1. Basis of Design

   a. Axis P3245-LVE

2. Known equals

   a. Bosch NIN-73023-A3A
   b. Pelco IMP221-1R
   c. Hanwha Techwin QND-7080R

F. Type 5 – Fixed 5.0MP Dome

1. Basis of Design

   a. Axis Q3517-LVE

2. Known equals

   a. Hanwha Techwin QNV-8082R
   b. Bosch NDI-50051-A3
   c. Pelco IMP521-1IRS

G. Type 8 Fixed 4K/8MP Dome with IR

1. Basis of Design
2. Hanwha Techwin XNV-9082R
3. Approved equal

H. Type 10 Fixed 180 Multi Imager

1. Basis of Design

   a. Axis Q3708-PVE

2. Known equals

   a. Hanwha Techwin PNM-9030V
   b. Pelco IMM12018-1ES

I. Type 20 Fixed 360 Multi Imager

1. Basis of Design

   a. Axis P3707-PE

2. Known equals

   a. Hanwha Techwin PNM-9084QZ
   b. Bosch Flexidome IP Panoramic 7000 MP, 12 MP
   c. Pelco IMM12036-1ES

J. Type 21 Fixed 360 Fish-eye Dome

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1. Basis of Design

   a. Axis

2. Known equals

   a. Hanwha Techwin XNF-9010RV
   b. Pelco

K. Type 30 Fixed 360 Panoramic

1. Basis of Design

   a. Hanwha PNF-9010RV

2. Approved equal

L. Type 40 PTZ Dome

1. Basis of Design

   a. Axis Q6075-E

2. Known equals

   a. Hanwha Techwin XNP-9300R
   b. Pelco S6230-EGL1
   c. Bosch VG5-7230-EPC4

M. Type 41 PTZ Dome

1. Basis of Design

   a. Axis Q6075-E

2. Known equals

   a. Hanwha Techwin XNP-6550RH
   b. Pelco S6230-EGL1

5. CABLES AND WIRING

A. See 28 05 13 Conductors and Cables Electronic Security.

B. Pathway shall follow Structured Cabling Division 27.

C. Coordinate cable type and installation with Division 27.

6. MISCELLANEOUS EQUIPMENT

A. Power Supply

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1. Power Over Ethernet (PoE, PoE+, PoE++) power sources provided by Owner.

7. FIBER OPTIC TRANSCEIVER LINK

A. Provide fiber optic transceivers for cameras that are over 90 meters from the MDF/IDF/IT rooms.

1. Provide NEMA 4 housing for transceiver to be mounted in near camera.
2. Provide NEMA 12 housing for mounting transceivers within IDF rooms.
3. Provide Din Rail mounting of devices in the enclosures.
4. Provide 48 VDC @ 0.85 A at transceiver per transceiver power supply in the IDF room. Power the transceiver next to the camera over composite cable (1) pair 12 AWG, (1) pair fiber copper cable with no splices from IDF.
5. Acceptable Product:

   a. (2) Comnet CNMCSFPPOE with Comnet SFP6 for single mode fiber or with SFP2 for multimode fiber. (FOT Type 1).
   b. (1) Comnet CNGE2FE8MSPOE2 with CNMC[2]SFP[POE][/M] and Comnet SFP-6 Module for single mode or with SFP 2 for multimode fiber. (FOT Type 2).

6. (1) Comnet PS-DRA240-48A (Adjust voltage at field transceiver to 48 VDC output 0.85A).

8. TECHNICAL REQUIREMENTS

A. Video management software

1. Shall support all features defined within the section above entitled “Summary of Work”.
2. Video management software shall be scalable up to an unlimited number of connected IP cameras, encoders, and other system devices.
3. Video management software shall be hardware-agnostic and shall support industry-standard hardware devices such as servers, workstation PCs, storage and other devices from standard industry sources.
4. Video management software must have Multi-cast capability from cameras and server to Client locations.
5. Mobile applications must be Apple IOS and Android capable.
6. Video management software must have seat mapping capability.

B. Server Hardware General

1. Provide operating system for the system server(s) as per VMS manufacturer requirements. Where multiple system server operating systems are supported by the VMS manufacturer, MS Windows® products shall be used. Provide specifications and requirements for all server hardware with product data submittals.
2. System server(s) shall comply with all relevant Owner IT requirements.
3. Where the Owner IT Requirements do not provide specific direction, system server and its individual components shall not be proprietary to a specific manufacturer.
4. Minimum specifications for the system server shall be as per the published minimum specifications of the VMS manufacturer. Confirm specific requirements with the VMS manufacturer based on Project capacity and project requirements.
5. Servers to be located within a secured air-conditioned space with Uninterruptable Power Supply power for up to Twenty-four (24) hours of standby power.

C. Video management server

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1. The video management server shall provide for central management of all video recording servers, client workstations, cameras, and other system devices.
2. Provide uninterruptable power supply (UPS) capable of supporting full server functions for a minimum of 24-hours
3. Acceptable Product:

    a. Streamvault Model SV-2020EX-R6S-D480-236
    b. Network Interface Card

        1) Provide quantity two (2) 1GbE RJ45 ports
        2) Provide quantity two (2) 10GbE SFP+ ports

D. Video recording server

1. The video recording server shall receive video streams from associated cameras, record the video data from these streams to the system database and attached storage, and serve live video to monitoring client workstations.
2. The system server shall incorporate RAID level 6 redundant storage technology or approved equivalent. Redundant disks shall be hot-swappable, shall be accessible from the front of the server unit and shall provide a visual indication of disk status on the front of each disk.
3. Video servers shall be populated such that no more than Seventy-five (75) per-cent of recording disk space is utilized for each server.

E. Video Storage device:

1. Provide a video storage device that can store all video from all cameras on this project and site project for forty-five (45) days at full resolution and full available frame rate per camera.
2. Acceptable Product:

    a. Streamvault Model SV-4020EX-R26-416T-16-216

        1) Provide additional drives as required to meet specified storage requirements.

    b. Rack Mount Console

        1) Provide rack mountable console for local access to ACS and VMS related servers:
        2) Basis of Design

            a) Middle Atlantic RM-KB-LCD17KVMHD

9. CLIENT WORKSTATION HARDWARE

A. Contractor shall provide the access control and video surveillance system workstation client software and computer workstations at the following locations;

1. Security Operation Center
2. Administration Reception

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B. Contractor shall integrate the access control system, the video management system, intercom system, and intrusion detection systems to work as one integrated system at all security operation monitoring locations.

1. The client workstation shall provide for operator interface to the system, including all management, monitoring and control activities.
2. Client workstation shall comply with all relevant Owner IT requirements.
3. Provide operating system for the client workstation as per VMS manufacturer requirements. Where multiple client workstation operating systems are supported by the VMS manufacturer, MS Windows® products shall be used.
4. Where Owner IT Requirements do not provide specific direction, client workstation and its individual components shall not be proprietary to a specific manufacturer.
5. Minimum specifications for the client workstation shall be as per the published minimum specifications of the VMS manufacturer. Confirm specific requirements with the VMS manufacturer based on Project capacity requirements. Provide specifications of proposed workstations and requirements with product data submittal.

C. Network transmission hardware: Coordinate with the Owner's IT/Telecom group for equipment requirements, including switches, power over Ethernet injectors, and any other network equipment specified within the Construction Documents.

10. DIGITAL DISPLAYS

A. 24" digital display

1. Max resolution: 1920x1200 pixels
2. Brightness: 400 cd/m2
3. Contrast ratio: 1000:1
4. Aspect ratio: 16:9
5. Inputs: 2 – composite video, 1 – S-Video, 1 – DVI/HDMI, Display port
6. Vendors with acceptable products;

a. Viewsonic
b. LG
c. Samsung
d. Others as approved

B. 55" digital display

1. Max resolution: 1920x1080 pixels
2. Brightness: 500 cd/m2
3. Contrast ratio: 1300:1
4. Aspect ratio: 16:9
5. Inputs: 2 – composite video, 1 – S-Video, 1 – DVI/HDMI, Display port
6. Vendors with acceptable products;

a. Viewsonic
b. LG
c. Samsung
d. Others as approved

3.EXECUTION

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1. GENERAL

A. Coordinate incorporation of the Work specified herein with other project work as to facilitate a cohesive final Product.

B. Mount equipment and enclosures plumb and level.

C. Permanently installed equipment to be firmly and safely held in place. Design equipment supports to support loads imposed with a safety factor of at least five. Seismic bracing shall be installed on appropriate equipment where local codes require such installation.

D. Verify all locations of equipment in all rooms with Owner's Representative, Owner, and Consultant.

2. PROGRAMMING

A. Provide all initial system programming and setup of the VMS system including, but not limited to the following:

1. Enrollment of all cameras, encoders, and other devices into the VMS software. Provide all necessary configuration of each device, including IP address, name, description, frame rate, compression ratio, resolution, and other required settings.
2. Configuration of all rules-based actions within the system including setup of initiating events, and all resulting actions.
3. Initial setup for the interface with the ACAMS. The interface shall provide for automatic VMS camera selection upon alarms within the ACAMS as specified herein and as indicated in the Contract Documents. Coordinate automatic VMS camera selection, real-time record initialization, and VMS record status alarm annunciation requirements with the Owner prior to programming.
4. VMS software graphical maps and icons. Coordinate with the Owner's Representative to obtain AutoCAD architectural backgrounds for implementation as graphical maps. Import all AutoCAD background information provided by the Owner's Representative and produce a complete set of graphical maps depicting all VMS points.
5. Automatic selection of a VMS camera adjacent to applicable card readers upon an invalid card use. Coordinate automatic camera selection requirements with the Owner prior to system programming.
6. Automatic selection of a VMS camera adjacent to applicable door position monitored openings upon a "Door Forced"/"Door Propped" condition. Coordinate automatic camera selection requirements with the Owner prior to system programming.
7. Automatic selection of a VMS camera adjacent to applicable radar and/or fiber optic fence monitoring sensor upon a "Alarm" condition. Coordinate automatic camera selection requirements with the Owner prior to system programming.
8. Cameras shall be programmed into the VMS in a logical format and with a naming structure that permits monitoring locations to easily track an individual from one camera view to the next.

3. COMMISSIONING

A. Prior to energizing or testing the system, ensure the following:

1. All products are installed in a proper and safe manner according to manufacturer's instructions.
2. Insulation and shrink tubing are present where required.

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3. Dust, debris, solder splatter, etc. is removed.
4. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
5. Labeling has been provided.
6. Temporary facilities and utilities have been properly disconnected, removed, and disposed of off-site.
7. Products are neat, clean, and unmarred and parts securely attached.
8. Broken work, including glass, raised flooring and supports, ceiling tiles and supports, walls, doors, etc. have been replaced or properly repaired, and debris cleaned up and discarded.

B. Prior to energizing the System verify and perform the following tests and adjustments in compliance with applicable EIA standards.

1. Electronic devices are properly grounded.
2. Test each AC power receptacle with a circuit checker for proper hot, neutral, and ground connections.
3. Verify each individual component is operating properly.

C. Verify each individual component's performance meets the manufacturer's published performance for this unit.

4. FINAL OBSERVATION AND TESTING

A. Upon completion of installation, initial adjustments, tests and measurements specified in Part 3, and submission and review of the results, a final observation and test will be performed by the Owner or Owner's representative no earlier than two weeks after receipt of the written results.

B. Provide a minimum of one (1) person for observation and testing familiar with aspects of the System to assist the Owner.

C. The process of testing the System may necessitate moving and adjusting certain components.

D. Testing includes operation of each major system and any other components deemed necessary. Perform tests and utilize required test equipment, tools and material required to make any necessary repairs, corrections, or adjustments.

E. The following procedures will be performed on each System:

1. Observation of the methods and means employed to incorporate the System within the facility.
2. Verification of proper operation, from controlling devices to controlled devices.
3. Verification of proper adjustment, balance, and alignment of equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for each level control, and appropriately record these settings within the Record Documents.
4. Other tests on equipment or systems deemed appropriate.

F. In the event the need for further adjustment or work becomes evident during testing, the Contractor is to continue his work until the System is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications and any extension of the observation and testing period is required, the Contractor shall pay for additional time and expenses of the Owner at the standard rate in effect at that time.

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G. Contractor shall plan on making one (1) additional pass through all video surveillance camera locations after system has been programmed and made operational in order to finalize camera aiming, views, and focus to Owner's satisfaction.

5. OWNER PERSONNEL TRAINING

A. See 28 05 00 Common Work Results for Electronic Security

6. WARRANTY

A. See 28 05 00 Common Work Results for Electronic Security

END OF SECTION 282000

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SECTION 283100 FIRE DETECTION & ALARM

PART 1 - GENERAL

1.1 SUMMARY

A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements, Division 1 Specifications, apply to this Section.

B. See Division 08 Section "Door Hardware" for door closers and holders with associated smoke detectors, electric door locks, and release devices that interface with the fire alarm system.

C. See Division 23 for any related HVAC equipment which requires interfacing to the fire alarm system.

D. Definitions:

1. FACP: Fire alarm control panel.
2. Definitions in NFPA 70 and 72 apply to fire alarm terms used in this Section.
3. Where specified within or noted on contract documents, the acronym EC (Electrical Contractor) or FAC (Fire Alarm Contractor) shall be considered as “one”. Where the electrical contractor has subcontracted to a licensed fire alarm contractor, both parties shall be responsible for a complete code compliant operational fire alarm system. Coordination of both parties is a requirement of the specification.
4. ASME: American Society of Mechanical Engineers
5. FM: FM Global (Factory Mutual)
6. Furnish: To supply the stated equipment or materials.
7. Install: To set in position and connect or adjust for use.
8. LED: Light-emitting diode.
9. NCC: Network Command Center
10. NFPA: National Fire Protection Association. Definitions in NFPA 72 apply to fire alarm terms used in this Section.
11. NICET: National Institute for Certification in Engineering Technologies.
12. Provide: To furnish and install the stated equipment or materials.
13. UL: Underwriters Laboratories

E. All equipment furnished shall be new and the latest state of the art products of a single manufacturer, engaged in the manufacturing and sale of fire detection devices for over ten years.

1. In the interest of job coordination, the installing contractor shall contract with a single source for supplying job materials, services, and programming, including final inspection/test services and UL listing for the completed fire alarm system.
2. The equipment, space requirements, expansion capabilities and features specified were selected to meet the special requirements for design of this project. The following manufacturers have been pre-approved for bidding purposes on this project. All requirements listed in this specification shall apply to all manufacturers. Listing as acceptable shall not be construed as approval for systems not performing to all requirements set forth herein.

F. System Description:

1. The work covered by this section of the specifications includes the providing of all labor, equipment, materials, and performance of all operations in connection with the installation of a new “in-compliance” fire alarm system.
2. Furnish and install a complete addressable fire alarm system as described herein and as required by code. Fire alarm manufacturer shall design and provide all required drawings, calculations, stamps, specification, equipment and required components for a complete operational in compliance system. Fire alarm drawings within Contract Documents are shown for coordination. All fire alarm components to be wired, connected, and left in first class operating condition. The system shall use closed loop initiating devices circuits with individual zone supervision, individual notification, appliance circuit supervision and power supervision.
3. Said system to include remote annunciator panels, NAC, transponders and/or amplifiers panels, manual pull stations automatic smoke/heat/duct detectors, notification devices, programming, training, wiring, terminations to devices, outlet boxes, junction boxes, and all other necessary material for a complete operating system. Operation of all notification appliances shall be synchronized as defined by NFPA 72.
4. Fire Alarm system shall be compatible with BACnet communication protocol.
5. The complete installation is to conform to the applicable sections of NFPA-72, Local Code Requirements, Maryland Building Code, Americans with Disabilities Act (ADA) and National Electrical Code with particular attention to Article 760.
6. Testing, certification and education labor shall be included.

G. Performance Requirements:

1. Premises protection includes use and occupancy classification of the building as shown on Architectural Life Safety sheets.
2. Software:
   a. The fire alarm system shall allow for loading and editing instructions and operating sequences as necessary. The system shall be capable of on-site programming via a stationary computer to accommodate system expansion and facilitate changes in operation. This complete computer station shall be provided as part of this contract and contain all software, hardware, cabling, interfaces or adapters required for all programming and maintenance functions. Computer hardware/software upgrades and updates shall be provided at no additional cost.
   b. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control unit. Loss of primary and secondary power shall not erase the instructions stored in memory.
   c. Upon final completion of installation, testing and programming the Owner shall receive at no additional cost a compact disc containing final fire alarm configuration, access software and miscellaneous documentation for future reference and programming restoration. This disc shall also contain relevant manuals, installation details, specifications sheets for all installed fire alarm devices and sub components.
   d. This Contractor shall provide all future software updates or hardware upgrades during warranty period.
3. Fire alarm signal initiation shall be by one or more of the following devices:

a. Manual stations.
b. Heat detectors.
c. Smoke detectors.
d. Duct detectors.
e. Automatic sprinkler system water flow and tamper switches.

4. Fire alarm signal shall initiate the following actions (Where Available):

   a. Alarm notification appliances shall operate continuously.
   b. Identify alarm at the FACP and remote annunciators.
   c. Transmit an alarm signal to the remote alarm receiving station.
   d. Unlock electric door locks in designated egress paths (where applicable)
   e. Release fire and smoke doors held open by magnetic door holders.
   f. Switch heating, ventilating, and air-conditioning equipment controls to fire alarm mode.
   g. Transmit signal to elevator controller for recall and code related functions (where applicable).
   h. Transmit signal to escalator controller(s) for fire alarm imitation sequences per awarding manufacturer installation requirements.
   i. Close smoke dampers in air ducts of system serving zone where alarm was initiated (where applicable.)
   j. Record events in the system memory.
   k. Transmit signal to master lighting controller for evacuation mode.
   l. Transmit notifications to PA system and main scoreboard broadcasting fire alarm evacuation message(s)
   m. Other NFPA 72 or Authority of Jurisdiction requirements.

5. Supervisory signal initiation shall be by one or more of the following devices or actions:

   a. Operation of a fire-protection system valve tamper.

   b. Gas valves servicing food service equipment shall be de-energized upon activation of local fire suppression system with notification to fire alarm system.

6. System trouble signal initiation shall be by one or more of the following devices or actions:

   a. Open circuits, shorts and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.
   b. Opening, tampering, or removal of alarm-initiating and supervisory signal-initiating devices.
   c. Loss of primary power at the FACP.
   d. Ground or a single break in FACP internal circuits.
   e. Abnormal ac voltage at the FACP.
   f. A break in standby battery circuitry.
   g. Failure of battery charging.
   h. Abnormal position of any switch at the FACP or annunciator.

7. Wiring/Signal Transmission:

   a. Transmission shall be addressable signal transmission, dedicated to fire alarm service.

b. System connections for initiating (signaling) circuits and notification appliance circuits shall be Class B.
c. Circuit Supervision: Circuit faults shall be indicated by a trouble signal at the FACP and annunciator panels. Provide a distinctive indicating audible tone and alphanumeric annunciation.

8. Remote Access:

a. FACP shall have the capacity to provide Remote Access through a data network communications. Communication shall be via a personal computer or technician’s laptop, configured with terminal emulation software shall have the ability to access the FACP for diagnostics, maintenance reporting and information gathering.

b. Service Gateway: A Service Gateway software application shall be provided that allows an authorized service person to remotely query panel status during testing, commissioning, and service without the need to return to the pane.

9. History Logs: The system shall provide a means to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history. A separate alarm and trouble log shall be provided.

H. Drill: A manual evacuation (drill) switch shall be provided to operate the notification appliances without causing other control circuits to be activated.

1.2 SUBMITTALS

A. Fire Alarm Contractor (FAC) shall verify, comply and adjust device quantities, device types, locations, while meeting code and local authority having jurisdiction requirements. FAC shall submit final drawings, specifications for devices and cabling, calculations (battery, voltage drop etc.), qualifications and other paperwork required for a passing permit.

B. Stamped drawings where required by the Authority Having Jurisdiction shall be stamped by an Engineer registered in the State of Ohio at the expense of the fire alarm system manufacturer.

C. Product Data: For each type of product indicated.

D. Shop Drawings:

1. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
2. Device Address List: Coordinate with final system programming.
3. System riser diagram with device addresses, conduit sizes, and cable and wire types and sizes.
4. Wiring Diagrams: Power, signal, and control wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Show wiring color code.

5. Batteries: Size calculations.

E. Field quality-control test reports.

F. Operation and maintenance data.

G. Submittals to Authorities Having Jurisdiction: In addition to distribution requirements for submittals specified in Division 01 Section "Submittals," make an identical submittal to Authorities Having Jurisdiction. To facilitate review, include copies of annotated Contract Drawings as needed to depict component locations. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from Authorities Having Jurisdiction, submit them to Architect for review.

H. Documentation:

1. Approval and Acceptance: Provide the "Record of Completion" form according to NFPA 72 to Owner, Architect, and Authorities Having Jurisdiction.

2. Record of Completion Documents: Provide the "Permanent Records" according to NFPA 72 to Owner, Architect, and Authorities Having Jurisdiction. Format of the written sequence of operation shall be the optional input/output matrix.

a. Hard copies on paper to Owner, Architect, and Authorities Having Jurisdiction.

b. Electronic media (AutoCAD®) provided to Architect.

1.3 QUALITY ASSURANCE

A. Each and all items of the Fire Alarm System shall be listed as a product of a SINGLE fire alarm system manufacturer under the appropriate category by Underwriters' Laboratories, Inc. (UL), and shall bear the "UL" label. All control equipment to be listed under UL category as a single control unit. Partial listing shall NOT be acceptable.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. The equipment and installation supervision furnished under this specification shall be provided by a manufacturer (independent dealers and/or distributors will NOT be considered) who has been engaged in production of this type (software driven) of equipment for at least ten (10) years, and has a fully-equipped service organization within fifty (100) miles of the installation. Technicians shall be factory trained and NICET certified.

D. All control equipment must have transient protection devices to comply with UL864 requirements.

1.4 ADDITIONAL DEVICES

A. Provisions for 10% extra of each notification and initiating appliance shall be provided. Where devices are not used in final arrangement, they shall be turned over to the Owner for spare allocation.

B. Break Rods for Manual Stations (Where used): Furnish quantity equal to 15 percent of the number of manual stations installed; minimum of 6 rods.

C. Sensor Bases: Furnish quantity equal to 2 percent of the number of units of each type installed but not less than one of each type.

1.5 MAINTENANCE SERVICE

A. Maintenance Service Contract: Provide maintenance of fire alarm systems and equipment for a period of 12 months, using factory-authorized service representatives.

B. Basic Services: Systematic, routine maintenance visits on a quarterly basis at times scheduled with the Owner. In addition, respond to service calls within 24 hours of notification of system trouble. Adjust and replace defective parts and components with original manufacturer's replacement parts, components, and supplies.

C. Additional Services: Perform services within the above 12-month period not classified as routine maintenance or as warranty work when authorized in writing. Compensation for additional services must be agreed upon in writing prior to performing services.

