



LEE'S SUMMIT
MISSOURI

LXT Hangar 2 and Eastside Development

City Project No. 47732472 PROJECT MANUAL

Prepared by: CMT

**City of Lee's Summit
Public Works Department
220 SE Green Street
Lee's Summit, MO 64063**

January 4, 2024



LEE'S SUMMIT MISSOURI

PROJECT MANUAL

PROJECT NO. 47732472 LXT HANGAR 2 AND EASTSIDE DEVELOPMENT AT LEE'S SUMMIT MUNICIPAL AIRPORT

The Sections of Contract Documents and Specifications bound in this Project Manual have been prepared under the immediate personal supervision as indicated by the seals shown on the following pages:



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LXT Hangar 2 and Eastside Development

Project #47732472

DOCUMENT - SEALS PAGE

The documents listed below and included with in this package of contract documents are intended to be represented by the Engineer, Tyler Horn, CMT. are limited to:

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G003	CONSTRUCTION ACTIVITY PLAN
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Division 1 – General Requirements

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21 00 CLEARING AND SITE PREPARATION

21 50 EROSION AND SEDIMENT CONTROL

22 00 PAVING

23 00 INCIDENTAL CONSTRUCTION

24 00 SEEDING AND SODDING

26 00 STORM SEWERS

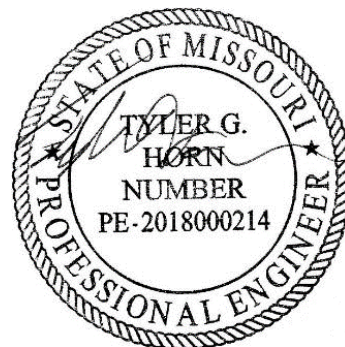
27 00 STRUCTURES

28 00 STREET LIGHTS

30 00 TRAFFIC CONTROL, MARKING AND SIGNING

35 00 SANITARY MAINS

39 00 WATER MAINS



SEALED DIGITALLY
NOVEMBER 10, 2023

(SEAL)

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DOCUMENT 000107B - SEALS PAGE

The documents listed below and included with in this package of contract documents are intended to be represented by the Architect, Julie Wellner, Wellner Architect, Inc, Inc. are limited to:

Drawings

AG001	ARCHITECTURAL LEGEND AND ABBREVEATIONS
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AG003	CODE INFORMATION & WALL TYPES
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AG005	INTERIOR ACCESSIBILITY
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A111	OVERALL ROOF PLAN
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A301	BUILDING SECTIONS
A302	BUILDING SECTIONS
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A311	WALL SECTIONS
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A402	ENLARGED RESTROOM PLANS & ELEVATIONS
A403	STAIR AND ELEVATOR DETAILS
A501	DETAILS
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A603	ALUM. STOREFRONT DOOR/WINDOW SCHEDULE

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A610	FINISH SCHEDULE
A612	FINISH FLOOR PLANS
A621	CASEWORK ELEVATIONS
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06 10 00	Rough Carpentry
06 16 00	Sheathing
06 41 16	Plastic-Laminate-Clad Architectural Cabinets
07 21 00	Thermal Insulation
07 25 00	Weather Barriers
07 27 26	Fluid-Applied Membrane Air Barriers
07 42 13.13	Formed Metal Wall Panels
07 42 93	Soffit Panels
07 54 23	Thermoplastic-Polyolefin (TPO) Roofing
07 62 00	Sheet Metal Flashing and Trim
07 72 53	Snow Guards
07 84 43	Joint Firestopping
07 92 00	Joint Sealants
08 11 13	Hollow Metal Doors and Frames
08 14 16	Flush Wood Doors
08 31 13	Access Doors and Frames
08 33 23	Overhead Coiling Doors
08 34 16	Hangar doors
08 36 13	Sectional Doors
08 41 13	Aluminum-Framed Entrances and Storefronts

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08 42 29.23 - Sliding Automatic Entrances

08 45 23 Fiberglass-Sandwich-Panel Assemblies

08 71 00 Door Hardware

08 80 00 Glazing

08 83 00 Mirrors

08 88 13 Fire-Rated Glazing

08 88 53 Security Glazing

09 22 16 Non-Structural Metal Framing

09 29 00 Gypsum Board

09 30 13 Ceramic Tiling

09 51 13 Acoustical Panel Ceilings

09 54 26 Suspended Wood Ceilings

09 65 13 Resilient Base and Accessories

09 67 23 Resinous Flooring

09 91 14 Exterior Painting (MPI Standards)

09 91 24 Interior Painting (MPI Standards)