D. Renewal of Maintenance Service Contract: No later than 60 days prior to the expiration of the maintenance services contract, deliver to the Owner a proposal to provide contract maintenance and repair services for an additional one-year term. Owner will be under no obligation to accept maintenance service contract renewal proposal.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. FACP and Equipment:

a. Simplex-Johnson Controls
b. Silent Knight-Honeywell
c. Notifier-Honeywell
d. Fire-Lite-Honeywell
e. EST-Edwards

2.2 EMERGENCY VOICE/ALARM COMMUNICATIONS SYSTEMS (EVACS):

A. The system shall incorporate one-way emergency voice communication via specified speakers. A central audible module shall provide for the necessary alarm message/tone generation, main and remote microphone connections and mixers/pre-amplifier circuits. Continuous supervision shall be provided along with specific information as to the type of failure (main microphone trouble, tone trouble, etc.)

1. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of

announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711.

a. Allow the application of, and evacuation signal to, indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.

b. Programmable tone and message sequence selection.

c. Standard digitally recorded messages for "Evacuation" and "All Clear."

d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire alarm control unit.

2. Hand held push to talk, noise canceling microphone in recessed protective panel mounted enclosure; 5 feet coiled cable; and LED to indicate the microphone push to talk has been pressed.

3. Audible power amplifiers shall be self filtered; contain 24 volt power supply, transformer and amplifier monitor circuits; Amplifier shall operate all system speakers plus twenty-five (25) percent spare capacity.

4. Digitized voice messages are required to notify building occupants during alarm conditions. Message player shall not rely on tape or mechanical means of transmitting the voice message. A standard evacuation message shall be provided; however, the system shall be capable of transmitting a custom message of up to five (5) minutes long.

5. Alarm sequence shall consist of a temporal (3) alarm tone for a maximum of 15 seconds followed by an automatic pre-selected message. At the end of the message the tone shall resume. This sequence shall continue until the fire alarm control panel has been silenced. Manual voice paging shall be available via panel switches to page individual floors or groups of floors. Each floor shall be an individual audible zone and have a corresponding audible switch.

B. Cabinet: Lockable steel red surface mount enclosure unless prohibited in final area of location. Arrange unit so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control unit, provide exact matching modular unit enclosure(s).

C. Alphanumeric Display and System Controls: Panel shall include an 80 character LCD display to indicate alarm, supervisory, and component status messages and shall include a keypad for use in entering and executing control commands.

D. The system control panel, over its two wire multi-drop channel, must be capable of communicating with the types of addressable devices as specified. Addressable

devices to be located as required per code, Authority of Jurisdiction and as shown within Contract documents.

E. Circuits:

1. Signaling Line Circuits: NFPA 72, Class B
2. Notification-Appliance Circuits: NFPA 72, Class B
3. Actuation of alarm notification appliances, annunciation, elevator recall and actuation of suppression systems shall occur within 10 seconds after the activation of an initiating device.

F. Distributed Module Operation: FACP shall be capable of allowing remote location of the following modules; interface of such modules shall be through a Style 4 (Class B) supervised serial communications channel (SLC):

1. Addressable Signaling Line Circuits
2. Initiating Device Circuits
3. Notification Appliance Circuits
4. Auxiliary Control Circuits

G. The FACP shall continuously perform an automatic self-test on each sensor which will check sensor electronics and ensure the accuracy of the values being transmitted. Any sensor that fails this test shall indicate a “SELF TEST ABNORMAL” trouble condition.

H. FACP shall individually monitor sensors for calibration, sensitivity and alarm condition, and shall individually adjust for sensitivity. The control unit shall determine the condition of each sensor by comparing the sensor value to the stored values.

I. Environmental Compensation: The FACP shall maintain a moving average of the sensor’s smoke chamber value to automatically compensate for dust, dirt and other conditions that could affect detection operations.

J. Four (2) two form “C” Auxiliary Relay Circuits (Form C contacts rated 2A @ 24VDC, resistive), operation is programmable for trouble, alarm, supervisory of other fire response functions. Relays shall be capable of switching up to 1/2A @ 120VAC, inductive.

K. Dual Municipal City Circuit Connection with disconnect switches for connection to either 24VDC Remote Station (reverse polarity) or local energy.

L. Battery Meter Module providing ammeter and voltmeter for power supply monitoring. Voltage and ammeter readouts for charging battery circuits in the system shall be displayed on the FACP.

M. One (1) Auxiliary electronically resettable fused 2A @ 24VDC Output, with programmable disconnect operation for 4-wire detector reset.

N. One (1) Auxiliary Relay, SPDT 2A @ 32VDC, programmable as a trouble relay, either as normally energized or de-energized or as an auxiliary control.

O. Remote Unit Interface: Supervised communication for control and monitoring of remotely located annunciators and I/O panels.

P. Modular Network Communications Card.

Q. Elevator Controls (where installed): Heat detector operation shuts down elevator power by operating a shunt trip circuit breaker feeding the elevator prior to sprinkler water-flow in elevator shaft and elevator machine room.

R. Upon alarm activation all doors normally held open by door control devices (where installed and indicated) shall be released.

S. All fire shutter doors (where installed) shall be programmed to close only on local smoke detector signal.

T. Alarm Silencing, Trouble, and Supervisory Alarm Reset: Manual reset at the FACP and remote annunciators, after initiating devices are restored to normal.

1. Silencing-switch operation halts alarm operation of notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained.

2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.

U. Walk Test: A test mode to allow one person to test alarm and supervisory features of initiating devices. Enabling of this mode shall require the entry of a password. The FACP and annunciators shall display a test indication while the test is underway. If testing ceases while in walk-test mode, after a preset delay, the system shall automatically return to normal.

1. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, trouble, and supervisory signals to a remote alarm station through a digital alarm communicator transmitter and telephone lines.

V. Firefighter's Phone: Provide a supervised, two-way communication system between the Command Center/main fire alarm control unit and emergency phones.

1. The firefighter's phone system shall be capable of handling single or simultaneous conversations with all phones connected into the system. As many as six phones shall be able to be connected into the active conversation.

2. The phone system circuits shall be designed to prevent static, hum or other interference for clear, intelligible two-way conversation between all phones of the system.

3. The phone system circuits shall be supervised, such that the FACU shall be able to differentiate between whether a handset has been plugged into the emergency phone jack and whether the circuit has a shorted wire.

4. A beeping busy signal shall indicate to the person attempting to use a remote phone that the signal is being received at the control unit and that the lines are intact.

5. The act of plugging a handset into an emergency phone jack or removal of any phone from its normal hook position shall cause an audible and visual indication at the control unit. Picking up of the master phone and acknowledgment of the phone circuit shall silence the tone and allow for direct two-way communications.

6. The act of unplugging handsets in use and replacement of remote phones to their cradle shall restore normal supervisory functions.

7. Provide emergency phone jacks for installation in each elevator car by the elevator contractor. Required wiring from elevator controls to each elevator car shall be furnished and installed by the elevator contractor.

8. Provide emergency phone jacks as shown on the plans. Each jack shall be mounted on a stainless steel single gang plate with the words "Fire Emergency Phone" screened on each.

9. Provide a minimum of five (5) pluggable emergency phones within a storage cabinet.

2.3 POWER REQUIREMENTS

A. Fire alarm system is to provide sufficient battery capacity to operate the entire system upon loss of 120VAC power in a normal supervisory mode for a period of seventy-two (72) hours with 15 minutes of alarm operation at the end of this period. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be fully automatic with self diagnosing and indication.

B. Power Supply for Supervision Equipment: Supply for audible and visual equipment for supervision of the ac power shall be from a dedicated dc power supply, and power for the dc component shall be from the ac supply.

C. The incoming power to the system shall be supervised so that any power failure will be indicated at the control panel. A green "power on" LED shall be displayed continuously while incoming power is present.

D. All circuits requiring system operating power shall be individually fused at the control panel.

E. Provide new remote NAC/transponder panels as required per manufacture requirements. Electrical Contractor shall provide required power to each NAC panel. FAC to coordinate circuit requirements with EC.

F. Primary Power: 24vDC obtained from 120vAC service and a power-supply module.

   a. The alarm current draw of the entire fire alarm system shall not exceed 80 percent of the power-supply module rating.

   b. Power supply shall have a dedicated circuit(s) for its connection. Circuit(s) shall be mechanically protects and identify as "FIRE ALARM SYSTEM POWER."

G. Secondary Power: 24vDC supply system with batteries and automatic battery charger and an automatic transfer switch.

   1. Batteries: Sealed lead calcium.

   2. Battery and Charger Capacity: Comply with NFPA 72.

H. Where required, provide intelligent remote battery charger for charging up to 110Ah batteries.

I. Power Supplied with integral intelligent Notification Appliance Circuit Class B for system expansion.

J. Surge Protection:

1. Install surge protection on normal ac power for the FACP and its accessories.

2. Install surge protectors recommended by FACP manufacturer. Install on all system wiring external to the building housing the FACP.

2.4 MANUAL FIRE ALARM BOXES

A. Description: UL 38 listed; finished in red with molded, raised-letter operating instructions in contrasting color. Station shall show visible indication of operation. Mounted on recessed outlet box; if indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism unless otherwise noted, pull-lever type mechanically latched upon operation remaining until reset by opening with common key to all fire alarm locks. Unit with integral addressable module, arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP.

2. Hinge front operated opening station with key operated switch to reset.

3. The addressable manual station shall be capable of field programming its ”address” location on an addressable signaling line circuit. There shall be no limit to the number of stations, detectors, or adaptor modules, which may be activated or “in alarm” simultaneously.

4. Unless noted otherwise within Project Documents, manual fire alarm boxes shall include labeled protective Lexan or polycarbonate cover with local self-powered 9vDC battery operated alarm horn.

2.5 SYSTEM SMOKE DETECTORS

A. General Description:

1. UL 268 listed, operating at 24vDC, nominal. Minimum operating temperature range: 32-120 degF.

2. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base.

3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP. Sensor base shall contain a LED that will flash each time it is scanned by the control panel (once every four (4) seconds). When the control panel determines that a sensor is in the alarm or a trouble condition,

the control panel shall command the LED on that sensor's base to turn on steady indicating the abnormal condition. Sensors which do not provide a visible indication of an abnormal condition at the sensor location shall not be acceptable.

4. Each sensor shall be scanned by the control panel for its type identification to prevent inadvertent substitution of another sensor type. The control panel shall operate with the installed device but shall initiate a "Wrong Device" trouble condition until the proper type is installed or the programmed sensor type is changed.

5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.

6. Each sensor shall contain a magnetically actuated test switch to provide for easy alarm testing at the sensor location.

7. The sensor's electronics shall be immune from false alarms caused by EMI and RFI.

B. Multi-Sensors shall combine photoelectric smoke sensing and heat sensing technologies. An alarm shall be determined by either smoke detection, with selectable sensitivity from 0.25 to 3.5% obscuration; or heat detection, selectable as fixed temperature or fixed with selectable rate-of-rise; or based on an analysis of the combination of smoke and heat activity.

C. Photoelectric Smoke Detectors:

1. Sensor: LED or infrared light source with matching silicon-cell receiver.

2. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.

3. Addressable smoke sensors shall be of the photoelectric type and shall communicate actual smoke chamber values to the system control panel.

4. Unit assembly shall be documented as compatible with the control equipment to which it's connected and be listed for both ceiling and wall mount applications.

D. Duct Mounted Smoke Detectors:

1. Photoelectric Smoke Detectors:

a. Sensor: LED or infrared light source with matching silicon-cell receiver.

b. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.

c. Duct detectors shall be rated for air velocities ranges available from air handling system.

2. UL 268A listed, operating at 24vDC, nominal within a NEMA 4X weatherproof duct housing enclosure shall be provided for the circulation of conditioned air around the internally mounted addressable duct sensor housing to maintain the

sensor housing at its rated temperature range. The housing shall be UL Listed to Standard 268A.

3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The base shall be designed for mounting directly to the air duct. Base shall be capable of being monitored by an addressable adaptor module.

5. Detector assembly shall be furnished with two (2) isolated alarm contacts rated 10amps at 250vAC.

6. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.

7. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status. Provide remote status and alarm indicator and test station where indicated on contract documents.

8. Sampling Tubes: Design and dimensions as recommended by manufacturer for the specific duct size, air velocity, and installation conditions where applied.

9. Detector shall use a remote keyed testing station with led visual status indicators.

10. Detectors upon activation shall alarm locally and remotely to fire alarm panel.

11. Smoke detectors associated with air handling systems shall deactivate associated air handling systems and deliver a trouble signal to the central fire alarm panel. Detectors shall be provided with additional contacts for monitoring by the Building Automation System (BAS). Coordinate BAS requirements with Temperature Controls Contractor (TCC).

2.6 HEAT DETECTORS

A. General: UL 521 listed.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or rate-of-rise of temperature that exceeds 15 deg F per minute, unless otherwise indicated.

1. Mounting: Adapter plate for outlet box mounting. UL and ULC listed for a spacing of 50’ and shall be documented as compatible with the control equipment to which they are connected. The sensors shall be mounted in accordance to NFPA 72-5.65 through 5.65.6.

2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

2.7 NOTIFICATION APPLIANCES

A. The system fire alarm shall operate notification appliances via activation of any manual station or automatic detection devices.

B. Visible alarm notification appliances within activated zone shall flash until extinguished by the Alarm Silence Switch.

C. Appliances shall be white in color.

D. Visible/Only: Strobe shall be listed to UL 1971. The V/O shall consist of a xenon flash tube and associated lens/reflector system. The V/O enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. V/O appliances shall be provided with different minimum flash intensities of 15cd, 75cd and 110cd. Provide a label inside the strobe lens to indicate the listed candela rating of the specific Visible/Only appliance.

E. Audible/Visible: Combination Audible/Visible (A/V) Notification Appliances shall be listed to UL 1971 and UL 464. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. Provide a label inside the strobe lens to indicate the listed candela rating of the specific strobe. The horn shall have a minimum sound pressure level of 79-88 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.. The audible/visible enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings.

F. Notification Appliance Circuit provides synchronization of strobes at a rate of 1Hz and operates audible tones with a Temporal Code Pattern operation. The circuit shall provide the capability to silence the audible signals, while the strobes continue to flash, over a single pair of wires. The capability to synchronize multiple notification appliance circuits shall be provided.

G. Accessories: This contractor shall furnish the necessary accessories including manufacturer required or recommended back box, transition plates or other required component required for installation.

H. Listed wire guards shall be installed on devices where specified.

I. Isolator Module: Isolator module provides short circuit isolation for addressable notification appliance SLC wiring. Isolator shall be listed to UL 864. The Isolator shall mount directly to a minimum 2 1/8" deep, standard 4" square electrical box, without the use of special adapter or trim rings. Power and communications shall be supplied by the Addressable Controller channel SLC; dual port design shall accept communications and power from either port and shall automatically isolate one port from the other when a short circuit occurs. The following functionality shall be included in the Isolator module:

1. Report faults to the host FACP.

2. On-board Yellow LED provides module status.

3. After the wiring fault is repaired, the Isolator modules shall test the lines and automatically restore the connection.

2.8 ADDRESSABLE APPLIANCES NAC POWER EXTENDER

A. The addressable controller shall be a stand-alone panel capable of powering a minimum of 3 signaling line circuits. Each channel shall be rated minimally for 2.5 amps and support addressable notification appliances. Power and communication for the notification appliances shall be provided on the same pair of wires.

B. The internal power supply & battery charger shall be capable of charging internally mounted or batteries mounted in an external cabinet. Battery ampacity requirements shall meet those specified for the main fire alarm controller.

C. The NAC extender panel may be mounted close to the host control panel or can be remotely located.

D. Cabinet color shall be red and identified as a component of the fire alarm system.

2.9 MAGNETIC DOOR HOLDERS (Where Noted)

A. Description: Units are equipped for wall mounting as indicated and are complete with matching door plate.

1. Electromagnet: Requires no more than 3 W to develop 25-lbf holding force.

2. Wall-Mounted Units or Flush mounted, unless otherwise indicated.

3. Rating: 24vDC powered from FACP.

B. Material and Finish: Match door hardware.

C. Bracing: It is the responsibility of this contractor to coordinate with the GC to provide additional bracing to adequately secure mounting box. Mounting assembly shall be able to withstand twice the holding force of the electromagnet without any deflection or distortion to the wall finish.

2.10 REMOTE ANNUNCIATORS

A. Provide Remote LCD Annunciator(s) as required with the same "look and feel" as the FACP operator interface. Duplicate annunciator functions of the FACP for alarm, supervisory, and trouble indications. Also duplicate manual switching functions of the FACP, including acknowledging, silencing, resetting, and testing. Alphanumeric display same as the FACP.

1. Mounting: Flush cabinet, NEMA 250, Class 1.
2. Where locking cover/display assembly is provided, key and lock shall be common to all secured fire alarm system enclosures.
   a. The Owner shall be provided with (2) extra sets of keys.
3. Provide remote microphone and emergency/voice alarm system controls

B. Display Type and Functional Performance: Controls with associated LED's permit acknowledging, silencing, resetting, and testing functions for alarm, supervisory, and trouble signals identical to those in the FACP.

C. The LCD shall display the following information relative to the abnormal condition of a point in the system:

1. 40 character custom location label.

2. Type of device (e.g., smoke, pull station, waterflow).

3. Point status (e.g., alarm, trouble).

D. Under normal conditions the LCD shall display a "SYSTEM IS NORMAL" message and the current time and date.

E. Should an abnormal condition be detected the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The unit audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.

F. Operator keys shall be key switch enabled to prevent unauthorized use. The key shall only be removable in the disabled position. Acknowledge, Silence and Reset operation shall be the same as the FACP.

2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Listed and labeled according to UL 632.

B. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP, and automatically captures one or two telephone lines and dials a preset number for a remote central station. When contact is made with the central station(s), the signal is transmitted. The unit supervises up to two telephone lines. Where supervising 2 lines, if service on either line is interrupted for longer than 45 seconds, the unit initiates a local trouble signal and transmits a signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. When telephone service is restored, unit automatically reports that event to the central station. If service is lost on both telephone lines, the local trouble signal is initiated.

C. Secondary Power: Integral rechargeable battery and automatic charger. Battery capacity is adequate to comply with NFPA 72 requirements or as noted within this specification.

D. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.12 DACT/IP/CELLULAR COMMUNICATOR TRANSMITTER

A. DACT/IP/Cellular communicator transmitter shall be listed to UL 864 for Central Station Service and be acceptable for use by the remote or central station.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for, or connected via TCP/IP or Cellular to a remote or central station. When contact is made with the remote or central station, signals shall be transmitted. If connecting by POTS and service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the remote or central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal. If service is by TCP/IP or Cellular and connection is lost, transmitter shall initiate the local trouble signal and a loss of connection shall be indicated at the central station.

C. Local functions of the DACT/IP/Cellular communicator transmitter shall include the following:

1. Configurable with a primary and secondary path.
2. Paths can use any of the external connections, telephone line, cellular, or LAN Ethernet connections.
3. 4G with 3G/2G fall back cellular connection through the cellular module. Antenna extension kits for areas of poor connectivity.
4. Communications failure with the remote or central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address or loss of power.
4. Low battery.
5. Abnormal test signal.
6. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Constant connection supervision and detects failures within 90 seconds for IP/Cellular connection.

2.13 ZONE ADAPTOR MODULE & INDIVIDUAL ADAPTOR MODULE

A. An addressable interface module shall be provided for interfacing non addressable devices or equipment to an addressable fire alarm signaling line circuit. The device shall be a Zone Adaptor Module (ZAM) or an Individual Adaptor Module (IAM).

B. ZAM's and IAM's will be capable of mounting in a standard outlet box. And will include cover plates. ZAM's will receive their 24VDC power from a separate two (2) wire pair running from an the FACP power supply or appropriate source.

C. There shall be two types of devices:

a. Type 1: Monitor

1) For conventional 2-wire contact device monitoring with Style B wiring supervision. These ZAM's will communicate the zone's status (normal, alarm, trouble) to the FACP. ZAM's shall be used for monitoring of water flow, valve tamper, non-addressable detectors, self contained fire suppression systems, elevator or other equipment or devices required for reporting conditions to the FACP.

b. Type 2: Control

1) For non-supervised control: This type of addressable device will provide double pole double throw relay switching for loads up to 120VAC. It will contain easily replaceable 2 amp fuse, one on each common leg of the relay.

D. The ZAM & IAM modules shall be supervised and uniquely identified by the FACP. Device identification shall be transmitted to the control panel for processing according to the program instructions. Should the ZAM or IAM become non-operational, tampered with, or removed, a discrete trouble signal, unique to the device, shall be transmitted to, and annunciated at, the control panel.

E. The ZAM or IAM module shall be capable of being programmed for its "address" location on the addressable device signaling line circuit. The ZAM shall be compatible with addressable manual stations and addressable detectors on the same addressable circuit.

F. All devices will be supervised for trouble conditions. The system control panel will be capable of indicating the type of trouble condition (open, short, device missing/failed). Should a device fail, it will not hinder the operation of other system devices. Should a problem occur on a particular wire run, it will not affect other wire runs.

2.14 WIRE AND CABLE

A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.

B. Signaling Line Circuits: Twisted, shielded pair sized not less than as recommended by system manufacturer.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

1. Low-Voltage Circuits: No. 16 AWG, minimum.

2. Line-Voltage Circuits: No. 12 AWG, minimum.

D. Wire or cable color shall be “red” unless otherwise restricted by manufacturer or applicable codes.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Provide and install the system in accordance with the plans and specifications, all applicable codes and the manufacturer’s recommendations.

B. Installation of equipment and devices that pertain to other work in the contract shall be closely coordinated with the appropriate subcontractors.

C. Provide fire alarm system status to HVAC building automation system (BAS), building security system and to door access controller for remote locking/unlocking of doors. Locations of headend system components to be field coordinated upon final equipment selection.

D. Smoke or Heat Detector Spacing:

1. Smooth ceiling spacing shall not exceed the rating of the detector.

2. Spacing of heat detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas, shall be determined according to Appendix A in NFPA 72.

3. Spacing of heat detectors shall be determined based on guidelines and recommendations in NFPA 72.

E. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.

F. HVAC Controller: FAC to provide a FACP communication status signal to the HVAC direct digital DDC controller. The Electrical Contractor shall extend conduit and wiring from the FACP to the DDC system controller. Termination of wiring to the DDC controller shall be performed by the Temperature Control Contractor.

G. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of the duct. Duct detectors shall include (2) two relays for shutdown and (1) one for the BAC controller.

H. Heat Detectors in Elevator Shafts and associated control room(s): Provide and coordinate temperature rating and location with sprinkler rating and location.

I. Provide fire alarm status to building security, HVAC building automation controller and door access controller.

J. Remote Status, Alarm Indicators and Testing Station: Install labeled readily accessible unit near each detector that is not visible from normal viewing position. Refer to plans for locations of remote status indicators.

K. Water-Flow and Valve Supervisory Switches: Connect for each sprinkler valve required to be supervised including those located in yard supply pit.

L. Device Location-Indicating Lights: Locate in the public space immediately adjacent to the device they monitor.

M. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling or otherwise required to meet ADA requirements. Install speakers and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

N. Visible Alarm-Indicating Devices: Install adjacent to each alarm speaker or horn and at least 6 inches below the ceiling or otherwise required per ADA requirements.

O. FACP: Surface mount with tops of cabinets not more than 72 inches above the finished floor.

P. Annunciator: Flush mounted and installed with top of panel not more than 72 inches above the finished floor. Remote annunciator(s) with voice communication to be located per local requirements and/or as shown within Project Documents. Provide within enclosed flush mounted cabinet. Coordinate enclosure requirements with GC prior to installation.

Q. Antenna for Radio Alarm Transmitter (Where Provided): Mount to building structure using mounting arrangement and substrate connection that will resist 100-mph (160-km/h) wind load with a 1.3 gust factor without damage.

3.2 WIRING INSTALLATION

A. Install wiring according to the following:

1. NECA 1.

2. TIA/EIA 568-B.

3. NEC 760.

B. Wiring Method:

1. Install wiring in metal raceway according to Division 26 Section "260533 Raceway and Boxes".

2. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This raceway system shall not be used for any other wire or cable. Fire alarm raceway including junction and mounting boxes shall be “RED” in color.

3. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.

4. Cables and wiring terminations shall conform to respected Manufacturer and NFPA 70 installation requirements.

C. Wiring within Enclosures:

1. Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Cable Taps:

1. Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

E. Color-Coding:

1. Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

F. Wiring to Remote Alarm Transmitting Device:

1. Provide 1-inch conduit between the FACP and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals according to Division 26 Section "Electrical Identification"

B. Install instructions frame in a location visible from the FACP.

C. Label FACP source of power "FIRE ALARM" and provide mechanical means of protection in accordance with NFPA 70 and 72.

D. Equipment/Room identification(s) shall be obtained from the Owner prior to fire alarm system programming. Do not use project documentation for naming assignments. Alterations to existing programing shall be include Owner’s current naming assignments.

3.4 GROUNDING

A. Ground the FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACP.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components, testing and adjustments of the system.

B. Personnel associated with fire alarm system installation shall be qualified and experienced in the installation, code requirements, inspection, testing and maintenance of fire alarm systems. Examples of qualified personnel shall be permitted to include, but shall not be limited to, individuals with the following qualifications:

1. Factory trained and certified.

2. National Institute for Certification in Engineering Technologies (NICET) fire alarm certified.

3. International Municipal Signal Association (IMSA) fire alarm certified.

4. Certified by a state or local authority.

5. Trained and qualified personnel employed by an organization listed by a national testing laboratory for the servicing of fire alarm systems.

C. Perform the following field tests and inspections and prepare test reports:

1. Before requesting final approval of the installation, submit a written statement using the form for Record of Completion shown in NFPA 72.

2. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters.

3. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.

4. Testing: Follow procedure and record results complying with requirements in NFPA 72.

a. Detectors that are outside their marked sensitivity range shall be replaced.

5. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.

3.6 CLEANING AND ADJUSTING

A. Cleaning: Remove paint splatters and other spots, dirt and debris. Clean unit internally using methods and materials recommended by manufacturer. Cleaning shall be performed prior to any certification testing.

3.7 WARRANTY

A. The contractor shall warrant the completed fire alarm system wiring and equipment to be free from inherent mechanical and electrical defects for a period of one (1) year from the date of final acceptance of the project.

3.8 DEMONSTRATION

A. At no additional cost a factory-authorized service representative shall train Owner's maintenance personnel to adjust, operate, program and maintain the fire alarm system, appliances and devices via 8-hours of in-house training videos. Owner shall receive direct manufacturer’s technical support for the complete fire alarm system including software updates, service passwords and services bulletins. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 283100

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, and removing site utilities.
7. Temporary erosion- and sedimentation-control measures.

B. Related Sections:

1. Section 01 5000 "Temporary Facilities and Controls" for temporary utility services, construction and support facilities, security and protection facilities.
2. Section 01 7419 "Construction Waste Management and Disposal for additional LEED requirements.
3. Section 02 4116 "Structure Demolition" for demolition of buildings, structures, and site improvements.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled. All removal costs, whether incurred directly by the Contractor or charged by a utility company or other third party, shall be included as part of the base contract.

B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

E. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

F. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

G. Topsoil: Top layer of the existing soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Note that this definition applies only to site clearing and earth moving operations. Topsoil for proposed planting and lawn making is defined elsewhere in these specifications.

H. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

I. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.

J. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or videotape.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

B. Soil and Water Protection Quality Protection Plan

C. Monthly reports of materials, quantities, and percentages of construction waste diverted from disposal to recycling or reuse.

D. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

A. 2018 International Green Construction Code (IgCC) as currently amended provisions for soil, water, and vegetation protection and restoration and building site waste management plan

B. Preinstallation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on premises where indicated as directed by Owner.

C. Utility Locator Service: Notify Miss Utility for area where Project is located before site clearing. Engage a private utility locating service to locate and mark on-site utilities outside of Miss Utility's service area.

D. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.

E. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.

F. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

G. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 31 2000 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Prepare a Soil and Water Quality Protection Plan in full accordance with IgCC Section 405 including, but not limited to, designated vegetation protection areas, soils that will be retained in place, topsoil areas to be stripped and stockpiled, location for all laydown and storage areas, construction trailer locations.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sediment control measures as depicted on approved Drawings and in accordance with all requirements of the Maryland Department of Environment (MDE) and its inspectors.

B. Notify MDE and conduct pre-installation conference at Project site with MDE inspector prior to any earth disturbance.

C. Establish soil, water, and vegetation protection measures in accordance with IgCC Section 405

D. Inspect, maintain, and repair erosion and sediment control measures during construction until permanent vegetation has been established.

E. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal after approval is granted by MDE inspector to do so.

3.3 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap remaining ends of all utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.
2. Owner will arrange to shut off indicated utilities when requested by Contractor.

B. Remove existing above- and below-grade utilities, structures, and appurtenances as indicated and necessary to facilitate new construction.

C. Relocate existing above- and below-grade utility services, structures, and appurtenances to remain as indicated and necessary to facilitate new construction.

D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Owner not less than ten days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

E. Removal of underground utilities is included in Divisions 21, 22, 23, 26, 27, and 28.

3.4 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Completely remove stumps, roots, and debris.
3. Use only hand methods for grubbing within protection zones.
4. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.5 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.

2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.6 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Develop Building Waste Management Plan Plan in accordance with IgCC Section 406 to divert not less than 75 percent of land clearing debris and excavated soils from disposal to recycling or reuse on the site. Contractor shall report monthly to Owner on materials, quantities, and percentages diverted.

B. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

C. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Preparing subgrades for slabs-on-grade walks pavements turf and grasses and plants.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
4. Base course for asphalt paving and concrete walks pavements.
5. Subbase course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Sections:
1. Section 01 3200 "Construction Progress Documentation" for recording pre-excavation and earth moving progress.
2. Section 01 5000 "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities; also for temporary site fencing if not in another Section.
3. Section 03 3000 "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
4. Section 31 1000 "Site Clearing" for site stripping, grubbing, stripping topsoil, and removal of above- and below-grade improvements and utilities.
5. Section 32 9200 "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
6. Section 32 9300 "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.

1.3 GEOTECHNICAL REPORT

A. A geotechnical study was conducted on the site. A copy of the preliminary geotechnical report dated July 8,2022 prepared by Hillis-Carnes Engineering Associates is included in the project manual for information only. The geotechnical report is not to be considered part of the contract documents, and the contractor shall rely on the information in the report at his own risk. The Owner assumes no responsibility for actual conditions that may be encountered in the execution of the contract. The Owner does not represent, warrant, or guarantee that the materials actually encountered in the prosecution of the work will be of the same character as those indicated by the samples or log or the test borings.
1. Contractor’s particular attention is directed to information in the Soils Report pertaining to obstructions encountered in the test borings.

1.4 UNIT PRICES

A. Work of this Section is affected by unit prices for earth moving specified in Section 01 2200 "Unit Prices."

1.5 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
   1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Graded Aggregate Base (GAB) layer placed between the subgrade, or if applicable, the subbase course and hot-mix asphalt paving, or the aggregate layer placed between the subgrade and a cement concrete pavement, or concrete or hot-mix asphalt walk.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
   1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Testing Agency. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
   2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
   3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Testing Agency. Unauthorized excavation, as well as remedial work directed by Testing Agency, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock

   1. Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D1586.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

J. Subbase Course: Aggregate layer placed between the subgrade and Base Course for hot-mix asphalt pavement.

K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:
   1. Geotextiles.
   2. Controlled low-strength material (flowable fill), including design mixture.
   3. Warning tapes.
   4. Graded Aggregate Base (GAB) material gradations and certification of compliance with MSHA specifications

B. Samples for Verification: For the following products, in sizes indicated below:

1. Geotextile: 12 by 12 inches.
2. Warning Tape: 12 inches long; of each color.

C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.
2. Laboratory compactions curve according to ASTM D 698 for each on-site or borrow soil material proposed for fill and backfill.

1.7 INFORMATIONAL SUBMITTALS

A. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated: :
1. Classification according to ASTM D 2487 of each on-site and borrow soil material proposed for fill and backfill.
2. Laboratory compaction curve according to ASTM D 698 for each on-site and borrow soil material proposed for fill and backfill.

B. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.8 QUALITY ASSURANCE

A. Testing Agency: Contractor will engage a qualified independent Testing Agency to perform field quality-control tests and inspections required by authorities having jurisdiction as the responsibility of Owner.

B. Pre-excavation Conference: Notify Maryland Department of the Environment, Water Management Administration and conduct pre-construction conference at Project site with inspector prior to any earth disturbance.

C. United States Department of Agriculture (U.S.D.A.) Textural Classification Diagram for Soils.

D. 2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control published jointly by the Maryland Department of the Environment, Water Management Administration in association with the Natural Resources Conservation Service and the Maryland Association of Soil Conservation Districts, as amended to date.

E. Maryland Department of Transportation, State Highway Administration, Standard Specifications for Construction and Materials, July 2022, (MSHA), as amended to date.
1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

F. Project Geotechnical Report: "Preliminary Geotechnical Engineering Study" for the Hagerstown Multi-Use Sports and Events Facility prepared by Hillis-Carnes Engineering Associates, dated July 8,2022
1. Refer to the geotechnical report for related information and recommendations.

1.9 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: No earth moving shall be permitted on any property adjoining Owner's property.

C. Utility Locator Service: Notify "Miss Utility" for area where Project is located before beginning earth moving operations. Engage a private utility locating service to locate and mark on-site utilities outside of Miss Utility's service area.

D. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Owner's Representative and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Owner not less than ten days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Owner's Representative's written permission.
   3. Contact utility-locator service for area where Project is located before excavating.
   4. If existing active service lines, utilities, and utility structures are uncovered or encountered during Contractor's operations, safeguard, protect from damage, and support as required to maintain service.
   5. Contractor is responsible to repair all damages to existing utility lines and structures to the satisfaction of the respective utility owner, at no expense to the Owner.
   6. If undocumented, or incorrectly documented, utilities are encountered during earthwork operations, stop work in area concerned and contact Owner for direction.

E. Demolish and completely remove from site existing underground utilities indicated to be removed. Abandon in place only those utilities specifically labeled. Coordinate with utility companies to shut off services if lines are active.

F. Do not commence earth moving operations until temporary erosion and sediment control measures are in place.

G. The following practices are prohibited within protection zones:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Foot traffic.
   4. Erection of sheds or structures.
   5. Impoundment of water.
   6. Excavation or other digging unless otherwise indicated.

H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: ASTM D 2487 Soil Classification Groups ML, SC, SM, SP, SW, GC, GM, GP, or GW or a combination of these groups, unless otherwise indicated; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter, subject to approval by the Owner's Geotechnical Engineer.

   1. Fill materials should exhibit Liquid Limit and Plasticity Index values of less than 40 and 15, respectively.

C. Unsatisfactory Soils: Soil Classification Groups CL, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups, unless otherwise indicated.
   1. Unsatisfactory soils for backfill against walls below grade: Soil Classification Groups CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.

2. Unsatisfactory soils also include the following:
   a. Satisfactory soils not maintained within 3 percent of optimum moisture content at time of compaction
   b. Material weighing less than 105 lb./cu. ft, (maximum laboratory dry density).
   c. Material with a liquid limit over 40 percent.
   d. Soils with a plasticity index over 15.

D. Subbase Material: MSHA Graded Aggregate Subbase

E. Base Course: MSHA Graded Aggregate Base (GAB)

F. Structural Fill / Engineered Fill: MSHA Graded Aggregate Base (GAB) or Satisfactory Soils as defined above, placed and compacted in accordance with Part 3 of this specification

G. Bedding Course: MSHA #57 aggregate

H. Drainage Course: MSHA #57 aggregate

I. Filter Material: MSHA #67 aggregate

J. Sand: ASTM C 33; fine aggregate.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
   1. Survivability: Class 2; AASHTO M 288.
   2. Grab Tensile Strength: 157 lbf; ASTM D 4632.
   3. Sewn Seam Strength: 142 lbf; ASTM D 4632.
   4. Tear Strength: 56 lbf; ASTM D 4533.
   5. Puncture Strength: 56 lbf; ASTM D 4833.
   6. Apparent Opening Size: No. 70 sieve, maximum; ASTM D 4751.
   7. Permittivity: 0.1 per second, minimum; ASTM D 4491.
   8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
   1. Survivability: Class 2; AASHTO M 288.
   2. Grab Tensile Strength: 247 lbf; ASTM D 4632.
   3. Sewn Seam Strength: 222 lbf; ASTM D 4632.
   4. Tear Strength: 90 lbf; ASTM D 4533.
   5. Puncture Strength: 90 lbf; ASTM D 4833.
   6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
   7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
   8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.3 CONTROLLED LOW-STRENGTH MATERIAL

A. Controlled Low-Strength Material: Self-compacting, flowable concrete material produced from the following:
   1. Portland Cement: ASTM C 150, Type II.
   2. Fly Ash: ASTM C 618, Class C or F.
   3. Normal-Weight Aggregate: ASTM C 33, 3/8-inch nominal maximum aggregate size.
   4. Water: ASTM C 94/C 94M.

5. Air-Entraining Admixture: ASTM C 260.

B. Produce conventional-weight, controlled low-strength material with 300-psi compressive strength when tested according to ASTM C 495.

2.4 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Protect and maintain erosion and sediment controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, from deteriorating subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
2. Install a dewatering system, specified in Division 31 Section "Dewatering," to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Architect. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.

1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; and soil, boulders, and other materials not classified as rock or unauthorized excavation.

    a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.

2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:

    a. 24 inches outside of concrete forms other than at footings.
    b. 12 inches outside of concrete forms at footings.
    c. 6 inches outside of minimum required dimensions of concrete cast against grade.
    d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
    e. 6 inches beneath bottom of concrete slabs-on-grade.
    f. 6 inches beneath pipe in trenches and the greater of 24 inches wider than pipe or 42 inches wide.

3.5 EXCAVATION FOR STRUCTURES

A. Subgrades to receive compacted structural fill for building support shall be stripped of vegetation, topsoil, and organic matter. Completely remove abandoned utility lines, buried foundations, and other obstructions, Geotechnical explorations indicate topsoil to depths of 2 to 5 inches. Loose or soft Stratum A existing fill soils are present below the topsoil. These soils, if deemed suitable by the testing agency, shall be recompacted with a minimum 6 passes of a ten ton smooth drum roller.

B. Any soils that pump or heave during rolling shall be undercut to firm soils.
    1. Removal of unsuitable soils should extend at least 5 ft horizontally beyond proposed building footprints.

C. Building slabs shall be supported on firm existing fill of Stratum A, suitable natural soils of Strata B and B2, or compacted structural fill.
    1. Footing and utility trenches beneath building slabs shall be backfilled with compacted structural fill.

D. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
    1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
    2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

B. Subgrades to receive compacted structural fill for pavement support shall be stripped of vegetation, topsoil, and organic matter. Geotechnical explorations indicate topsoil to depths of 6 inches. Loose or soft Stratum A existing fill soils are present below the topsoil. These soils shall be recompacted with a minimum 6 passes of a ten ton smooth drum roller. Any soils that pump or heave during rolling shall be undercut to firm soils.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.
   1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
   1. Clearance: 12 inches each side of pipe or conduit.

   2. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.

      a. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

C. For excavation for utility trenches on public property, comply with City of Hagerstown, Department of Public Works regulations.

3.8 SUBGRADE INSPECTION

A. Notify Testing Agency when excavations have reached required subgrade.

B. If Testing Agency determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with a loaded 10-wheel, tandem-axle dump truck weighing not less than 20 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
   1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
   2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Testing Agency, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Testing Agency, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, or flowable fill with 28-day compressive strength of 300-psi may be used when approved by Testing Agency.
   1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Testing Agency.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:
   1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
   2. Surveying locations of underground utilities for Record Documents.
   3. Testing and inspecting underground utilities.
   4. Removing concrete formwork.
   5. Removing trash and debris.
   6. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of soft loose soils, uncontrolled fill, mud, frost, snow, or ice.

C. The use of recycled concrete for backfill material is not permitted.

3.12 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of soft loose soils, uncontrolled fill, mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trench excavations under footings shall not be permitted, unless otherwise accounted for in the design by the Project's Structural Engineer.

D. Trenches under Roadways: Provide 4-inch-thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.

E. Backfill voids with satisfactory soil while removing shoring and bracing.

F. Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
   1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

G. Place and compact final backfill of satisfactory soil to final subgrade elevation.

H. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

I. For utility trench backfill on public property, comply with City of Hagerstown, Department of Public Works regulations.

J. The use of recycled concrete materials for backfill materials is not permitted.

3.13 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:
   1. Under grass and planted areas, use satisfactory soil material.
   2. Under walks and pavements, use satisfactory soil material.
   3. Under steps and ramps, use engineered fill, SC, SM, or GM soil material.

4. Under building slabs, use engineered fill or satisfactory soil material.
5. Under footings and foundations, use engineered fill or satisfactory soil material, subject to approval by the Testing Agency.
6. Behind below grade walls and retaining walls, use satisfactory soil material, subject to approval by the Testing Agency.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

D. The use of recycled concrete for soil fill material is not permitted.

3.14 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 3 percent of optimum moisture content.
1. Do not place backfill or fill soil material on soft loose soils, uncontrolled fill, or surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 3 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698 (Standard Proctor) as recommended by Testing Agency, unless otherwise indicated:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.

2. Under pavements, compact upper 12-inches of backfill or fill soil material at 100 percent.

3. Under footings, compact subgrade and each layer of backfill or fill soil material at 95 percent.
4. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
5. Under turf or unpaved areas, scarify the subgrade and compact each layer of backfill or fill soil material at 90 percent except in bottoms of infiltration devices and facilities as specifically noted on drawings.
6. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.
7. For areas below bottom surfaces of stormwater infiltration and/or bioretention facilities noted on drawings, maximum compaction shall not exceed 85 percent.

3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
1. Turf or Unpaved Areas: Plus or minus 1 inch.

2. Walks: Plus or minus 1/2 inch.
3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.17 SUBSURFACE DRAINAGE

A. Subdrainage Pipe: Specified in Section 33 4600 "Subdrainage."

B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
1. Compact the top of the filter material with at least 3 passes of compaction equipment approved by the Testing Agency.

C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
1. Compact the top of the filter material with at least 3 passes of compaction equipment approved by the Testing Agency.
2. Place and compact impervious fill over drainage backfill in 6-inch-thick compacted layers to final subgrade.

3.18 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course (if required by drawings or Testing Agency) and/or base course on subgrades free of soft loose soils, uncontrolled fill, mud, frost, snow, or ice.

B. On prepared subgrade, place base course under pavements and walks as follows:
1. Install separation geotextile (if required by drawings or Testing Agency) on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place base course material over subbase, if required, or subgrade under hot-mix asphalt pavement.
3. Shape base course to required crown elevations and cross-slope grades.
4. Place base course 6 inches or less in compacted thickness in a single layer.
5. Place base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
6. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 100 percent of maximum dry unit weight according to ASTM D 698.

3.19 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of soft loose soils, uncontrolled fill, mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place drainage course 6 inches or less in compacted thickness in a single layer.
3. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.20 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified independent Testing Agency to perform field quality-control tests and inspections.

B. Allow Testing Agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Testing Agency.

D. Testing Agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
   1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2500 sq. ft. or less of paved area or building slab, but in no case fewer than two tests.
   2. Foundation and Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length, but no fewer than two tests.
   3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length, but no fewer than two tests.

E. When Testing Agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.21 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
   1. Scarify or remove and replace soil material to depth as directed by Testing Agency; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 316100

FOOTINGS

PART 1 - GENERAL

1.1 GENERAL

Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 SCOPE

The work covered by this Section shall include all labor, material, equipment, permits, engineering and other services necessary for the fabrication and installation of footings and related work, complete, in accordance with the Drawings and as specified herein.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Division 1
Quality Control	Division 1
Quality Assurance: Structural Testing and Inspection	Section 014500
Concrete Reinforcement and Embedded Assemblies	Section 032000
Cast-In-Place Concrete	Section 033000
Thermal and Moisture Protection	Division 7

1.4 CODES AND STANDARDS

A. Building Code: Footing work shall conform to the requirements of the Building Code identified on the structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.

B. Standards:

1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301 – Standard Specifications for Structural Concrete.
3. ACI 315 – Details and Detailing of Concrete Reinforcement.
4. ACI 318 – Building Code Requirements for Reinforced Concrete.
5. American Concrete Institute “Manual of Concrete Practice”, various committee reports as referenced herein.
6. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein.
7. AWS D1.4 – Structural Welding Code-Reinforcing Steel.

C. Definitions:

1. See Section 033000.
2. The term Owner's Geotechnical Engineer in this Specification is defined as the Owner's representative specifically authorized to perform the responsibilities defined herein.

1.5 CONTRACTOR QUALIFICATIONS

A. The Footing Installer shall be a company which specializes in installing footings, with a minimum of 10 years of documented successful experience. Installation shall be performed by skilled workmen thoroughly experienced in the necessary execution.

B. The Contractor's Field Supervisor shall have 10 years of experience in installing footings and provide full-time supervision.

C. The Contractor's Professional Surveyor shall have 10 years of previous experience in laying out foundation locations to perform surveys, layouts, and measurements for footing work. The Contractor's Professional Surveyor shall be licensed in the state where the project is located. Conduct layout work for each footing to lines and levels required before excavation, and actual measurements of each footing's horizontal location, top elevations, deviations from specified tolerances, and other required data.

1.6 SUBMITTALS

A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested.

(1) Submittal Schedule
(2) Footing Construction Methods
(3) Installer Qualifications
(4) Shop drawings
(5) Construction Log
(6) Contractor's Survey Report
(7) Submittals required by Related Documents
(8) Mill Certificates
(9) Owner's Concrete Testing Agency Reports
(10) Product Data

1. **Submittal Schedule**: See Section 033000.
2. **Footing Construction Methods**: Submit for record, footing construction procedures developed by the Footing Contractor.
3. **Installer Qualifications**: Submit proof of qualifications as stated in the CONTRACTOR QUALIFICATIONS section of this Specification.
4. **Shop drawings in accordance with 032000 and 033000, and as noted.**

   a) Concrete mix designs in accordance with Section 033000.

b) Footing reinforcement in accordance with Section 032000 and 033000.
c) Footing layout drawing showing the location of each footing (with respect to building gridlines), size and depth of footing, and top of footing elevation.