10 14 19 Dimensional Letter Signage

101423.16 Room-Identification Panel Signage

10 21 13.17 Phenolic-Core Toilet Compartments

10 21 13.17 Phenolic-Core Toilet Compartments

10 28 00 Toilet, Bath, And Laundry Accessories

10 44 13 Fire Protection Cabinets

10 44 16 Fire Extinguishers

11 30 13 Residential Appliances

11 52 13 Projection Screens

12 36 23.13 Plastic-Laminate-Clad Countertops

12 36 61.16 Solid Surfacing Countertops

133419 Metal Building Systems

14 21 23.16 - Machine Room-Less Electric Traction Passenger Elevators

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The documents listed below and included with in this package of contract documents are intended to be represented by the Engineer, James Rongish, Olsson, Inc. are limited to:

Drawings

S000	STRUCTURAL GENERAL NOTES
S001	STRUCTURAL GENERAL NOTES
S002	SPECIAL INSPECTIONS
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S101	FOUNDATION PARTIAL PLANS
S102	MEZZANINE FRAMING PLAN
S200	TYPICAL FOUNDATION DETAILS
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042000	Unit Masonry
051200	Structural Steel Framing
053100	Steel Decking
054000	Cold-Formed Metal Framing
055000	Metal Fabrications
055113	Metal Pan Stairs

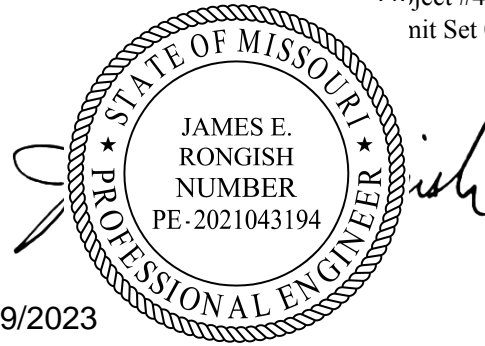
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The documents listed below and included with in this package of contract documents are intended to be represented by the Engineer, Cory Wilson, Olsson, Inc. are limited to:

Drawings

E001	GENERAL ELECTRICAL INFORMATION
E002	SITE LIGHTING PHOTOMETRICS PLAN
E003	ELECTRICAL SITE PLAN
E101	LIGHTING FLOOR PLANS
E102	LIGHTING HANGAR FLOOR PLAN
E201	POWER FLOOR PLANS
E202	POWER HANGAR PLAN
E301	SYSTEMS FLOOR PLANS
E302	SYSTEMS HANGAR PLAN
E401	ENLARGED PLANS
E501	DIAGRAMS
E601	ELECTRICAL DETAILS
E602	ELECTRICAL DETAILS
E701	ELECTRICAL SCHEDULES
E702	ELECTRICAL SCHEDULES
E703	ELECTRICAL SCHEDULES
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FP101	FIRE PROTECTION FLOOR PLANS
FP102	FIRE PROTECTION HANGAR FLOOR PLAN
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210529	HANGERS AND SUPPORTS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT
210553	IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT
210800	COMMISSIONING OF FIRE SUPPRESSION
211000	WATER-BASED FIRE-SUPPRESSION SYSTEMS
220010	BASIC MECHANICAL REQUIREMENTS FOR PLUMBING
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221119	DOMESTIC WATER PIPING SPECIALTIES
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230553	IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
230593	TESTING, ADJUSTING, AND BALANCING FOR HVAC
230713	DUCT INSULATION
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230719	HVAC PIPING INSULATION
231123	FACILITY NATURAL-GAS PIPING
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233300	AIR DUCT ACCESSORIES
233346	FLEXIBLE DUCTS
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26 27 26 WIRING DEVICES
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26 43 13 SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS
26 51 19 LED INTERIOR LIGHTING
26 56 13 LIGHTING POLES AND STANDARDS
26 56 19 LED EXTERIOR LIGHTING
27 05 26 GROUNDING AND BONDING FOR COMMUNICATIONS
28 46 21.11 ADDRESSABLE FIRE-ALARM SYSTEMS



09/29/2023

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06 10 00 ROUGH CARPENTRY
06 16 00 SHEATHING
06 41 16 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS
07 21 00 THERMAL INSULATION
07 25 00 WEATHER BARRIERS
07 27 26 FLUID-APPLIED MEMBRANE AIR BARRIERS
07 42 13.13 FORMED METAL WALL PANELS
07 42 93 SOFFIT PANELS
07 54 23 THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING
07 62 00 SHEET METAL FLASHING AND TRIM
07 72 53 SNOW GUARDS
07 84 43 JOINT FIRESTOPPING
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22 05 00	COMMON WORK RESULTS FOR PLUMBING
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23 05 00	COMMON WORK RESULTS FOR HVAC
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23 07 19	HVAC PIPING INSULATION
23 11 23	FACILITY NATURAL-GAS PIPING
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23 37 13.13	AIR DIFFUSERS
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28 46 21.11	ADDRESSABLE FIRE-ALARM SYSTEMS