5. **Construction Log**: Testing Agency shall document, sign, and submit for record, a record of each footing construction, including:

a) Footing designation, top and where possible bottom elevation, and size of footing.
b) Size, length, and location of installed reinforcement.
c) Deviation of centerline plan location.
d) Actual allowable soil bearing capacity
e) Inspection and testing
f) Method of concrete placement, time of beginning and ending concrete discharge for each truck, (including any delays in concreting and location of construction joints in shafts) and any deviation from planned construction methods.
g) Volume of concrete supplied to footing and ratio of actual volume to theoretical volume.

6. **Contractor's Survey Report**: Submit for record plans sealed and signed by a Professional Surveyor licensed in the state where the project is located, indicating as built plan locations of footing centerlines (with respect to building gridlines), top and where possible bottom elevations, and identifying deviations of footing centerlines from design plan locations. Footings that are outside of specified tolerances shall be specifically identified on the plan.
7. **Submittals required by Related Documents.**
8. **Mill Certificates**: Per Specification section 032000, submit for record certified reports for physical and chemical properties of following materials:

a) Reinforcement bars.

9. **Owner's Concrete Testing Agency Reports**: Submit for record

a) Reports of field observations.
b) Reports of field quality control tests, as related to concrete and reinforcement.
c) Immediately notify the Design Professionals of any deviations from the Drawings.

10. **Product Data**: Submit for record for each type of product identified in Part 2. Product Data shall be clearly marked to indicate all technical information which specifies full compliance with this section and Contract Documents, including published installation instructions and ICC reports, where applicable, for products of each manufacturer specified in this section.

B. Submittal Process: See Section 033000.

C. SER Submittal Review: See Section 033000.

D. Substitution Request: See Section 033000.

E. Request for Information (RFI): See Section 033000.

1.7 DELIVERY, STORAGE, AND HANDLING

A. See Sections 032000 and 033000.

1.8 PRE-INSTALLATION CONFERENCE

A. Conduct meeting at Project Site to comply with requirements in Division 1.

1.9 PROJECT SITE CONDITIONS

A. Geotechnical Information: Contractor to examine site, records of test borings, soil samples, and Geotechnical Reports that are available from the Owner. Soil boring test results are provided by the Owner for information, and are not guaranteed to represent conditions that are present at footing locations. Soil boring test results are not intended as representations or warranties of the continuity of the reported conditions. It is expressly understood that the Owner will not be responsible for interpretation or conclusions drawn by Contractor from the Geotechnical Report. At no additional cost to the Owner, evaluate the available data and provide additional test borings and other investigations as necessary for installing footings.

B. Site Survey: Survey of site, existing utilities, and existing construction available from the Owner represent conditions known to Owner. Other obstructions may be encountered.

1.10 QUALITY ASSURANCE BY OWNER’S TESTING AGENCY

A. See Section 014500.

1.11 QUALITY CONTROL BY CONTRACTOR

A. See Section 033000.

B. The Contractor's Geotechnical Engineer shall be qualified to perform the type of work required by the Project. The Engineer shall be a Licensed Professional Engineer in the state where the project is located. The engineer shall develop a site dewatering plan and advise on footing construction techniques, including assistance in the development of construction procedures and the development of solutions to construction problems.

1.12 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS

A. See Section 033000.

1.13 PERMITS AND WARRANTY

A. Permits: See Section 033000.

Drawings and calculations prepared by the Contractor's Licensed Professional Engineer in the state where the project is located for temporary shoring and/or earth retention shall be submitted to the City, State, or other governing authority for review.

B. Warranty: See Section 033000.

PART 2 - PRODUCTS

2.1 CONCRETE

A. See Section 033000.

2.2 REINFORCEMENT

A. See Section 032000.

PART 3 - EXECUTION

3.1 PROTECTION OF EXISTING UTILITIES AND STRUCTURES

A. Before installing footings adjacent to known existing utilities, notify utility owner to ensure that protective work will be coordinated and performed by Contractor in accordance with requirements of the owner of utility or building. If any existing service lines, utilities, and utility structures to remain in service are uncovered or encountered during work, protect the uncovered element from damage and provide support where necessary.

B. Should uncharted or incorrectly charted piping or other utilities be encountered during footing excavation, immediately notify the Owner, Design Professionals and utility owner. Cooperate with Owner and utility owner in keeping their respective services, utilities and facilities in operation. Repair damaged utilities to entire satisfaction of Owner and utility owner concerned.

C. Do not interrupt existing utility service facilities occupied and used by Owner and others, except when permitted in writing by the Design Professionals and then only after acceptable temporary utility services have been provided.

D. Protect structures, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by footing operations.

3.2 SITE DEWATERING

A. Before installing footings, provide site dewatering based on the Contractor's site dewatering plan.

B. Provide and maintain pumping equipment to keep excavations free of water before placing concrete. If excessive water is encountered and drilling operations must be halted, consult the Geotechnical Engineer before using alternate methods of construction.

C. If excessive seepage is coming in from below the bottom of the footing excavation, removal by pumping within the excavation is inappropriate, as this may loosen the bearing soils and reduce the bearing soil capacity; therefore, an alternate means of dewatering will be required.

3.3 GENERAL FOOTING EXCAVATION

A. Tolerances: Plan location tolerance is 2% of footing dimension but no greater than 2 inches (50 mm), whichever is greater, If indicated tolerances are exceeded, see “Footing Corrective Measures” in Part 3.

B. Forming Sides of Footings:

1. Provide forms for footings and grade beams if soil or other conditions are such that earth trench forms are unsuitable.
2. When trench forms are used, provide an additional 1” (25 mm) of concrete on each side of the minimum design profiles and dimensions indicated.

C. Cleanup of Footing Bottom: Excavate bottom to a level plane. Remove loose materials or free water as determined by Owner's Geotechnical Engineer.

D. Bottom of adjacent footings that are at different elevations should never result in an excavation slope between footings greater than 1.0 vertical to 1.5 horizontal unless otherwise noted in the drawings or geotechnical engineering report. If steeper slopes occur, the EOR should be notified before any concrete is placed.

3.4 ADDITIONAL EXCAVATION AND FOOTING DEPTH

A. Do not excavate below elevations noted by Owner's Geotechnical Engineer without prior review by Owner's Geotechnical Engineer.

B. Where Owner's Geotechnical Engineer determines that soil encountered at design bearing elevation is not capable of providing minimum design bearing capacity, perform additional excavation as recommended by Owner's Geotechnical Engineer.

C. If obstructions are encountered that interfere with new construction, remove such existing elements or develop corrective methods. The Contractor shall propose corrective actions and their recommendations in writing and submit them for review by the Design Professionals. Efforts shall be made to address obstructions at no additional cost to the Owner.

3.5 DISPOSAL OF EXCAVATED MATERIALS

Dispose excavated materials off site in a manner that will not interfere with other construction activities. Keep construction site at all times clean and free of soil and other debris that could affect progress of other construction activities.

3.6 FOOTING REINFORCEMENT

A. Fabrication in accordance with 032000 from approved shop drawings.

3.7 FOOTING BEARING STRATA

A. Footing Bearing Stratum Criteria and Verification

1. Footings shall be founded on soil strata with bearing capacity indicated on Drawings. Footings shall not be excavated until test results by Owner's Geotechnical Engineer confirm allowable bearing values indicated on Drawings, but shall be excavated immediately thereafter.
2. Each footing bearing strata must be inspected and be acceptable to the Owner's Geotechnical Engineer before placing concrete
3. Footing excavations to acceptable bearing strata shall not be left exposed to weather for more than 48 hours before footing concrete is placed.
4. At no time before or after footing concrete is placed shall the soil below the footing be allowed to freeze. Adequate freeze protection must be sufficient depth to provide adequate frost protection per the geotechnical engineering report.

3.8 CORRECTIVE MEASURES

A. If unforeseen field conditions require corrective installation methods, immediately notify the Design Professionals.

1. Where a change to the construction installation method result in an as-built footing in compliance with the Contract Documents, submit installation method for record.
2. Where the as-built footing does not meet the design intent of the Contract Documents. The Contractor shall propose corrective actions and their recommendations in writing and submit them for review by the Design Professionals.

B. If footings are installed outside allowable tolerances, develop and provide corrective methods at no extra cost to the Owner including calculations based on actual locations of footings, taking into account eccentricity between final centerline of footing and design location of column centerline. The Contractor shall propose corrective actions and their recommendations in writing and submit them for review by the Design Professionals. Calculations shall be sealed and signed by a Professional Engineer licensed in the state where the project is located.

C. Where the Contractor requests that the Design Professionals develop the corrective actions or review corrective actions developed by others, the Design

Professional shall be compensated as outlined in Part 3 – CORRECTIVE MEASURES section of Specification 033000.

END OF SECTION

SECTION 316329

CAISSONS

PART 1 - GENERAL

1.1 GENERAL

Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 SCOPE

The work covered by this Section shall include all labor, material, equipment, permits, engineering and other services necessary for the fabrication and installation of caissons and related work, complete, in accordance with the Drawings and as specified herein.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Division 1
Quality Control	Division 1
Quality Assurance: Structural Testing and Inspection	Section 014500
Concrete Reinforcement and Embedded Assemblies	Section 032000
Cast-In-Place Concrete	Section 033000

1.4 CODES AND STANDARDS

A. Building Code: Caisson work shall conform to the requirements of the Building Code identified on the structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.

B. Standards:

1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301 – Standard Specifications for Structural Concrete.
3. ACI 315 – Details and Detailing of Concrete Reinforcement.
4. ACI 318 – Building Code Requirements for Reinforced Concrete.
5. ACI 336.1 – Specification for the Construction of Drilled Piers.
6. American Concrete Institute “Manual of Concrete Practice”, various committee reports as referenced herein.
7. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein.
8. AWS D1.4 – Structural Welding Code-Reinforcing Steel.

C. Definitions:

1. See Section 033000.

2. The term “Owner’s Geotechnical Engineer” in this Specification is defined as the Owner’s representative specifically authorized to perform the responsibilities defined herein.

1.5 CONTRACTOR QUALIFICATIONS

A. The Caisson Installer shall be a company which specializes in installing caissons, with a minimum of 10 years of documented successful experience. Installation shall be performed by skilled workmen thoroughly experienced in the necessary execution.

B. The Contractor’s Field Supervisor shall have 10 years of experience in installing caissons and provide full-time supervision.

C. The Contractor’s Professional Surveyor shall have 10 years of previous experience in laying out foundation locations to perform surveys, layouts, and measurements for caisson work. The Contractor’s Professional Surveyor shall be licensed in the state in which the project is located. Conduct layout work for each caisson to lines and levels required before excavation; actual measurements of each caisson’s horizontal axial location, shaft diameter, bottom and top elevations; deviations from specified tolerances, and other required data.

1.6 SUBMITTALS

A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested.

(1) Submittal Schedule
(2) Caisson Construction Methods
(3) Installer Qualifications
(4) Shop drawings
(5) Contractor’s Geotechnical Reports
(6) Contractor’s Material Testing Reports
(7) Construction Log
(8) Contractor’s Survey Report
(9) Mill Certificates
(10) Owner’s Geotechnical Engineer Report
(11) Owner’s Concrete Testing Agency Reports
(12) Product Data
(13) **[LEED Submittals]**

1. **Submittal Schedule**: See Section 033000.
2. **Caisson Construction Procedures**: Submit for record, caisson construction procedures developed by the Caisson Contractor.
3. **Installer Qualifications**: Submit proof of qualifications as stated in the CONTRACTOR QUALIFICATIONS section of this Specification.
4. **Shop drawings in accordance with 032000 and 033000, and as noted.**

a) Concrete mix designs in accordance with Section 033000.

b) Caisson reinforcement in accordance with Section 032000 and 033000. Submittal shall also indicate spacer and/or centralizers.
c) Caisson layout drawing showing the location of each caisson (with respect to building gridlines), diameter of shaft and bell, and top of shaft elevation.
d) Permanent steel liners, where required: Submit for record calculations sealed and signed by a Professional Engineer licensed in the state where the project is located.

5. **Contractor's Geotechnical Reports**: Submit for record reports sealed and signed by a Professional Engineer licensed in the state where the project is located, addressing any additional geotechnical investigation required by the Contractor, describing the planned caisson construction methods, discussing potential problems, and outlining planned methods of addressing potential problems.
6. **Contractor's Material Testing Reports**: Submit for record reports sealed and signed by a Professional Engineer licensed in the state where the project is located addressing proposed concrete mix design, trial batching test results, reports of ASTM C88.
7. **Construction Log**: Testing Agency shall document, sign, and submit for record, a record of each caisson construction, including:

a) Caisson designation, top and bottom elevation, bell and shaft diameter.
b) Size, length and location of permanent liner and casing.
c) Size, length, and location of installed reinforcement.
d) Deviation of centerline from vertical (tilt) measured after excavation.
e) Levelness of as-built caisson end bearing surface.
f) Actual allowable soil bearing capacity
g) Seepage of water
h) Inspection and testing
i) Method of concrete placement, time of beginning and ending concrete discharge for each truck, (including any delays in concreting and location of construction joints in shafts) and any deviation from planned construction methods.
j) Volume of concrete supplied to caisson and ratio of actual volume to theoretical volume.

8. **Contractor’s Survey Report**: Submit for record plans sealed and signed by a Professional Surveyor licensed in the state where the project is located**,** indicating as built plan locations of caisson centerlines (with respect to building gridlines) and identifying deviations of caisson centerlines at cutoff level from design plan locations. Caissons that are outside of specified tolerances shall be specifically identified on the plan.
9. **Mill Certificates**: Per Specification section 032000, submit for record certified reports for physical and chemical properties of following materials:

a) Reinforcement bars.
b) Permanent steel liners.

10. **Owner's Geotechnical Engineer Report**: submit for record

    a) Comments on the Contractor's Geotechnical Engineer's submittals.
    b) Comments on the Contractor's construction log, based on notes taken during caisson construction.
    c) Immediately notify the Design Professionals of any deviations from the Drawings.

11. **Owner's Concrete Testing Agency Reports**: submit for record

    a) Reports of field observations.
    b) Reports of field quality control tests, as related to concrete, reinforcement, and permanent liner fabrication and welding.
    c) Immediately notify the Design Professionals of any deviations from the Drawings.

12. **Product Data**: Submit for record for each type of product identified in Part 2. Product Data shall be clearly marked to indicate all technical information which specifies full compliance with this section and Contract Documents, including published installation instructions and ICC reports, where applicable, for products of each manufacturer specified in this section.
13. **[LEED Submittals:]**

B. Submittal Process: See Section 033000.

C. SER Submittal Review: See Section 033000.

D. Substitution Request: See Section 033000.

E. Request for Information (RFI): See Section 033000.

1.7 DELIVERY, STORAGE, AND HANDLING

A. See Sections 032000 and 033000.

1.8 PRE-INSTALLATION CONFERENCE

Conduct meeting at Project Site to comply with requirements in Division 1.

1.9 PROJECT SITE CONDITIONS

A. Geotechnical Information: Contractor to examine site, records of test borings, soil samples, and Geotechnical Reports that are available from the Owner. Soil boring test results are provided by the Owner for information, and are not guaranteed to represent conditions that are present at caisson locations. Soil boring test results are not intended as representations or warranties of the continuity of the reported conditions. It is expressly understood that the Owner will not be responsible for interpretation or conclusions drawn by Contractor from the Geotechnical Report. At no additional cost to the Owner, evaluate the

available data and provide additional test borings and other investigations as necessary for installing caissons.

B. Site Survey: Survey of site, existing utilities, and existing construction available from the Owner represent conditions known to Owner. Other obstructions may be encountered.

1.10 QUALITY ASSURANCE BY OWNER'S TESTING AGENCY

A. See Section 014500.

1.11 QUALITY CONTROL BY CONTRACTOR

A. See Section 033000.

B. The Contractor's Geotechnical Engineer shall be qualified to perform the type of work required by the Project. The Engineer shall be a Licensed Professional Engineer in the state where the project is located. The engineer shall develop a site dewatering plan and advise on caisson construction techniques, including assistance in the development of construction procedures and the development of solutions to construction problems.

C. Caisson contractor's Responsibilities

1. Examine the areas and conditions under which caissons are to be installed. Notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner.

1.12 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS

A. See Section 033000.

1.13 PERMITS AND WARRANTY

A. Permits: See Section 033000.

Drawings and calculations prepared by the Contractor's Licensed Professional Engineer in the state where the project is located for temporary shoring and/or earth retention shall be submitted to the City, State, or other governing authority for review.

B. Warranty: See Section 033000.

PART 2 - PRODUCTS

2.1 PERMANENT CORRUGATED STEEL LINER

ASTM A929, sheet steel, zinc coated. Design corrugated steel liners to withstand handling stresses, construction loads, and pressures induced by hydrostatic head, concrete placement, soil, and other forces, as applicable, including appropriate safety

factors. Provide manufacturer's standard finish. Limit out of roundness to 2% of diameter. Design for the indicated tolerances.

2.2 TEMPORARY STEEL CASING

A. ASTM A283, Grade C; or ASTM A36, all vertical joints provided with full penetration welds, per AWS D1.1. Temporary casings shall be provided to prevent cave-ins and displacement of earth, and for keeping silt and water out of the caisson excavation. This casing shall extend from the height of 1’-0” (one foot) above grade, through the miscellaneous fill, into the strata of clay. Where necessary, the inside diameter of the casing shall be large enough to permit installation of a permanent corrugated liner inside of the temporary casing.

B. Design casing to withstand handling stresses, construction loads, and pressures induced by hydrostatic head, concrete placement, soil, and other forces as applicable, including appropriate safety factors. Limit out of roundness to 2% of diameter. Design for the indicated tolerances.

2.3 CONCRETE

A. See Section 033000 and additional requirements listed below.

B. Retarder: Sufficient to prevent temporary set for a period of 4 hours from completion of batching.

C. Concrete Placed by Tremie Method: Include coarse aggregates with maximum size conforming to Size 7 per ASTM C33 and a water/cement ratio less than or equal to 0.45. For concrete placed in a dry open hole, provide slump of 5" to 7". For concrete placed by tremie method, provide slump of 7" to 9".

D. Controlled Slurry: stable colloidal suspension of various pulverized clays or polymers thoroughly mixed with water and in compliance with ACI 336.1.

2.4 REINFORCEMENT

A. See Section 032000.

2.5 LEAN GROUT

A. Provide sand-cement grout suitable to fill annular void outside permanent or temporary casing.

1. Minimum cube strength at 28 days, as stated in typical details.
2. Water-cementitious materials ratio of less than 1.0.

PART 3 - EXECUTION

3.1 PROTECTION OF EXISTING UTILITIES AND STRUCTURES

A. Before installing caissons adjacent to known existing utilities, notify utility owner to ensure that protective work will be coordinated and performed by Contractor in accordance with requirements of the owner of utility or building. If any existing

service lines, utilities, and utility structures to remain in service are uncovered or encountered during work, protect the uncovered element from damage and provide support where necessary.

B. Should uncharted or incorrectly charted piping or other utilities be encountered during caisson drilling operations, immediately notify the Owner, Design Professionals and utility owner. Cooperate with Owner and utility owner in keeping their respective services, utilities and facilities in operation. Repair damaged utilities to entire satisfaction of Owner and utility owner concerned.

C. Do not interrupt existing utility service facilities occupied and used by Owner and others, except when permitted in writing by the Design Professionals and then only after acceptable temporary utility services have been provided.

D. Protect structures, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by caisson operations.

3.2 SITE DEWATERING

A. Before installing caissons, provide site dewatering based on the Contractor’s site dewatering plan.

B. Provide and maintain pumping equipment to keep excavations free of water before placing concrete. If excessive water is encountered and drilling operations must be halted, consult the Geotechnical Engineer before using alternate methods of construction.

C. If excessive seepage is coming in from below the bottom of the caisson excavation, removal by pumping is inappropriate, as this may loosen the bearing soils and reduce the bearing soil capacity; therefore, an alternate means of construction will be required.

3.3 GENERAL CAISSON EXCAVATION

A. Tolerances: Plan location tolerance at cut-off shall be no greater than 1/24 of the specified shaft diameter or 3 inches (75 mm), whichever is greater, from shaft centerline location indicated on Structural Drawings. Provide caisson centerline with a local slope of no more than 1/8 in. per foot at any point, and an overall slope of no more than 1/8 in. per foot. If indicated tolerances are exceeded, see “Belled Caisson Corrective Measures” in Part 3.

B. Concrete cut-off elevation: plus 1 inch, minus 3 inches.

C. Cleanup of Caisson Bottom: Excavate bottom to a level plane. Remove loose materials or free water as determined by Owner's Geotechnical Engineer. Per the Geotechnical Report, it is necessary to oversize the bell area by 15 percent or the bell diameter by 1 foot, whichever is smaller. Oversizing of the bell diameter is indicated on the Drawings. Alternately, to eliminate oversized bell requirements, a camera can be lowered into the bell after final cleanup to verify that the bell is suitably free of loose materials. This may be used at Contractor’s option.

D. Equipment: Use equipment of adequate capacity and proven methods.

E. Install permanent corrugated steel liners inside of temporary casings to form the caisson shaft before the concrete pour. Remove and replace, or repair liners, which are damaged during installation and which could impair the strength or efficiency of the completed caisson.

F. All excavation required to install the temporary casing through any water bearing soils shall be performed under a slurry head sufficient to prevent caving. All excavation shall be supported by the slurry until the temporary casing has been installed with a minimum seal into the clay strata as required per the Geotechnical Report. The casing shall be pushed or twisted to a depth sufficient to prevent soft clay squeeze.

G. Loss of Soils: Minimize loss of soils due to pumping. Minimize squeezing of excavation. Limit loss of ground and subsequent settlement to least possible amount by limiting annular spaces beyond permanent liners to specified values, performing excavation under slurry if needed, grouting annular spaces beyond permanent liners, and limiting soil quantity pumped out.

H. Excavate holes for caissons to the required bearing strata as determined by the Owner’s Geotechnical Engineer. Excavate holes for closely spaced caissons, and those occurring in fragile or sand strata, only after adjacent holes are filled with concrete and allowed to set.

I. Holes for caissons at or near underground utilities shall be hand dug where required to protect the utilities when within 1’-0” of utilities elevation.

3.4 ADDITIONAL EXCAVATION AND CAISSON LENGTH

A. Do not excavate below elevations noted by Owner's Geotechnical Engineer without prior review by Owner's Geotechnical Engineer. No payment will be made for extra length when caisson shafts are excavated to a greater depth than indicated on Drawings, due to over-drilling by Contractor. In the event of an over-excavated shaft, complete caisson and fill extra depth with concrete, if other conditions are satisfactory. Over-excavated shafts will be measured and paid for to original design or authorized depth.

B. Where Owner's Geotechnical Engineer determines that soil encountered at design bearing elevation is not capable of providing minimum design bearing capacity, perform additional excavation as recommended by Owner's Geotechnical Engineer.

C. If obstructions are encountered that interfere with new construction, remove such existing elements or develop corrective methods. The Contractor shall propose corrective actions and their recommendations in writing and submit them for review by the Design Professionals. Efforts shall be made to address obstructions at no additional cost to the Owner.

3.5 DISPOSAL OF EXCAVATED MATERIALS

Dispose excavated materials off site in a manner that will not interfere with other construction activities. Keep construction site at all times clean and free of soil and other debris that could affect progress of other construction activities.

3.6 CAISSON REINFORCEMENT

A. Fabrication in accordance with 032000 from approved shop drawings.

B. Fabricate and install reinforcement cage symmetrically about axis of shaft in a single unit. Cages shall be properly and securely fabricated to maintain their design locations and configurations without permanent distortion after lifted and placed in hole for caisson.

C. Use spacers and/or centralizers as required to:

1. Attain and maintain minimum cover to reinforcement, and
2. Accurately position, support and secure reinforcement against displacement during concreting.

3.7 CAISSON BEARING STRATA

A. Belled Caisson Bearing Stratum Criteria and Verification

1. Belled caissons shall be founded on soil strata with bearing capacity indicated on Drawings. Caisson bells shall not be excavated until test results by Owner’s Geotechnical Engineer confirm allowable bearing values indicated on Drawings, but shall be excavated immediately thereafter. In no case shall bottom of belled caisson be excavated to a depth that may produce a bottom blowout due to high underlying hydrostatic pressure. If test results indicate that soil is incapable of providing required safe-bearing values, advance shaft length as recommended by Owner's Geotechnical Engineer or enlarge bells as recommended by Owner's Geotechnical Engineer and SER.
2. Each caisson bearing strata must be inspected and be acceptable to the Owner’s Geotechnical Engineer before placing concrete.

3.8 PLACING CONCRETE IN DRY HOLE

A. Place concrete in dry hole unless specifically reviewed by Owner's Geotechnical Engineer. A dry hole has less than 2” of water at the bottom of the hole prior to concrete being placed.

B. Place concrete only after all of the following has occurred:

1. Caisson excavation is complete and reinforcement cage has been placed and secured.
2. Caisson bottom is cleaned.
3. Inspections by Owner's Geotechnical Engineer and Testing Agency are completed.

C. Place concrete in belled caisson within 8 hours of exposing bearing stratum. Place concrete only after receipt of verification of bearing stratum by Owner’s Geotechnical Engineer.

D. Where concrete cannot be directed down shaft without striking shaft wall or reinforcement cage, place concrete with chutes, tremies, or pumps. Avoid contact between concrete placing equipment and shaft wall or reinforcement cage.

E. Place concrete immediately after mixing, and in no case more than 90 minutes after initial mixing. Do not allow concrete to hit caisson shaft wall or reinforcement cage during placement. Continue depositing concrete until completion of caisson to top of shaft. If placement of concrete is suspended for more than 60 minutes, install construction joint as proposed in advance by the Contractor and reviewed by the Design Professionals. Remove laitance and excess water from top of completed caisson.

F. Place concrete for belled caissons only after receiving approval from the Owner’s Geotechnical Engineer, based on an evaluation of water inflow, where applicable.

3.9 PLACING CONCRETE UNDER SLURRY OR WATER USING TREMIE OR PUMP METHODS

A. Placement of concrete under slurry or water is allowed only based on review comments from Design Professionals and Owner's Geotechnical Engineer. Use "controlled" bentonite clay or polymer slurry, as reviewed by Owner's Geotechnical Engineer, with density not less than 64 pcf. Control quality and application of slurry material to preclude contamination of concrete. Placing concrete under water will be considered only in the presence of continuous steel plate casing, to protect against caving. Installation of casing may require drilling under slurry.

B. Allow water and slurry to rise to stable static level, as determined by Owner's Geotechnical Engineer.

C. Clean bottom of caisson with a high capacity air-lift, suction pump. De-sand slurry to less than 4% sand content. Assist Owner's Geotechnical Engineer in "sounding" bearing stratum with air lift pipe.

D. Place concrete in caisson within 8 hours of exposing bearing stratum. Place concrete only after verification of bearing stratum and securing of reinforcement cage has been completed.

E. Agitate slurry or water by an air hose at bottom of caisson, until concrete placement is started, to keep any remaining excavation material fines in suspension.

F. Provide continuous tremie pipe with a minimum diameter of 10 inches or continuous pumping pipe with a minimum diameter of 5 inches.

G. Provide separator plug suitable for keeping concrete separated from slurry or water in pipe. Lower pipe to bottom of caisson. Fill pipe with concrete to its top and release plug by lifting pipe 10 inches. Maintain concrete head above hydrostatic pressure.

H. Allow concrete to rise from bottom. Pipe shall always penetrate into concrete and pipe shall not be initially raised until a 30 foot depth of concrete is reached, after which it may be raised to maintain a minimum penetration of 10 feet into fresh concrete.

I. At option of Contractor, upon preconstruction request, review and approval, concrete placement may be suspended after a minimum of 30 feet of concrete is placed from bottom. Remainder of caisson may be placed in dry hole after cleaning and removal of laitance and installing a construction joint as detailed on Drawings. For this option of combining concrete placement methods, extend reinforcement to full length of caisson.

3.10 CORRECTIVE MEASURES

A. Immediately notify the Design Professionals if unforeseen field conditions require corrective installation methods.

1. Where a change to the construction installation method result in an as-built caisson in compliance with the Contract Documents, submit installation method for record.
2. Where the as built caisson does not meet the design intent of the Contract Documents. The Contractor shall propose corrective actions and their recommendations in writing and submit them for review by the Design Professionals.

B. If concrete placement is suspended before completion of caisson or a construction joint is required for some other reason, indicate location on construction log. Submit a construction joint for approval and remove debris and laitance from joint before placing additional concrete.

C. If caissons are installed outside allowable tolerances, develop and provide corrective methods at no extra cost to the Owner including calculations based on actual locations of caissons, taking into account eccentricity between final centerline of caisson and design location of column centerline. The Contractor shall propose corrective actions and their recommendations in writing and submit them for review by the Design Professionals. Calculations shall be sealed and signed by a Professional Engineer licensed in the state where the project is located.

D. Where the Contractor requests that the Design Professionals develop the corrective actions or review corrective actions developed by others, the Design Professional shall be compensated as outlined in Part 3 – CORRECTIVE MEASURES section of Specification 033000.

END OF SECTION

SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Hot-mix asphalt patching.
2. Hot-mix asphalt paving.
3. Hot-mix asphalt overlay.

B. Related Requirements:

1. Section 02 4116 "Structure Demolition" and Section 02 4119 "Selective Demolition" for demolition and removal of existing asphalt pavement.
2. Section 31 2000 "Earth Moving" for subgrade preparation, fill material, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.
3. Section 32 1400 "Unit Paving" for bituminous setting bed for pavers.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
b. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include technical data and tested physical and performance properties.
2. Job-Mix Designs: Certification, by MSHA, of approval of each job mix proposed for the Work.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Material Test Reports: For each paving material, by a qualified testing agency.

C. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Contractor will engage a qualified independent testing agency qualified according to ASTM D 3666 for testing indicated.

B. Maryland Department of Transportation, State Highway Administration, Standard Specifications for Construction and Materials, July 2022, (MSHA), as amended to date.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

C. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by MSHA.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime and Tack Coats: Minimum surface temperature of 60 deg F.
2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
3. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 50 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Base Course: Graded Aggregate Base crushed stone in accordance with MSHA standard specifications for construction and materials.

2.2 ASPHALT MATERIALS

A. Prime Coat: Asphalt emulsion prime complying with MSHA standard specifications for construction and materials.

B. Tack Coat: AASHTO M 140, emulsified asphalt, of suitable grade and consistency for application complying with MSHA standard specifications for construction and materials.

C. Asphalt Binder: Per MSHA specifications

D. Water: Potable.

2.3 AUXILIARY MATERIALS

A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than three minutes.

1. Color: White.

2.4 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes (HMA) in accordance with MSHA standard specifications for construction and materials for bituminous concrete mixtures.

1. Surface Course: Per drawings.
2. Base/Binder Course: Per drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.

3.3 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd..

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

C. Placing Patch Material: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.4 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Cutback Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd.. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd..

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.5 PLACING HOT-MIX ASPHALT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted. Installation shall be in accordance with MSHA specifications.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Place hot-mix asphalt surface course in single lift.
3. Spread mix at a minimum temperature of 250 deg F.
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.
2. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.6 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time.
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.7 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference laboratory density according to ASTM D 6927, but not less than 94 percent or greater than 100 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.8 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus 1/2 inch, no minus.
2. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch.
2. Surface Course: 1/8 inch.
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.9 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Owner's Representative.

B. Allow paving to age for 15 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to AASHTO T 168.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than three cores taken.
b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

E. Replace and compact hot-mix asphalt where core tests were taken.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

END OF SECTION

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Driveways.
2. Roadways.
3. Parking lots.
4. Curbs and gutters.
5. Walks.

B. Related Sections:

1. Section 03 3000 "Cast-in-Place Concrete for general building applications of concrete.
2. Section 32 1373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixes: For each concrete mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments. Include certification by MSHA that mix and alternate(s) comply with MSHA specifications.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified ready-mix concrete manufacturer.

B. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.

8. Joint fillers.

C. LEED Submittals:

1. Product Data for Credit MR 2: BPDO – Environmental Product Declarations
   a. For steel, cement, and slag, if available: Product-specific declaration or Industry-wide EPD of product-specific EPD. Include EPD Summary
2. Design Mixtures for Credit ID 1: For each concrete mixture containing fly ash as a replacement for portland cement or other portland cement replacements. For each design mixture submitted, include an equivalent concrete mixture that does not contain portland cement replacements, to determine amount of portland cement replaced.
3. MR Credit 3: BPDO – Sourcing of Raw Materials
   a. For recycled content in concrete mix (fly ash / slag) and steel reinforcement: Documentation indicating Percentages by weight of pre-consumer and past-consumer recycled content.
   b. For regionally sourced recycled content materials: documentation indicating locations of recovery, manufacture, purchase of recycled raw materials

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Maryland Department of Transportation, State Highway Administration, Standard Specifications for Construction and Materials, July 2022, (MSHA), as amended to date.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

B. Installer Qualifications: An experienced installer who has completed pavement work similar in material, design, and extent to that indicated for this Project and who can demonstrate no less than a 5-year record of similar construction work that has resulted in successful in-service performance.

C. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

1. Manufacturer must be certified according to the Maryland State Highway Administration

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from one source.

E. ACI Publications: Comply with ACI 301 unless otherwise indicated.

F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.
2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Architect and not less than 96 inches by 96 inches.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.
2. Non-uniform curves and/or kinks in curved edges or joints shall be cause for rejection of the work.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

A. Recycled Content: minimum 90 percent total recycled content, including at least 60 percent post-consumer content..

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.

C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

D. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

E. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.

F. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.

G. Deformed-Steel Wire: ASTM A 496/A 496M.

H. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A 767/A 767M, Class I coating. Cut bars true to length with ends square and free of burrs.

I. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.

J. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

K. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

L. Zinc Repair Material: ASTM A 780.

2.3 CONCRETE MATERIALS

A. Concrete Mixes:

1. Portland Cement Concrete mixes shall be as indicated on the Drawings and in accordance with MSHA specifications.

2.4 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Axim Italcementi Group, Inc.; Caltexol CIMFILM.
   b. BASF Construction Chemicals, LLC; Confilm.
   c. ChemMasters; Spray-Film.
   d. Conspec by Dayton Superior; Aquafilm.
   e. Dayton Superior Corporation; Sure Film (J-74).
   f. Edoco by Dayton Superior; BurkeFilm.
   g. Euclid Chemical Company (The), an RPM company; Eucobar.
   h. Kaufman Products, Inc.; VaporAid.
   i. Lambert Corporation; LAMBCO Skin.
   j. L&M Construction Chemicals, Inc.; E-CON.
   k. Meadows, W. R., Inc.; EVAPRE.
   l. Metalcrete Industries; Waterhold.
   m. Nox-Crete Products Group; MONOFILM.
   n. Sika Corporation, Inc.; SikaFilm.
   o. SpecChem, LLC; Spec Film.
   p. Symons by Dayton Superior; Finishing Aid.
   q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
   r. Unitex; PRO-FILM.
   s. Vexcon Chemicals Inc.; Certi-Vex EnvioAssist.
   t. .

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Anti-Hydro International, Inc.; A-H Curing Compound #2 DR WB.
   b. ChemMasters; Safe-Cure Clear.
   c. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
   d. Euclid Chemical Company (The), an RPM company; Kurez W VOX.

e. Kaufman Products, Inc.; Thinfilm 420.
f. Lambert Corporation; AQUA KURE - CLEAR.
g. L&M Construction Chemicals, Inc.; L&M CURE R.
h. Meadows, W. R., Inc.; 1100-CLEAR SERIES.
i. Nox-Crete Products Group; Resin Cure E.
j. SpecChem, LLC; PaveCure Rez.
k. Symons by Dayton Superior; Resi-Chem Clear.
l. Tamms Industries, Inc., Euclid Chemical Company (The); TAMMSCURE WB 30C.
m. Vexcon Chemicals Inc.; Certi-Vex Enviocure 100.

2.5 RELATED MATERIALS

A. Joint Fillers: ASTM D 1752, cork or self-expanding cork in preformed strips.

B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.6 PAVEMENT MARKINGS

A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than three minutes.

1. Colors: White, yellow, blue (handicap parking), & red (fire lanes).

2.7 CONCRETE MIXTURES

A. Portland Cement Concrete mixes shall be as indicated on the drawings and in accordance with MSHA specifications.

B. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction. Limit vehicle speed to 3 mph.

2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 31 2000 "Earth Moving."

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
2. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feetunless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
4. Place top of joint filler 1/4 inch below finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Control Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
   a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
   a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.

3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

L. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

M. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
2. Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

3.8 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing moisture-retaining-cover curing curing compound or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.9 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot-long, unleveled straightedge not to exceed 1/2 inch.
4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
5. Lateral Alignment and Spacing of Dowels: 1 inch.
6. Vertical Alignment of Dowels: 1/4 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.10 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow concrete paving to cure for a minimum of 28 days and be dry before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to concrete surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
   a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.
   a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.12 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 323113 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Chain-link fences.
2. Horizontal-slide gates.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for cast-in-place concrete post footings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
   a. Fence and gate posts, rails, and fittings.
   b. Chain-link fabric, reinforcements, and attachments.
   c. Gates and hardware.

B. Shop Drawings: For each type of fence and gate assembly.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include accessories, hardware, gate operation, and operational clearances.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing fence grounding; member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

B. Emergency Access Requirements: According to requirements of authorities having jurisdiction for gates with automatic gate operators serving as a required means of access.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.7 WARRANTY

A. Special Warranty: Installer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Failure to comply with performance requirements.
   b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   c. Faulty operation of gate operators and controls.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CHAIN-LINK FENCE FABRIC

A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist according to "CLFMI Product Manual" and requirements indicated below:

1. Fabric Height: As indicated on Drawings.
2. Steel Wire for Fabric: Wire diameter of 0.148 inch.
   a. Mesh Size: 2 inches.
   a. Polymer-Coated Fabric: ASTM F668, Class 2a over zinc-coated steel wire.
   b. Color: As selected by Architect from manufacturer's full range, according to ASTM F934.

3. Selvage: Twisted top and knuckled bottom.

2.2 FENCE FRAMEWORK

A. Posts and Rails: ASTM F1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F1043 based on the following:

1. Fence Height: As indicated on Drawings.
2. Light-Industrial-Strength Material: Group IC-L, round steel pipe, electric-resistance-welded pipe.
   a. Line Post: 1.9 inches in diameter.
   b. End, Corner, and Pull Posts: 4.0 inches.

3. Brace Rails: ASTM F1043.

4. Polymer coating over metallic coating.
   a. Color: Match chain-link fabric, according to ASTM F934..

2.3 TENSION WIRE

A. Metallic-Coated Steel Wire: 0.177-inch-diameter, marcelled tension wire according to ASTM A817 or ASTM A824, with the following metallic coating:

1. Type II: Zinc coated (galvanized) by electrolytic process, with the following minimum coating weight:
   a. Matching chain-link fabric coating weight.

2.4 HORIZONTAL-SLIDE GATES

A. General: ASTM F1184 for gate posts and single sliding gate types.

1. Classification: Type II Cantilever Slide, Class 2 with internal roller assemblies.
   a. Gate Frame Width and Height: As indicated on drawings.

B. Pipe and Tubing:
1. Gate Posts: ASTM F1184. Provide round tubular steel posts.
2. Gate Frames and Bracing: Rectangular tubular aluminum.

C. Frame Corner Construction: Welded.

D. Extended Gate Posts and Frame Members: Extend gate posts and frame end members above top of chain-link fabric at both ends of gate frame 12 inches as required to attach barbed wire assemblies.

E. Overhead Track Assembly: Manufacturer's standard track, with overhead framework supports, bracing, and accessories, engineered to support size, weight, width, operation, and design of gate and roller assemblies.

F. Hardware:

1. Hangers, Roller Assemblies, and Stops: Fabricated from mill-finished Grade 319 aluminum-alloy casting with stainless-steel fasteners.
2. Latch: Permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
3. Padlock and Chain: To be provided by Owner.

2.5 FITTINGS

A. Provide fittings according to ASTM F626.

B. Tension and Brace Bands: Pressed steel.

C. Tension Bars: Steel, length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

D. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.

E. Barbed Wire Arms: Pressed steel or cast iron, with clips, slots, or other means for attaching strands of barbed wire, integral with post cap, for each post unless otherwise indicated, and as follows:

1. Provide line posts with arms that accommodate top rail or tension wire.
2. Provide corner arms at fence corner posts unless extended posts are indicated.
3. Single-Arm Type: Type I, slanted arm.

F. Tie Wires, Clips, and Fasteners: According to ASTM F626.

1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, according to the following:

a. Hot-Dip Galvanized Steel: 6 gauge wire; galvanized coating thickness matching coating thickness of chain-link fence fabric.

G. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz./sq. ft. of zinc.

2.6 BARBED WIRE

A. Steel Barbed Wire: ASTM A121, two-strand barbed wire, 0.099-inch-diameter line wire with 0.080-inch-diameter, four-point round barbs spaced not more than 5 inches o.c.

1. Zinc Coating: Type Z, Class 3.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.

1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 CHAIN-LINK FENCE INSTALLATION

A. Install chain-link fencing according to ASTM F567

B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.

2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
   a. Exposed Concrete: Extend 2 inches above grade; shape and smooth to shed water.

D. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment of 30 degrees or more. For runs exceeding 500 feet, space pull posts an equal distance between corner or end posts.

E. Line Posts: Space line posts uniformly at 10 feet o.c.

F. Post Bracing and Intermediate Rails: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.

1. Locate horizontal braces at midheight of fabric 72 inches or higher, on fences with top rail, and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.

G. Tension Wire: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch-diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:

1. Extended along top and bottom of fence fabric. Install top tension wire through post cap loops. Install bottom tension wire within 6 inches of bottom of fabric and tie to each post with not less than same diameter and type of wire.
2. Extended along top of extended posts and top of fence fabric to support barbed wire.

H. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 1-inch bottom clearance between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

I. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts, with tension bands spaced not more than 15 inches o.c.

J. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric according to ASTM F626. Bend ends of wire to minimize hazard to individuals and clothing.

1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.

K. Fasteners: Install nuts for tension bands and carriage bolts on the side of fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

L. Barbed Wire: Install barbed wire uniformly spaced as indicated on Drawings. Pull wire taut, install securely to extension arms, and secure to end post or terminal arms.

3.4 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests.

B. Grounding Tests: Comply with requirements in Section 264113 "Lightning Protection for Structures."

C. Prepare test reports.

3.6 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware and other moving parts.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain chain-link fences and gates.

END OF SECTION 323113

SECTION 323119 - DECORATIVE METAL FENCES AND GATES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel welded Wire Fences
2. Steel welded Wire gates
3. Concrete Post Foundations

B. Related Sections:

1. Division : Administrative procedural, temporary work requirements
2. Section --//--Cast-in Place Concrete
3. Section --//--Excavation and Fill

1.2 REFERENCES

A. ASTM International (ASTM):

1. A185/A18M-Standard Specification for welded Wire Reinforcement, Plain, for Concrete

2. A641/A64M-Standard Specifications for Zinc-Coated (Galvanized) Carbon Steel Wire.

3. B117-Standard Practice for Operation Salt Spray (fog) apparatus

4. C94-Standard Specification for Ready Mix Concrete.

5. D3359-Standard Practice for Measuring Adhesion by Tape test

BASTM International (ASTM): ASTM B 221/B 221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.

C. American Architectural Manufacturers Association (AAMA): AAMA 2603 - Voluntary Specification, Performance Requirements, and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.

D. American Welding Society (AWS):

1. AWS D1.1 - Structural Welding Code - Steel (copyrighted by AWS, ANSI approved).
2. AWS D1.2 - Structural Welding Code - Aluminum (copyrighted by AWS, ANSI approved).

1.3 SUBMITTALS

A. Submittal for Review

1. Shop Drawings: Indicate fence locations, posts, system component, and accessories
2. Product Data: Manufacture’s descriptive data.

3. Samples:
a. 12X12 inch long fence panel samples.
b. 12” inch long post sample

Cap and Bracket samples

B. Sustainable Design Submittals:

1. Recycle Content: Certify recycled content of steel, indicate recycled content percent and whether pre-consumer or post consumer
2. Regional Materials: Certify materials extracted processed and manufactured within 500 miles radius of project site.

C. General: Submit under provisions of Section 01300 - Submittal Procedures.

D. Product Data: Submit product data showing materials proposed for use. Submit sufficient information to determine compliance with the Drawings and Specifications.

E. Shop Drawings: Submit shop drawings for each product and accessory required. Include information not fully detailed in manufacturer's standard product data.

F. Samples:

1. Submit samples for initial color selection. Submit samples of each specified finish. Submit samples in form of manufacturer's color charts showing full range of colors and finishes available. Where finishes involve normal color variations, include samples showing the full, range of variations expected.
2. Submit samples for verification purposes. Additional samples may be required to show fabrication techniques and workmanship. Samples shall be submitted prior to installation.

G. Closeout Submittals: Submit the following:

1. Maintenance and operation data, including methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.
2. Warranty documents specified herein.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Minimum (2) years documented experience in work of this section.

1. Manufacturer Qualifications: Manufacturer shall be a firm engaged in the manufacture of ornamental metal fences and gates of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of five years.
2. Installer Qualifications: Installer shall be a firm that shall have a minimum of two years of successful installation experience with projects utilizing ornamental metal fences and gates similar in type and scope to that required for this Project.

B. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and local authorities having jurisdiction. Obtain necessary approvals from such authorities.

1. Welding Standards: Comply with applicable provisions of AWS D1.1 and AWS D1.2. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

C.

Pre-Installation Conference: Conduct pre-installation conference in accordance with Section 01200 - Project Meetings. Prior to commencing the installation, meet at the Project site to review the material selections, installation procedures, and coordination with other trades. Mock-ups shall be reviewed during the pre-installation conference. Pre-installation

conference shall include the Contractor, the Installer, and any trade that requires coordination with the work. Date and time of the pre-installation conference shall be acceptable to the Owner and the Architect.

D. Single Source Responsibility: Obtain ornamental metal fences and gates from a single source with resources to produce products of consistent quality in appearance and physical properties without delaying the work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and lot number, if any.

B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.6 PROJECT CONDITIONS

A. Field Measurements: Take field measurements prior to fabrication of the work and preparation of shop drawings, to ensure proper fitting of the work. Show recorded measurements on final shop drawings. Notify the Owner and the Architect, in writing, of any dimensions found which are not within specified dimensions and tolerances in the Contract Documents, prior to proceeding with the fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the work.

1.7 WARRANTY

A. Furnish manufacture’s 10 year warranty providing coverage against corrosion of galvanized steel coating and blistering r loosening of powder coatings.

B. Special Finish Warranty: Submit a written warranty, signed by manufacturer, covering failure of the factory-applied exterior finish within the specified warranty period and agreeing to repair finish or replace work that shows evidence of finish deterioration. Deterioration of finish includes cracking, checking, or peeling.
   1. Warranty Period: Lifetime.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Contract Documents are based on products by Seegars Fence Company (Charlotte NC) – Ornamental-Aluminum Fencing. Base Bid

B. Alternate Fencing areas (per drawings) are based on www.designmasterfence.com “classic”

or equal.

C. Substitutions:
   Ameristar Fence Products

American Fence Association

Elite Fence Products

2.2 COMPONENTS:

A. Fence Panels:

1. Resistance welded steel wire mesh steel wire mesh, ASTM 185/A185M, 6 guage class 1 galvanized steel wire per ASTM A641/A641M, 2X6 inch mesh, stiffened with horizontal V-shaped braces.
2. Height: 8’
3. Wire breaking load: Minium 80,000PSI
4. Weld shears strength: Minuim 1,050 pounds

B. Posts:

1. Galvanized steel tube, ASTM A5137/A787, G60 coating class, 2X2 inches, 16 guage (except 12 gauge for posts supporting extension arms)
2. Length: to suit panel height and post mounting method.
3. Posts bases: Ultraviolet protected plastic, sized to posts dimensions, friction fit.
4. Post bases: Steel plate welded to bottom of posts, with four plated steel anchor bolts per base.
5. Extension arms: Same material and size as postrs, welded to posts tops at 45 degree angle, for attachment of fence panels using post brackets.

C. Post Brackets:

1. Galvanized steel and powder coated, sized to post dimension, with a 1-1/4” galvanized nut and bolt.

D. Gates:

2.3 ACCESSORIES

A. Concrete:……<<<<<<<<<

2.4 FINISHES:

A. Fence panles and posts:

1. Polyester powder coated to approximately 4 mils thickness,
2. Salt spray resistance: No rusting or blistering tested to ASTM B117 for 1000 hours.
3. Adhesion: Tested to ASTM D3359, method B.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install Fenceing in accordance with manufactures instructions and approved shop Drawings.

3.2 INSTALLATION TOLERANCES

A. Maximum Variation from plumb: ¼ inch in 10 feet

B. Maxium Offset from True Position 1 inch

END OF SECTION

SECTION 330500 - COMMON WORK RESULTS FOR UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Piping joining materials.
2. Transition fittings.
3. Dielectric fittings.
4. Sleeves.
5. Identification devices.
6. Grout.
7. Flowable fill.
8. Piped utility demolition.
9. Piping system common requirements.
10. Equipment installation common requirements.
11. Painting.
12. Concrete bases.
13. Metal supports and anchorages.

1.3 DEFINITIONS

A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.

B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

C. ABS: Acrylonitrile-butadiene-styrene plastic.

D. CPVC: Chlorinated polyvinyl chloride plastic.

E. PE: Polyethylene plastic.

F. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:
1. Dielectric fittings.
2. Identification devices.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.6 QUALITY ASSURANCE

A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Steel Piping Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.8 COORDINATION

A. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

B. Coordinate installation of identifying devices after completing covering and painting if devices are applied to surfaces.

C. Prior to demolition, coordinate utility shutdown requirements with the respective utility providers. Temporary and permanent service piping, joints, caps and installation shall meet or exceed the minimum pressure and temperature ratings of the service.

PART 2 - PRODUCTS

2.1 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness, unless otherwise indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
   2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for Joining Plastic Piping:
1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

H. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.2 TRANSITION FITTINGS

A. Transition Fittings, General: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

B. Transition Couplings NPS 1-1/2 and Smaller:
1. Underground Piping: Manufactured piping coupling or specified piping system fitting.
2. Aboveground Piping: Specified piping system fitting.

C. AWWA Transition Couplings NPS 2 and Larger:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cascade Waterworks Mfg. Co.
   b. Dresser, Inc.; DMD Div.
   c. Ford Meter Box Company, Inc. (The); Pipe Products Div.
   d. JCM Industries.
   e. Smith-Blair, Inc.
   f. Viking Johnson.
2. Description: AWWA C219, metal sleeve-type coupling for underground pressure piping.

D. Plastic-to-Metal Transition Fittings:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Spears Manufacturing Co.
2. Description: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint or threaded end.

E. Plastic-to-Metal Transition Unions:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Colonial Engineering, Inc.
   b. NIBCO INC.
   c. Spears Manufacturing Co.
2. Description: MSS SP-107, CPVC and PVC four-part union. Include brass threaded end, solvent-cement-joint or threaded plastic end, rubber O-ring, and union nut.

F. Flexible Transition Couplings for Underground Nonpressure Drainage Piping:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cascade Waterworks Mfg. Co.
   b. Fernco, Inc.
   c. Mission Rubber Company.
   d. Plastic Oddities.
2. Description: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.3 DIELECTRIC FITTINGS

A. Dielectric Fittings, General: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Capitol Manufacturing Co.
   b. Central Plastics Company.
   c. Epco Sales, Inc.
   d. Hart Industries, International, Inc.
   e. Watts Water Technologies, Inc.
   f. Zurn Plumbing Products Group; Wilkins Div.
2. Description: Factory fabricated, union, NPS 2 and smaller.
   a. Pressure Rating: 150 psig minimum at 180 deg F.
   b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded ferrous.

C. Dielectric Flanges:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Capitol Manufacturing Co.
   b. Central Plastics Company.
   c. Epco Sales, Inc.
   d. Watts Water Technologies, Inc.
2. Description: Factory-fabricated, bolted, companion-flange assembly, NPS 2-1/2 to NPS 4 and larger.
   a. Pressure Rating: 175 psig minimum.
   b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Kits:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.
2. Description: Nonconducting materials for field assembly of companion flanges, NPS 2-1/2 and larger.
   a. Pressure Rating: 150 psig minimum.
   b. Gasket: Neoprene or phenolic.
   c. Bolt Sleeves: Phenolic or polyethylene.
   d. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Calpico, Inc.
b. Lochinvar Corporation.

2. Description: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining, NPS 3 and smaller.
   a. Pressure Rating: 300 psig at 225 deg F.
   b. End Connections: Threaded.

F. Dielectric Nipples:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Perfection Corporation.
   b. Precision Plumbing Products, Inc.
   c. Victaulic Company.
2. Description: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining.
   a. Pressure Rating: 300 psig at 225 deg F.
   b. End Connections: Threaded or grooved.

2.4 SLEEVES

A. Mechanical sleeve seals for pipe penetrations are specified in Section 22 0517 "Sleeves and Sleeve Seals for Plumbing Piping."

B. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized, plain ends.

D. Cast-Iron Sleeves: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

E. Molded PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.

G. Molded PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.5 IDENTIFICATION DEVICES

A. General: Products specified are for applications referenced in other utilities Sections. If more than single type is specified for listed applications, selection is Installer's option.

B. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.
1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
2. Location: Accessible and visible.

C. Stencils: Standard stencils prepared with letter sizes complying with recommendations in ASME A13.1. Minimum letter height is 1-1/4 inches for ducts, and 3/4 inch for access door signs and similar operational instructions.
1. Material: Brass.
2. Stencil Paint: Exterior, oil-based, alkyd-gloss black enamel, unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, oil-based, alkyd enamel in colors according to ASME A13.1, unless otherwise indicated.

D. Snap-on Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap-on type. Include color-coding according to ASME A13.1, unless otherwise indicated.

E. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers, extending 360 degrees around pipe at each location.

F. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers, at least three times letter height and of length required for label.

G. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
   1. Arrows: Either integrally with piping system service lettering to accommodate both directions of flow, or as separate unit on each pipe marker to indicate direction of flow.

H. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive vinyl tape, at least 3 mils thick.
   1. Width: 1-1/2 inches on pipes with OD, including insulation, less than 6 inches; 2-1/2 inches for larger pipes.
   2. Color: Comply with ASME A13.1, unless otherwise indicated.

I. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers. Include 5/32-inch hole for fastener.
   1. Material: 0.032-inch-thick, polished brass or aluminum.
   2. Material: 0.0375-inch-thick stainless steel.
   3. Material: 3/32-inch-thick plastic laminate with 2 black surfaces and a white inner layer.
   4. Material: Valve manufacturer's standard solid plastic.
   5. Size: 1-1/2 inches in diameter, unless otherwise indicated.

J. Valve Tag Fasteners: Brass, wire-link or beaded chain; or brass S-hooks.

K. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
   1. Engraving: Engraver's standard letter style, of sizes and with terms to match equipment identification.
   2. Thickness: 1/16 inch, for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.
   3. Fasteners: Self-tapping, stainless-steel screws or contact-type permanent adhesive.

L. Plastic Equipment Markers: Manufacturer's standard laminated plastic, in the following color codes:
   1. Green: Cooling equipment and components.
   2. Yellow: Heating equipment and components.
   3. Brown: Energy reclamation equipment and components.
   4. Blue: Equipment and components that do not meet criteria above.
   5. Hazardous Equipment: Use colors and designs recommended by ASME A13.1.
   6. Terminology: Match schedules as closely as possible. Include the following:
      a. Name and plan number.
      b. Equipment service.
      c. Design capacity.
      d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
   7. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

M. Plasticized Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with mat finish suitable for writing.
   1. Size: 3-1/4 by 5-5/8 inches.
   2. Fasteners: Brass grommets and wire.
   3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.

N. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in piped utility identification with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of piped utility systems and equipment.
   1. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.

2.6 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   1. Characteristics: Post hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.
   3. Packaging: Premixed and factory packaged.

2.7 FLOWABLE FILL

A. As specified in Section 31 2000 - “Earth Moving”

PART 3 - EXECUTION

3.1 PIPED UTILITY DEMOLITION

A. Disconnect, demolish, and remove piped utility systems, equipment, and components indicated to be removed.
   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Piping to Be Abandoned in Place: Drain piping. Fill abandoned piping with flowable fill, and cap or plug piping with same or compatible piping material.
   3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
   4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make operational.
   5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 DIELECTRIC FITTING APPLICATIONS

A. Dry Piping Systems: Connect piping of dissimilar metals with the following:
   1. NPS 2 and Smaller: Dielectric unions.
   2. NPS 2-1/2 to NPS 12: Dielectric flanges or dielectric flange kits.

B. Wet Piping Systems: Connect piping of dissimilar metals with the following:
   1. NPS 2 and Smaller: Dielectric couplings or dielectric nipples.
   2. NPS 2-1/2 to NPS 4: Dielectric nipples.
   3. NPS 2-1/2 to NPS 8: Dielectric nipples or dielectric flange kits.
   4. NPS 10 and NPS 12: Dielectric flange kits.

3.3 PIPING INSTALLATION

A. Install piping according to the following requirements and utilities Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on the Coordination Drawings.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping to permit valve servicing.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Select system components with pressure rating equal to or greater than system operating pressure.

I. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of equipment areas or other wet areas 2 inches above finished floor level.
   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
      a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
      b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.

J. Verify final equipment locations for roughing-in.

K. Refer to equipment specifications in other Sections for roughing-in requirements.

3.4 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and utilities Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

G. Grooved Joints: Assemble joints with grooved-end pipe coupling with coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

H. Soldered Joints: Apply ASTM B 813 water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.

I. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

J. Pressure-Sealed Joints: Assemble joints for plain-end copper tube and mechanical pressure seal fitting with proprietary crimping tool to according to fitting manufacturer's written instructions.

K. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
   3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
   5. PVC Nonpressure Piping: Join according to ASTM D 2855.
   6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

L. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

M. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

N. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   1. Plain-End PE Pipe and Fittings: Use butt fusion.
   2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.

O. Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.5 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
   3. Install dielectric fittings at connections of dissimilar metal pipes.

3.6 EQUIPMENT INSTALLATION

A. Install equipment level and plumb, unless otherwise indicated.

B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.

C. Install equipment to allow right of way to piping systems installed at required slope.

3.7 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
   1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
   7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section 03 3000 "Cast-in-Place Concrete."

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Section 05 5000 "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor piped utility materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.9 GROUTING

A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION

SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Pipe and fittings.
2. Nonpressure transition couplings.
3. Pressure pipe couplings.
4. Expansion joints and deflection fittings.
5. Backwater valves.
6. Cleanouts.
7. Drains.
8. Encasement for piping.
9. Manholes.
10. Channel drainage systems.
11. Catch basins.
12. Stormwater inlets.
13. Pipe outlets.

1.3 QUALITY ASSURANCE

A. Maryland Department of Transportation, State Highway Administration, Standard Specifications for Construction and Materials, July 2022, (MSHA), as amended to date.
1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.4 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:
1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Stormwater inlets, and trench drain systems. Include plans, elevations, sections, details, frames, covers, and grates.
3. Include certifications that pre-cast structures comply with all applicable MSHA specifications and standard details

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

B. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.

C. Field quality-control reports.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

D. Handle trench drain components and stormwater inlets according to manufacturer's written rigging instructions.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
   1. Notify Owner no fewer than ten days in advance of proposed interruption of service.
   2. Do not proceed with interruption of service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PE PIPE AND FITTINGS

A. Corrugated PE Pipe and Fittings NPS 12 to NPS 60: AASHTO M 294M, Type S, with smooth waterway for coupling joints.
   1. Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.
   2. Soiltight Couplings: AASHTO M 294M, corrugated, matching pipe and fittings.

2.2 PVC PIPE AND FITTINGS

A. PVC Cellular-Core Piping:
   1. PVC Cellular-Core Pipe and Fittings: ASTM F 891, Sewer and Drain Series, PS 50 minimum stiffness, PVC cellular-core pipe with plain ends for solvent-cemented joints.
   2. Fittings: ASTM D 3034, SDR 35, PVC socket-type fittings.

B. PVC Type PSM Sewer Piping:
   1. Pipe: ASTM D 3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
   2. Fittings: ASTM D 3034, PVC with bell ends.
   3. Gaskets: ASTM F 477, elastomeric seals.

C. PVC Water-Service Piping:

1. Pipe: ASTM D 1785, Schedule 40 PVC, with plain ends for solvent-cemented joints.
2. Fittings: ASTM D 2466, Schedule 40 PVC, socket type.

2.3 CONCRETE PIPE AND FITTINGS

A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76.
1. Class IV, bell-and-spigot ends and gasketed joints with ASTM C 443, rubber gaskets

2.4 NONPRESSURE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:
1. For Concrete Pipes: ASTM C 443, rubber.
2. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
3. For Fiberglass Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
4. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
5. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Ring-Type, Flexible Couplings:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Fernco Inc.
   b. Logan Clay Pipe.
   c. Mission Rubber Company; a division of MCP Industries, Inc.
2. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.5 EXPANSION JOINTS AND DEFLECTION FITTINGS

A. Ductile-Iron Flexible Expansion Joints:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. EBAA Iron Sales, Inc.
   b. Romac Industries, Inc.
   c. Star Pipe Products.
2. Description: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections, rated for 250-psig minimum working pressure and for offset and expansion indicated.

B. Ductile-Iron Expansion Joints:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Dresser, Inc.
   b. EBAA Iron Sales, Inc.
   c. JCM Industries, Inc.
   d. Smith-Blair, Inc.; a Sensus company.
2. Description: Three-piece assembly of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Include rating for 250-psig minimum working pressure and for expansion indicated.

2.6 CLEANOUTS

A. Cast-Iron Cleanouts:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Josam Company.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.
   d. Tyler Pipe.
   e. Watts Water Technologies, Inc.
   f. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
2. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
3. Top-Loading Classification(s): Medium Duty.
4. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

2.7 MANHOLES

A. Standard Precast Concrete Manholes: Per MSHA standard details and specifications

B. Manhole Frames and Covers: Per MSHA standard details and specifications

2.8 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, and the following:
1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.
1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.
1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

2.9 CHANNEL DRAINAGE SYSTEMS

A. General Requirements for Polymer and Polymer-Concrete, Channel Drainage Systems: Modular system of preformed polymer or precast, polymer-concrete channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling. Include quantity of units required to form total lengths indicated.

B. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

C. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable heavy duty, non-combustible product by one of the following:
1. Zurn
2. ACO USA.
3. Poly-Cast.

D. Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.

E. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

F. Grates: Ductile iron, Class F load rating per DIN EN1433, with positive locking mechanism

2.10 STORMWATER INLETS

A. Inlets: Per MSHA standard details and specifications

B. Frames and Grates: Per MSHA standard details and specifications.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 31 2000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

F. Install gravity-flow, nonpressure drainage piping according to the following:
   1. Install piping pitched down in direction of flow.
   2. Install piping with 24 inches minimum cover.
   3. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
   4. Install hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
   5. Install ductile-iron piping and special fittings according to AWWA C600 or AWWA M41.
   6. Install PE corrugated sewer piping according to ASTM D 2321.
   7. Install PVC cellular-core piping according to ASTM D 2321 and ASTM F 1668.
   8. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
   9. Install PVC profile gravity sewer piping according to ASTM D 2321 and ASTM F 1668.
   10. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping according to the following:
   1. Join hub-and-spigot, cast-iron soil piping with gasketed joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
   2. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
   3. Join ductile-iron culvert piping according to AWWA C600 for push-on joints.
   4. Join ductile-iron piping and special fittings according to AWWA C600 or AWWA M41.
   5. Join corrugated PE piping according to ASTM D 3212 for push-on joints.
   6. Join PVC cellular-core piping according to ASTM D 2321 and ASTM F 891 for solvent-cemented joints.
   7. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasketed joints.
   8. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
   9. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
   10. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.4 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.5 DRAIN INSTALLATION

A. Install type of drains in locations indicated.

B. Fasten grates to drains if indicated.

C. Set drain frames and covers with tops flush with pavement surface.

3.6 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

3.7 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.8 CHANNEL DRAINAGE SYSTEM INSTALLATION

A. Install with top surfaces of components, except piping, flush with finished surface.

B. Carefully lay out curved channel drain runs as shown on plans with consistent radii and angles of deflection between adjacent units. Visible kinks, straights, and/or inconsistent radius within curved runs shall be cause for rejection of the work.

C. Assemble channel sections to form sloping invert that flows toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.

D. Firmly secure each channel drain section to prevent movement during placement of surrounding concrete.

E. Protect top edges of precast units from damage during installation.

F. Embed channel sections and drainage specialties in 4-inch minimum concrete around bottom and sides. Cover and protect open tops as necessary to prevent concrete from entering drainage channel.

G. Fasten grates to channel sections using manufacturer’s lockdown devices.

H. Assemble channel sections with flanged or interlocking joints.

3.9 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Section 22 1413 "Facility Storm Drainage Piping."

B. Connect force-main piping to building's storm drainage force mains specified in Section 22 1413 "Facility Storm Drainage Piping." Terminate piping where indicated.

C. Make connections to existing piping and underground manholes.
   1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
   2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
   3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
      a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
      b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
   4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

D. Connect to sediment interceptors specified in Section 22 1323 "Sanitary Waste Interceptors."

E. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
   1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
      a. Shielded flexible couplings for same or minor difference OD pipes.

b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
2. Use pressure-type pipe couplings for force-main joints.

3.10 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
1. Close open ends of piping with at least 8-inch-thick, brick masonry bulkheads.
2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:
1. Remove manhole or structure and close open ends of remaining piping.
2. Remove top of manhole or structure down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

C. Backfill to grade according to Section 31 2000 "Earth Moving."

3.11 IDENTIFICATION

A. Materials and their installation are specified in Section 31 2000 "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
1. Use detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.12 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:
a. Alignment: Less than full diameter of inside of pipe is visible between structures.
b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
d. Infiltration: Water leakage into piping.
e. Exfiltration: Water leakage from or around piping.
3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
b. Option: Test plastic piping according to ASTM F 1417.
c. Option: Test concrete piping according to ASTM C 924.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.13 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with water.

END OF SECTION

Attachment G

CAPACITY SUMMARY SHEET

CAPACITY SUMMARY SHEET FOR KEY MANAGEMENT AND PERSONNEL

Name of Firm:
RFP Title:

In this table, your firm must include information for all key management and other personnel (**including subconsultants**) who were listed as part of the project team in the Work Plan. Please add rows as necessary.

Name/Position Description (must be consistent with Financial Proposal)	Current and Projected Assignments	Value of Contract	Role on Current and Projected Assignments	NTP Date	Approx. Completion Date	Project on Schedule (Y/N)	Committed hours for the next 24 months	Identify issues which may affect individual's ability to perform the services described in this RFP. Indicate if a current project is high-priority/rush. If project is behind schedule, provide brief explanation.
					Total		0	
					Total		0	

Attachment H

PRICING FORM

NAME OF OFFEROR: _____

DATE:

Building Commissioning Services
Hagerstown Multi-Use Sports & Event Facility

Name	Position (Project Role)	Firm	**Meetings:** Design	**Meetings:** Construction	**Reviews:** Design document review & reporting, submittal review, O&M review, mock-up review	**Deliverables:** Commissioning Plan, Commissioning Specifications, Building Maintenance Plan, Building Enclosure Preventive Maintenance Plan	**Cx Services:** Installation verification, start-up, functional testing, issue log management, etc.	**Site Visits** (Excludes Onsite Meetings during Construction)	**Post Occupancy Warranty Phase**	**Hourly rate (loaded)**	**Total cost per position**
										$0.00	**$0.00**
										$0.00	**$0.00**
										$0.00	**$0.00**
										$0.00	**$0.00**
										$0.00	**$0.00**
										$0.00	**$0.00**
										$0.00	**$0.00**
										$0.00	**$0.00**
										$0.00	**$0.00**
										$0.00	**$0.00**
		Total Hours per Phase	0	0	0	0	0	0	0		
		Total Project Hours								0	

Sub-total of Costs:	$0.00
CxA Reimbursable Allowance:	$0.00
Owner Contingency:	$30,000.00
Commissioning Services Total Cost:	$30,000.00

Costs shall consist of fully loaded rates, inclusive of all labor and overhead costs (e.g. direct and indirect costs, reimbursable and incidental expenses) in connection with providing the services required under this Contract. A reimbursable allowance shall be included for all reasonable, allowable and allocable direct costs and expenses in accordance with the Building Commissioning Services Agreement.

The fee provided shall not be subject to cost escalation from time of award through 24 month warranty period. Offeror is responsible for verifying the accuracy of the information included herein, including calculations and formulas.

Attachment I

ANTICIPATED PROJECT SCHEDULE

#	Activity ID	Activity Name	OD	Start	Finish	Total Float	Lag
1	**Hagerstown Municipal Stadium Proposal_20220709 GMP-1**		541	09-Mar-22 A	23-Apr-24	0	
2	**Project Milestones**		532	09-Mar-22 A	23-Apr-24	0	
3	**Design and Preconstruction Milestones**		240	09-Mar-22 A	23-Feb-23	292	
4	MLST-1000	Project Award - Design & Pre-Construction Services NTP	0	09-Mar-22 A			
5	MLST-1001	Approval of SD & Cost Estimate	0		10-Jun-22 A		
6	MLST-1005	Obtain Building Demolition Permit	0		19-Aug-22	416	
7	MLST-1002	Approval of DD & Cost Estimate	0		13-Sep-22	14	
8	MLST-1003	Approval of 70% Construction Document & Cost Estimate	0		23-Nov-22	1	
9	MLST-1006	Obtain Building Permit	0		23-Dec-22	332	
10	MLST-1004	Approval of GMP on 70% CDs	0		08-Feb-23	1	
11	MLST-1028	NTP for New Construction	0	09-Feb-23		302	
12	MLST-1038	Approval of 100% CDs	0		23-Feb-23	272	
13	**Construction Milestones**		426	08-Aug-22	23-Apr-24	0	
14	MLST-1008	Mobilize Onsite for Enabling Work	0	08-Aug-22		10	
15	MLST-1009	Completion of Demolition, Site Grading	0		12-Dec-22	10	
16	MLST-1010	Completion of Foundations	0		07-Apr-23	261	
17	MLST-1011	Completion of Structural Steel Erection	0		25-Jul-23	40	
18	MLST-1012	Building Dry-In	0		27-Sep-23	26	
19	MLST-1013	Final Building System TAB	0		12-Jan-24	40	
20	MLST-1014	Completion of Start-Up & Commissioning	0		29-Jan-24	30	
21	MLST-1015	Final Inspections Complete	0		05-Mar-24	5	
22	MLST-1016	Certificate of Occupancy	0		12-Mar-24	0	
23	MLST-1017	Project Substantial Completion	0		12-Mar-24	30	
24	MLST-1018	Post Construction Phase Complete	0		23-Apr-24	0	
25	**Design Phase & GMP Development**		275	09-Mar-22 A	06-Apr-23	266	
26	**Schematic Design (SD) Phase**		126	09-Mar-22 A	05-Aug-22	11	
27	SD-1000	SD - Kick-Off Meeting with MSA	5	09-Mar-22 A	15-Mar-22 A		
28	SD-1001	SD - Document Development by Design/Build Team	25	09-Mar-22 A	12-May-22 A		
29	SD-1003	SD - Submit Cost Estimate to MSA	10	13-Apr-22 A	12-May-22 A		
30	SD-1004	SD - Submit VE Study Constructability Report to MSA	10	13-Apr-22 A	12-May-22 A		
31	SD-1005	MSA Review & Approval of SD & Cost Estimate	10	27-Apr-22 A	10-Jun-22 A		
32	SD-1002	SD - Submit to MSA	0		12-May-22 A		
33	SD-1006	Perform Historic Viewshed Analysis	40	10-Jun-22 A	05-Aug-22	11	
34	**Design Development (DD) Phase**		121	13-Apr-22 A	13-Sep-22	400	
35	DD-1002	DD - Document Development by Design/Build Team	50	13-Apr-22 A	15-Aug-22	1	
36	DD-1000	MSA Issue Design Development - NTP	0	10-Jun-22 A			
37	DD-1001	DD - Kick-Off Meeting with MSA	5	10-Jun-22 A	16-Jun-22 A		
38	DD-1007	Submit initial Quality Control Program to MSA	30	10-Jun-22 A	19-Aug-22	65	
39	DD-1008	Submit Initial Site Utilization & Logistics Plan to MSA	30	10-Jun-22 A	19-Aug-22	30	
40	DD-1009	Submit Life Cycle, Bldg Energy Efficiency & Sustainability Report to MSA	30	10-Jun-22 A	19-Aug-22	1	
41	DD-1010	Submit Hagerstown Cultural Trail Relocation to MSA/Client/COH	5	15-Jun-22 A	15-Jun-22 A		
42	DD-1003	DD - Submit to MSA	0		15-Aug-22	5	

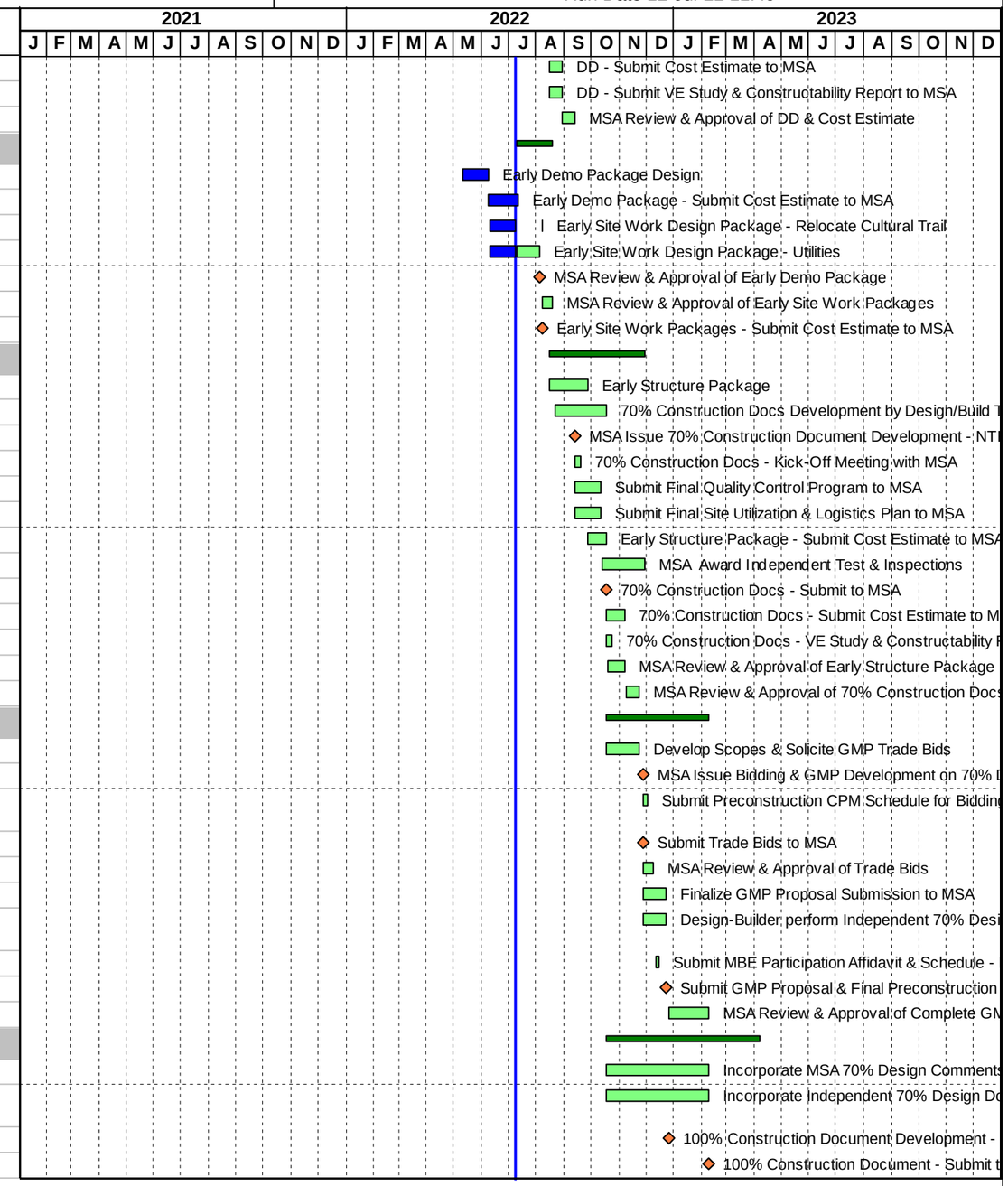
Remaining Level of Effort
Critical Remaining Work
Actual Level of Effort
Milestone
Actual Level of Effort
Actual Work
Remaining Work

Hagerstown Municipal Stadium Proposal_20220709 GMP-1

Turner

Start Date 09-Mar-22
Finish Date 23-Apr-24
Data Date 09-Jul-22

#	Activity ID	Activity Name	OD	Start	Finish	Total Float	Lag
43	DD-1004	DD - Submit Cost Estimate to MSA	10	16-Aug-22	29-Aug-22	14	
44	DD-1005	DD - Submit VE Study & Constructability Report to MSA	10	16-Aug-22	29-Aug-22	14	
45	DD-1006	MSA Review & Approval of DD & Cost Estimate	10	30-Aug-22	13-Sep-22	14	
46	**Early Demo & Site Work Design**		137	11-May-22 A	19-Aug-22	35	
47	ES-1010	Early Demo Package Design	20	11-May-22 A	08-Jun-22 A		
48	ES-1050	Early Demo Package - Submit Cost Estimate to MSA	10	09-Jun-22 A	12-Jul-22 A		
49	ES-1000	Early Site Work Design Package - Relocate Cultural Trail	30	10-Jun-22 A	08-Aug-22	35	
50	ES-1020	Early Site Work Design Package - Utilities	30	10-Jun-22 A	04-Aug-22	36	
51	ES-1060	MSA Review & Approval of Early Demo Package	0		05-Aug-22	0	
52	ES-1030	MSA Review & Approval of Early Site Work Packages	10	08-Aug-22	19-Aug-22	35	
53	ES-1040	Early Site Work Packages - Submit Cost Estimate to MSA	0		08-Aug-22	35	
54	**Construction Documents - 70% Development Phase**		73	16-Aug-22	29-Nov-22	356	
55	CD-1010	Early Structure Package	30	16-Aug-22	27-Sep-22	1	
56	CD-1002	70% Construction Docs Development by Design/Build Team	39	22-Aug-22	17-Oct-22	1	
57	CD-1000	MSA Issue 70% Construction Document Development - NTP	0	14-Sep-22		14	
58	CD-1001	70% Construction Docs - Kick-Off Meeting with MSA	5	14-Sep-22	20-Sep-22	395	
59	CD-1007	Submit Final Quality Control Program to MSA	20	14-Sep-22	12-Oct-22	49	
60	CD-1009	Submit Final Site Utilization & Logistics Plan to MSA	20	14-Sep-22	12-Oct-22	14	
61	CD-1020	Early Structure Package - Submit Cost Estimate to MSA	15	28-Sep-22	18-Oct-22	1	
62	CD-1008	MSA Award Independent Test & Inspections	30	13-Oct-22	29-Nov-22	49	
63	CD-1003	70% Construction Docs - Submit to MSA	0		17-Oct-22	1	
64	CD-1004	70% Construction Docs - Submit Cost Estimate to MSA	15	18-Oct-22	07-Nov-22	1	
65	CD-1005	70% Construction Docs - VE Study & Constructability Report to I	5	18-Oct-22	24-Oct-22	11	
66	CD-1030	MSA Review & Approval of Early Structure Package	15	19-Oct-22	08-Nov-22	1	
67	CD-1006	MSA Review & Approval of 70% Construction Docs & Cost Estin	10	09-Nov-22	23-Nov-22	1	
68	**GMP Development Phase - 70% CDs**		75	18-Oct-22	08-Feb-23	302	
69	GMP-1003	Develop Scopes & Solicite GMP Trade Bids	25	18-Oct-22	23-Nov-22	1	
70	GMP-1000	MSA Issue Bidding & GMP Development on 70% Document - NT	0	28-Nov-22		1	
71	GMP-1001	Submit Preconstruction CPM Schedule for Bidding & GMP Development Phase	5	28-Nov-22	02-Dec-22	16	
72	GMP-1004	Submit Trade Bids to MSA	0		28-Nov-22	1	
73	GMP-1005	MSA Review & Approval of Trade Bids	10	28-Nov-22	09-Dec-22	1	
74	GMP-1006	Finalize GMP Proposal Submission to MSA	20	28-Nov-22	23-Dec-22	1	
75	GMP-1009	Design-Builder perform Independent 70% Design Documents Review	20	28-Nov-22	23-Dec-22	332	
76	GMP-1011	Submit MBE Participation Affidavit & Schedule - Draft	5	12-Dec-22	16-Dec-22	6	
77	GMP-1007	Submit GMP Proposal & Final Preconstruction CPM Schedule to	0		23-Dec-22	1	
78	GMP-1008	MSA Review & Approval of Complete GMP Proposal Submission	30	27-Dec-22	08-Feb-23	1	
79	**Construction Documents - 100% Development Phase**		115	18-Oct-22	06-Apr-23	262	
80	CD-2001	Incorporate MSA 70% Design Comments	75	18-Oct-22	08-Feb-23	262	
81	CD-2002	Incorporate Independent 70% Design Document Reviewer Comments	75	18-Oct-22	08-Feb-23	262	
82	CD-2000	100% Construction Document Development - NTP	0	27-Dec-22		332	
83	CD-2003	100% Construction Document - Submit to MSA	0		08-Feb-23	262	



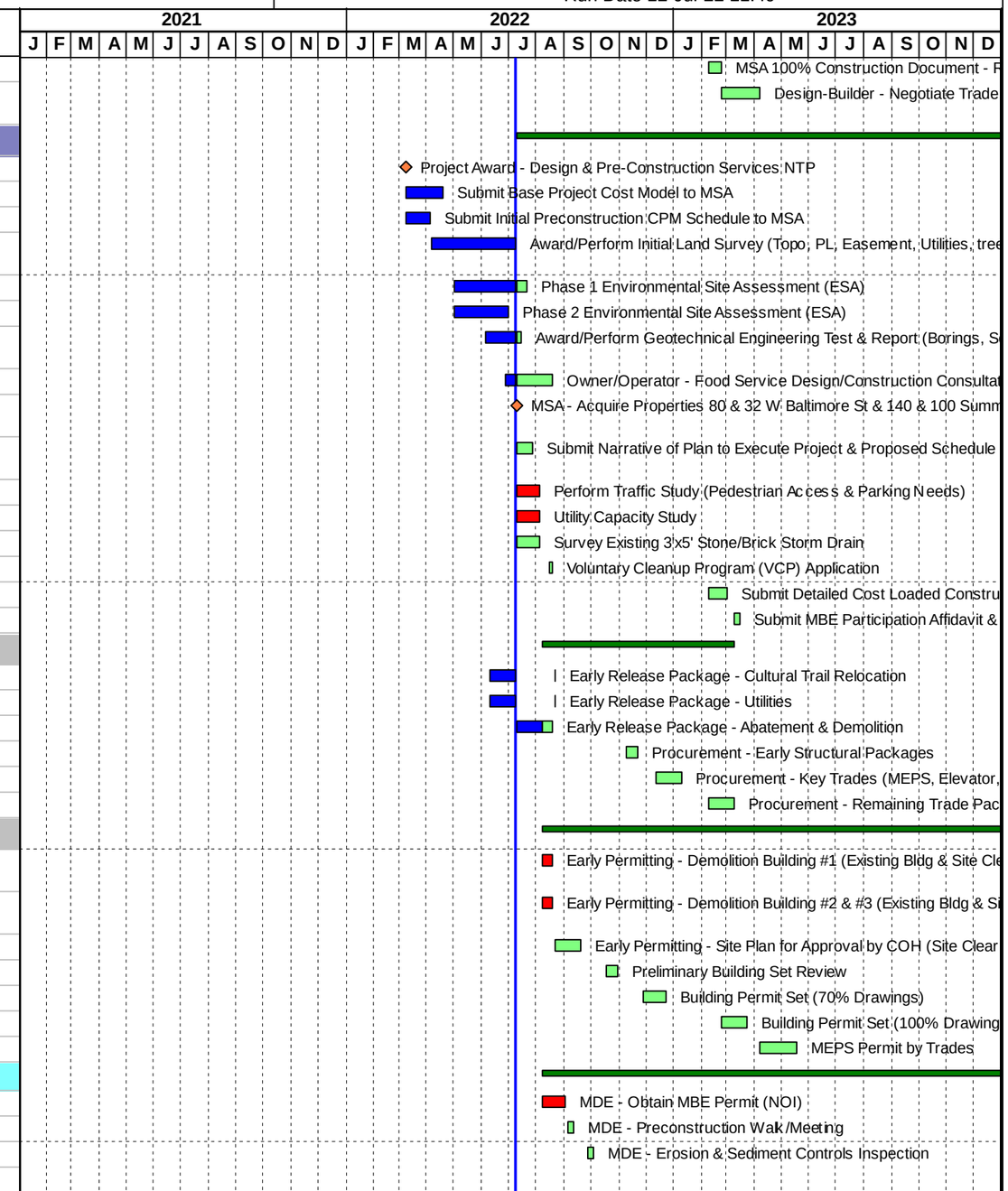
Remaining Level of Effort
Critical Remaining Work
Actual Level of Effort
Milestone
Actual Level of Effort
Actual Work
Remaining Work

Hagerstown Municipal Stadium Proposal_20220709 GMP-1

Turner

Start Date 09-Mar-22
Finish Date 23-Apr-24
Data Date 09-Jul-22

#	Activity ID	Activity Name	OD	Start	Finish	Total Float	Lag
84	CD-2004	MSA 100% Construction Document - Review & Approval	10	09-Feb-23	23-Feb-23	262	
85	CD-2005	Design-Builder - Negotiate Trade Final Pricing - Review/Settle to 100% Docs	30	24-Feb-23	06-Apr-23	262	
86	**Preconstruction Phase**		516	09-Mar-22 A	19-Mar-24	25	
87	PREC-1000	Project Award - Design & Pre-Construction Services NTP	0	09-Mar-22 A			
88	PREC-1020	Submit Base Project Cost Model to MSA	30	09-Mar-22 A	19-Apr-22 A		
89	PREC-1040	Submit Initial Preconstruction CPM Schedule to MSA	30	09-Mar-22 A	04-Apr-22 A		
90	PREC-1070	Award/Perform Initial Land Survey (Topo, PL, Easement, Utilities, trees…)	45	06-Apr-22 A	08-Jul-22 A		
91	PREC-1110	Phase 1 Environmental Site Assessment (ESA)	30	01-May-22 A	21-Jul-22	21	
92	PREC-1120	Phase 2 Environmental Site Assessment (ESA)	30	01-May-22 A	01-Jul-22 A		
93	PREC-1080	Award/Perform Geotechnical Engineering Test & Report (Borings, Soil Analysis, Lab/Infiltation Test)	66	06-Jun-22 A	15-Jul-22	22	
94	PREC-1090	Owner/Operator - Food Service Design/Construction Consultati	60	27-Jun-22 A	19-Aug-22	1	
95	PREC-1010	MSA - Acquire Properties 80 & 32 W Baltimore St & 140 & 100 Summit Ave	0	11-Jul-22		446	
96	PREC-1030	Submit Narrative of Plan to Execute Project & Proposed Schedule Elements	14	11-Jul-22	28-Jul-22	6	
97	PREC-1050	Perform Traffic Study (Pedestrian Access & Parking Needs)	20	11-Jul-22	05-Aug-22	0	
98	PREC-1060	Utility Capacity Study	20	11-Jul-22	05-Aug-22	0	
99	PREC-1100	Survey Existing 3'x5' Stone/Brick Storm Drain	20	11-Jul-22	05-Aug-22	406	
100	PREC-1130	Voluntary Cleanup Program (VCP) Application	5	15-Aug-22	19-Aug-22	386	
101	PREC-1140	Submit Detailed Cost Loaded Construction CPM Schedule	15	09-Feb-23	02-Mar-23	257	
102	PREC-1150	Submit MBE Participation Affidavit & Schedule - Final	5	10-Mar-23	16-Mar-23	247	
103	**Procurement of Trade Packages**		149	10-Jun-22 A	09-Mar-23	251	
104	PROC-1000	Early Release Package - Cultural Trail Relocation	20	10-Jun-22 A	22-Aug-22	376	
105	PROC-1002	Early Release Package - Utilities	20	10-Jun-22 A	22-Aug-22	55	
106	PROC-1001	Early Release Package - Abatement & Demolition	20	11-Jul-22 A	19-Aug-22	381	
107	PROC-1014	Procurement - Early Structural Packages	10	09-Nov-22	22-Nov-22	1	
108	PROC-1003	Procurement - Key Trades (MEPS, Elevator, Long Lead)	20	12-Dec-22	10-Jan-23	21	
109	PROC-1004	Procurement - Remaining Trade Packages	20	09-Feb-23	09-Mar-23	16	
110	**Permitting**		401	08-Aug-22	19-Mar-24	25	
111	P-1000	Early Permitting - Demolition Building #1 (Existing Bldg & Site Clearing)	10	08-Aug-22	19-Aug-22	0	
112	P-1010	Early Permitting - Demolition Building #2 & #3 (Existing Bldg & Site Clearing)	10	08-Aug-22	19-Aug-22	0	
113	P-1050	Early Permitting - Site Plan for Approval by COH (Site Clear & Gr	20	22-Aug-22	19-Sep-22	35	
114	P-1060	Preliminary Building Set Review	10	18-Oct-22	31-Oct-22	46	
115	P-1070	Building Permit Set (70% Drawings)	20	28-Nov-22	23-Dec-22	31	
116	P-1080	Building Permit Set (100% Drawings)	20	24-Feb-23	23-Mar-23	272	
117	P-1090	MEPS Permit by Trades	30	07-Apr-23	18-May-23	71	
118	**MDE Permitting & Inspections**		401	08-Aug-22	19-Mar-24	25	
119	P-1020	MDE - Obtain MBE Permit (NOI)	20	08-Aug-22	02-Sep-22	0	
120	P-1030	MDE - Preconstruction Walk/Meeting	5	06-Sep-22	12-Sep-22	95	
121	P-1040	MDE - Erosion & Sediment Controls Inspection	5	27-Sep-22	03-Oct-22	85	
122	P-1100	MDE Post Construction Stabilization Walk & Close Permit (NOT)	5	13-Mar-24	19-Mar-24	25	



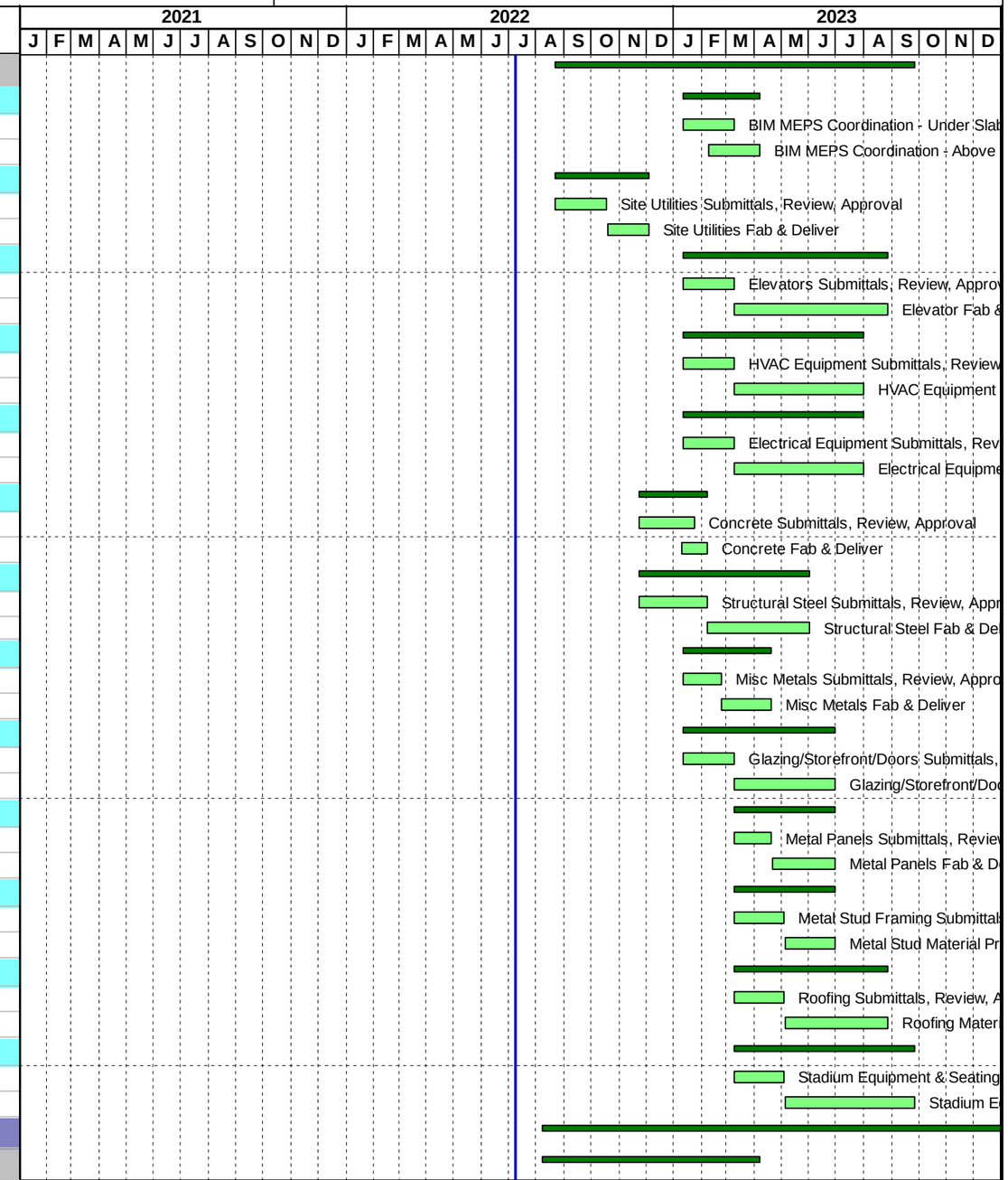
Remaining Level of Effort
Critical Remaining Work
Actual Level of Effort
Milestone
Actual Level of Effort
Actual Work
Remaining Work

Hagerstown Municipal Stadium Proposal_20220709 GMP-1

Turner

Start Date 09-Mar-22
Finish Date 23-Apr-24
Data Date 09-Jul-22

#	Activity ID	Activity Name	OD	Start	Finish	Total Float	Lag
123	**Engineering, Coordination, & Fabrication**		274	22-Aug-22	26-Sep-23	52	
124	**BIM Coordination**		60	11-Jan-23	06-Apr-23	71	
125	M-1030	BIM MEPS Coordination - Under Slab	40	11-Jan-23	09-Mar-23	71	
126	M-1080	BIM MEPS Coordination - Above Slab	40	09-Feb-23	06-Apr-23	71	
127	**Site Utilities**		70	22-Aug-22	05-Dec-22	55	
128	M-1000	Site Utilities Submittals, Review, Approval	40	22-Aug-22	18-Oct-22	55	
129	M-1010	Site Utilities Fab & Deliver	30	19-Oct-22	05-Dec-22	55	
130	**Elevator**		160	11-Jan-23	28-Aug-23	72	
131	M-1040	Elevators Submittals, Review, Approval	40	11-Jan-23	09-Mar-23	72	
132	M-1150	Elevator Fab & Deliver	120	10-Mar-23	28-Aug-23	72	
133	**HVAC Equipment**		140	11-Jan-23	31-Jul-23	21	
134	M-1050	HVAC Equipment Submittals, Review, Approval	40	11-Jan-23	09-Mar-23	21	
135	M-1160	HVAC Equipment Fab & Deliver	100	10-Mar-23	31-Jul-23	21	
136	**Electrical Equipment**		140	11-Jan-23	31-Jul-23	21	
137	M-1060	Electrical Equipment Submittals, Review, Approval	40	11-Jan-23	09-Mar-23	21	
138	M-1170	Electrical Equipment Fab & Deliver	100	10-Mar-23	31-Jul-23	21	
139	**Concrete**		50	23-Nov-22	07-Feb-23	2	
140	M-1020	Concrete Submittals, Review, Approval	40	23-Nov-22	24-Jan-23	2	
141	M-1090	Concrete Fab & Deliver	20	10-Jan-23	07-Feb-23	2	
142	**Structural Steel**		130	23-Nov-22	01-Jun-23	1	
143	M-1070	Structural Steel Submittals, Review, Approval	50	23-Nov-22	07-Feb-23	1	
144	M-1190	Structural Steel Fab & Deliver	80	08-Feb-23	01-Jun-23	1	
145	**Misc. Metals**		70	11-Jan-23	20-Apr-23	31	
146	M-1100	Misc Metals Submittals, Review, Approval	30	11-Jan-23	23-Feb-23	31	
147	M-1200	Misc Metals Fab & Deliver	40	24-Feb-23	20-Apr-23	31	
148	**Glazing/ Storefront / Doors**		120	11-Jan-23	30-Jun-23	21	
149	M-1110	Glazing/Storefront/Doors Submittals, Review, Approval	40	11-Jan-23	09-Mar-23	21	
150	M-1220	Glazing/Storefront/Doors Fab & Deliver	80	10-Mar-23	30-Jun-23	21	
151	**Metal Panels**		80	10-Mar-23	30-Jun-23	21	
152	M-1120	Metal Panels Submittals, Review, Approval	30	10-Mar-23	20-Apr-23	21	
153	M-1210	Metal Panels Fab & Deliver	50	21-Apr-23	30-Jun-23	21	
154	**Metal Stud Framing**		80	10-Mar-23	30-Jun-23	16	
155	M-1130	Metal Stud Framing Submittals, Review, Approval	40	10-Mar-23	04-May-23	16	
156	M-1230	Metal Stud Material Procurement	40	05-May-23	30-Jun-23	16	
157	**Roofing**		120	10-Mar-23	28-Aug-23	27	
158	M-1140	Roofing Submittals, Review, Approval	40	10-Mar-23	04-May-23	27	
159	M-1240	Roofing Material Procurement	80	05-May-23	28-Aug-23	27	
160	**Stadium Equip & Seating**		140	10-Mar-23	26-Sep-23	32	
161	M-1180	Stadium Equipment & Seating Submittals, Review, Approval	40	10-Mar-23	04-May-23	32	
162	M-1250	Stadium Equipment & Seating Fab & Deliver	100	05-May-23	26-Sep-23	32	
163	**Construction**		396	08-Aug-22	12-Mar-24	30	
164	**Early Release - Construction Mobilization & Enabling Work**		165	08-Aug-22	07-Apr-23	261	



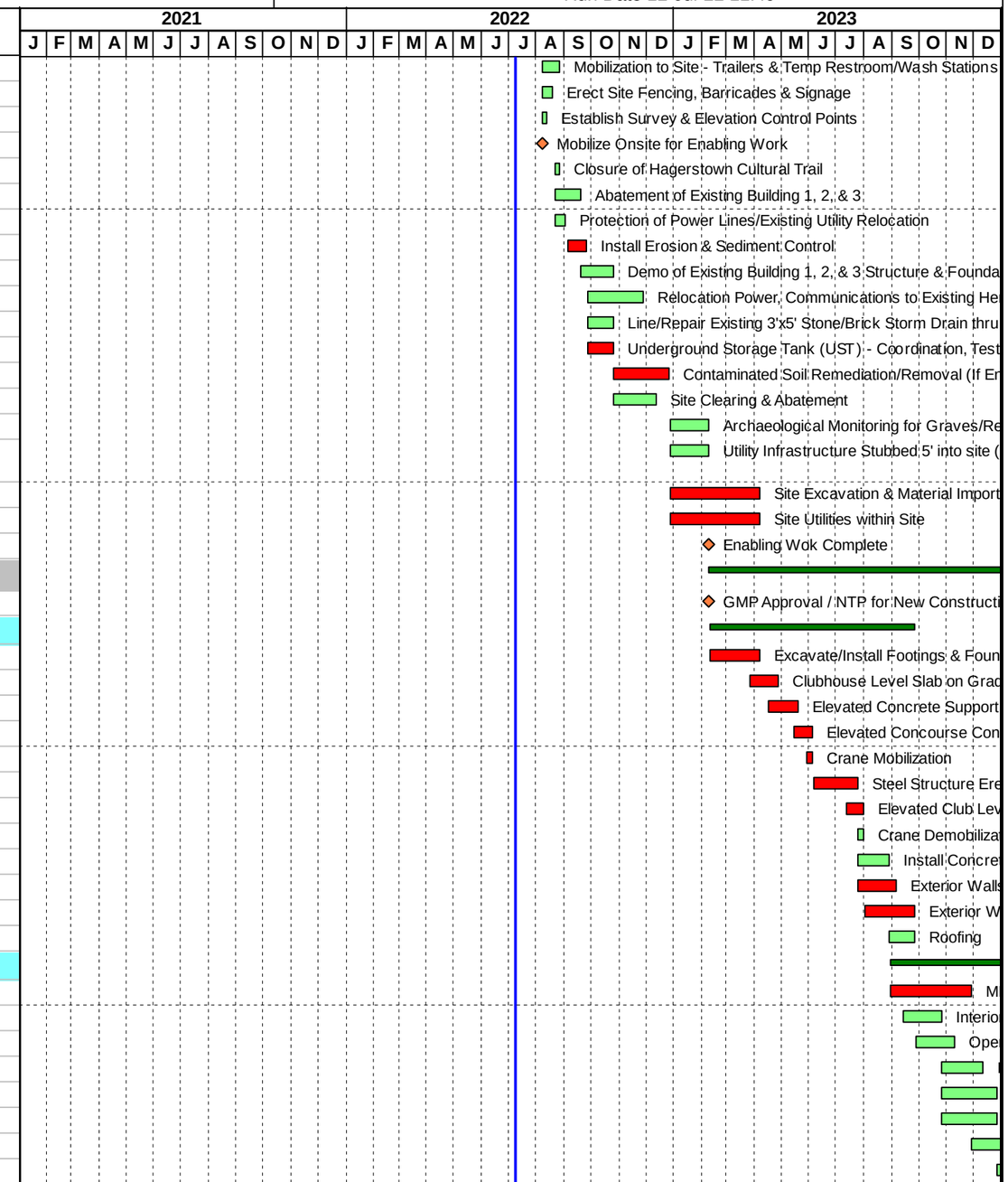
Remaining Level of Effort
Critical Remaining Work
Actual Level of Effort
Milestone
Actual Level of Effort
Actual Work
Remaining Work

Hagerstown Municipal Stadium Proposal_20220709 GMP-1

Turner

Start Date 09-Mar-22
Finish Date 23-Apr-24
Data Date 09-Jul-22

#	Activity ID	Activity Name	OD	Start	Finish	Total Float	Lag
165	ERC-1000	Mobilization to Site - Trailers & Temp Restroom/Wash Stations	15	08-Aug-22	26-Aug-22	10	
166	ERC-1010	Erect Site Fencing, Barricades & Signage	10	08-Aug-22	19-Aug-22	10	
167	ERC-1020	Establish Survey & Elevation Control Points	5	08-Aug-22	12-Aug-22	381	
168	ERC-1040	Mobilize Onsite for Enabling Work	0	08-Aug-22		10	
169	ERC-1110	Closure of Hagerstown Cultural Trail	5	22-Aug-22	26-Aug-22	376	
170	ERC-1070	Abatement of Existing Building 1, 2, & 3	20	22-Aug-22	19-Sep-22	10	
171	ERC-1100	Protection of Power Lines/Existing Utility Relocation	10	22-Aug-22	02-Sep-22	406	
172	ERC-1030	Install Erosion & Sediment Control	15	06-Sep-22	26-Sep-22	0	
173	ERC-1080	Demo of Existing Building 1, 2, & 3 Structure & Foundations	25	20-Sep-22	25-Oct-22	10	
174	ERC-1120	Relocation Power, Communications to Existing Herald Mail Buildi	40	27-Sep-22	28-Nov-22	351	
175	ERC-1050	Line/Repair Existing 3'x5' Stone/Brick Storm Drain thru Site	20	27-Sep-22	25-Oct-22	371	
176	ERC-1060	Underground Storage Tank (UST) - Coordination, Testing & Rem	20	27-Sep-22	25-Oct-22	0	
177	ERC-1090	Contaminated Soil Remediation/Removal (If Encountered)	40	26-Oct-22	27-Dec-22	0	
178	ERC-1130	Site Clearing & Abatement	30	26-Oct-22	12-Dec-22	10	
179	ERC-1140	Archaeological Monitoring for Graves/Remains in SE Corner	30	28-Dec-22	09-Feb-23	301	
180	ERC-1150	Utility Infrastructure Stubbed 5' into site (Gas, Water, Power, telephone, cable)	30	28-Dec-22	09-Feb-23	301	
181	ERC-1160	Site Excavation & Material Import/ Export	70	28-Dec-22	07-Apr-23	0	
182	ERC-1170	Site Utilities within Site	70	28-Dec-22	07-Apr-23	0	
183	ERC-1180	Enabling Wok Complete	0		09-Feb-23	301	
184	**New Construction**		272	09-Feb-23	12-Mar-24	0	
185	C-2000	GMP Approval / NTP for New Construction	0	09-Feb-23		1	
186	**Structure & Envelope**		160	10-Feb-23	27-Sep-23	41	
187	C-2030	Excavate/Install Footings & Foundation Walls	40	10-Feb-23	07-Apr-23	0	
188	C-2040	Clubhouse Level Slab on Grade	25	27-Mar-23	28-Apr-23	0	
189	C-2050	Elevated Concrete Support Walls/Columns	25	17-Apr-23	19-May-23	0	
190	C-2060	Elevated Concourse Concrete Deck Slab	15	15-May-23	05-Jun-23	0	
191	C-2070	Crane Mobilization	5	30-May-23	05-Jun-23	0	
192	C-2080	Steel Structure Erection & Decking	35	06-Jun-23	25-Jul-23	0	
193	C-2090	Elevated Club Level Concrete Deck Slab	15	12-Jul-23	01-Aug-23	0	
194	C-2100	Crane Demobilization	5	26-Jul-23	01-Aug-23	40	
195	C-2110	Install Concrete Site Walls, Ramps, Stairs	25	26-Jul-23	29-Aug-23	61	
196	C-2120	Exterior Walls Frame/Sheath	30	26-Jul-23	06-Sep-23	0	
197	C-2130	Exterior Wall Masonry, Glazing & Metal Panel	40	02-Aug-23	27-Sep-23	0	
198	C-2140	Roofing	20	29-Aug-23	26-Sep-23	27	
199	**Interior Construction**		105	30-Aug-23	02-Feb-24	6	
200	C-2150	MEP Equipment Install & Rough in	60	30-Aug-23	28-Nov-23	0	
201	C-2160	Interior Framing, Rough in, Hang/Finish	30	14-Sep-23	26-Oct-23	6	
202	C-2170	Operable Windows & Partitions	30	28-Sep-23	09-Nov-23	36	
203	C-2240	Interior Finishes	30	27-Oct-23	12-Dec-23	6	
204	C-2250	Flooring/Carpet/Epoxy/Sealer	40	27-Oct-23	27-Dec-23	6	
205	C-2260	Elevator Installation, Adjust/Balance, MEP Connections	40	27-Oct-23	27-Dec-23	31	
206	C-2290	Food Service Equipment Install & Connections	25	29-Nov-23	04-Jan-24	16	
207	C-2310	FF&E Install	25	28-Dec-23	02-Feb-24	6	



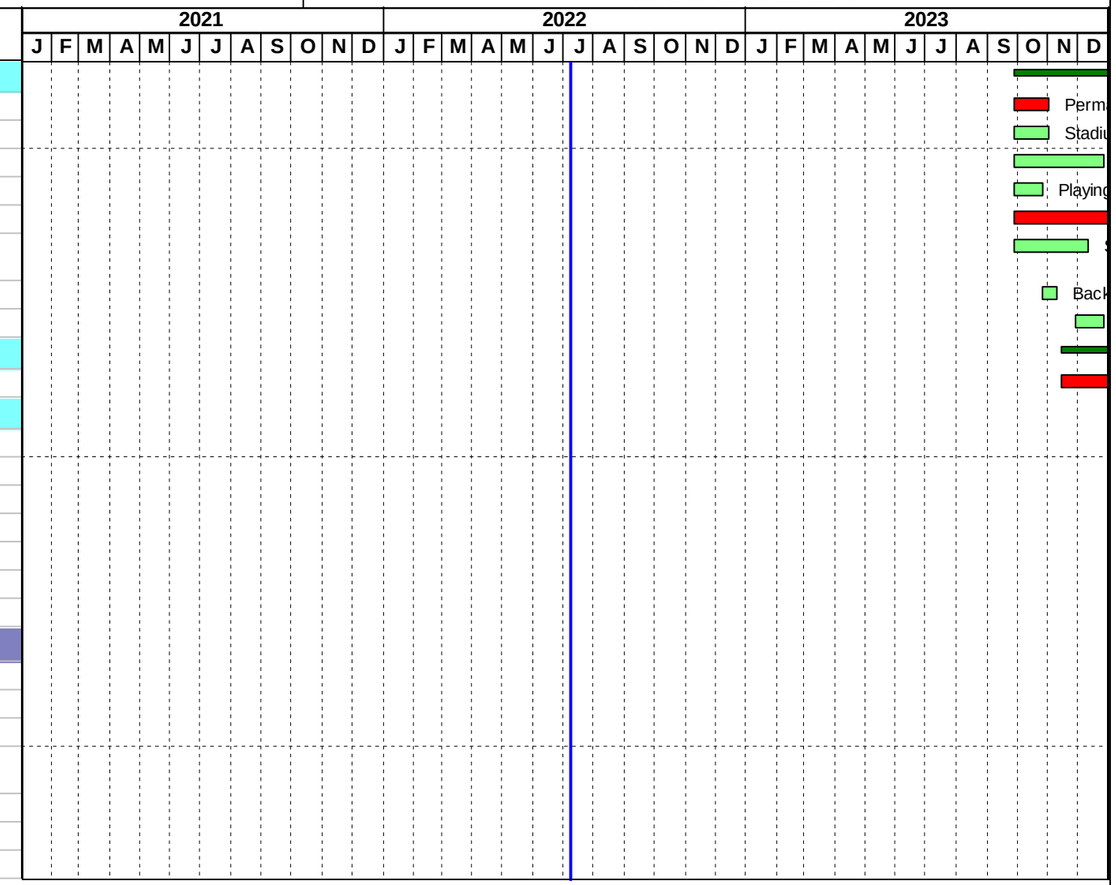
Remaining Level of Effort
Critical Remaining Work
Actual Level of Effort
Milestone
Actual Level of Effort
Actual Work
Remaining Work

Hagerstown Municipal Stadium Proposal_20220709 GMP-1

Turner

Start Date 09-Mar-22
Finish Date 23-Apr-24
Data Date 09-Jul-22

#	Activity ID	Activity Name	OD	Start	Finish	Total Float	Lag
208	**Grandstand, Field, and Site**		100	28-Sep-23	26-Feb-24	0	
209	C-2180	Permanent Site Fencing/Grilles	25	28-Sep-23	02-Nov-23	0	
210	C-2190	Stadium Seating	25	28-Sep-23	02-Nov-23	66	
211	C-2200	Scoreboard & AV	60	28-Sep-23	27-Dec-23	31	
212	C-2210	Playing Field LED Lighting	20	28-Sep-23	26-Oct-23	31	
213	C-2230	Playing Field Surface	100	28-Sep-23	26-Feb-24	0	
214	C-2220	Site Work - Player/Staff Parking Lot & Curbs, Gutter Sidewalks, etc…	50	28-Sep-23	12-Dec-23	41	
215	C-2300	Back Stop Netting & Foul Poles	10	27-Oct-23	09-Nov-23	61	
216	C-2280	Wifi System Install	20	29-Nov-23	27-Dec-23	31	
217	**Start Up & Commissioning**		50	14-Nov-23	29-Jan-24	0	
218	C-2270	Start-Up, TAB, & Commissioning	50	14-Nov-23	29-Jan-24	0	
219	**Final Inspections**		35	23-Jan-24	12-Mar-24	0	
220	C-2320	Turnover Final O&M	20	23-Jan-24	20-Feb-24	15	
221	C-2340	Training & Demonstration Sessions	15	30-Jan-24	20-Feb-24	15	
222	C-2330	Turnover Final As-Built	10	30-Jan-24	12-Feb-24	20	
223	C-2350	Create Punchlist	15	13-Feb-24	05-Mar-24	0	
224	C-2360	Final Inspections by AHJ	15	13-Feb-24	05-Mar-24	0	
225	C-2370	Certificate of Use & Occupancy	0		12-Mar-24	0	
226	C-2380	Certificate of Substantial Completion	0		12-Mar-24	0	
227	**Closeout**		30	13-Mar-24	23-Apr-24	0	
228	CL-1000	Complete Punchlist	30	13-Mar-24	23-Apr-24	0	
229	CL-1010	Close Out Waste Tracking Documentation	20	13-Mar-24	09-Apr-24	10	
230	CL-1020	Turnover Final Certified Site Survey	20	13-Mar-24	09-Apr-24	10	
231	CL-1030	Provide New Monuments of Property Corners (at Construction Completion)	20	13-Mar-24	09-Apr-24	10	
232	CL-1040	Submit Final As-Built Schedule	30	13-Mar-24	23-Apr-24	0	
233	CL-1050	Submit Final Project Report	30	13-Mar-24	23-Apr-24	0	
234	CL-1060	Final Completion	0		23-Apr-24	0	



Remaining Level of Effort
Actual Level of Effort
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Actual Work
Remaining Work
Critical Remaining Work
Milestone

Hagerstown Municipal Stadium Proposal_20220709 GMP-1

Turner

Start Date 09-Mar-22
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Attachment J

SAMPLE CONTRACT

(to be issued via addendum)

Attachment K

EXPERIENCE FORM

Request for Proposals - Building Commissioning Services
Hagerstown Multi-Use Sports & Events Facility

Attachment K - Experience Form

Offering Firm: _____

Project Name	Project Description (including square footage, venue, etc.	Services Provided	Project Value	Contract Value	Project Location (City/County, State)	Year Complete