PERMITS AND SWPPP

Construction Stormwater Pollution Prevention Plan – LXT Eastside Development

DRAWINGS AND DETAILS

Plans Titled: LXT Eastside Development

**ADVERTISEMENT FOR BIDS
CITY OF LEE'S SUMMIT
LEE'S SUMMIT, MISSOURI**

**LXT Hangar 2 and Eastside Development
Project No. 47732472**

General Notice

The City of Lee's Summit, Missouri (Owner) is requesting Bids for the construction of the following Project:

**LXT Hangar 2 and Eastside Development
Project No. 47732472**

Bids for the construction of the Project will be received electronically submitted via QuestCDN (www.QuestCDN.com), until **2:00 P.M. local time on January 25, 2024**. At that time the Bids received will be publicly opened and read via Zoom video conferencing at

Join Zoom Meeting

<https://cmtengr.zoom.us/j/83235368872>

Meeting ID: 832 3536 8872

Dial by your location

- +1 309 205 3325 US

Meeting ID: 832 3536 8872

The Project includes the following Work:

The Work for the project, **LXT Hangar 2 and Eastside Development** includes, but is not necessarily limited to:

Construct a new hangar west of NE Hagan Road and east of the East Apron at Lee's Summit Municipal Airport. To facilitate this hangar, roads with sidewalks, a parking lot, street lighting, pavement markings, perimeter fencing, extended airfield apron, and an enclosed storm drainage system will also be constructed.

Bids are requested for the following Contract:

LXT Hangar 2 and Eastside Development: Project No. 47732472

Information and Bidding Documents for the Project can be found at the following designated website:

www.QuestCDN.com

The Quest Bid number is **8852991**. A fee of **\$22** will be required to obtain the Bidding Document files. An additional fee of **\$20** is required for Contractors who submit a bid for the Work.

Bidding Documents may be downloaded from the designated website. Prospective Bidders are urged to register with the designated website as a plan holder, even if Bidding Documents are obtained from a plan room or source other than the designated website in either electronic or paper format. The designated website will be updated periodically with addenda, lists of registered plan holders, reports, and other information relevant to submitting a Bid for the Project. All official notifications, addenda, and other Bidding Documents will be offered only through the designated website. Neither Owner nor Engineer will be responsible for Bidding Documents, including addenda, if any, obtained from sources other than the designated website.

Pre-Bid Conference

A Pre-Bid conference for the Project will be held on **January 11, 2024, at 10:00 A.M central time** via Zoom video conferencing at:

Join Zoom Meeting

<https://cmtengr.zoom.us/j/83393492000>

Meeting ID: 833 9349 2000

Dial by your location

- +1 309 205 3325 US

Meeting ID: 833 9349 2000

Attendance at the pre-bid conference is encouraged but not required.

Bid Security

Each Bid shall enclose Bid Security, as specified in the Instructions to Bidders, representing five percent (5%) of the sum of the Bidder's Base Bid plus all alternates.

Prevailing Wages

The Department of Labor and Industrial Relations Prevailing Wage Determination - *Annual Wage Order No. 30*, covering the Work is attached to the Form of Agreement (Section C520).

Tax Exemption

All or certain items required for this contract are for constructing, repairing, or remodeling facilities for an exempt entity and qualify for exemption from State and local sales and use taxes under RSMo 144.062. The Instruction to Bidders and General Conditions include tax exemption provisions covering the submission of the application for tax exemption determination by the Bidder awarded the Contract.

Work Authorization

For all contracts in excess of \$5,000, the bidder shall comply with § 285.530, RSMo, as amended and shall: (1) provide sworn affidavit affirming that it does not knowingly employ any person who is an unauthorized alien; and (2) provide documentation affirming its enrollment and participation in a federal work authorization program with respect to the employees working in connection with this contract. The required documentation must be from the federal work authorization program provider. e.g. the electronic signature page from the E-Verify program's Memorandum of Understanding. E-Verify, <http://www.dhs.gov/everify>, is a FREE Internet-based federal work authorization program operated by the Department of Homeland Security, U.S. Citizenship and Immigration Services. Letter from contractors reciting compliance is not sufficient.

The successful bidder shall comply with the requirements of § 292.675 RSMo.

The requirements include on-site employees to complete the ten (10) hour Occupational Safety and Health Administration (OSHA) construction safety program, which includes a course in construction safety and health approved by OSHA or a similar program approved by the Department of Labor and Industrial Relations.

Instructions to Bidders.

For all further requirements regarding bid submittal, qualifications, procedures, and contract award, refer to the Instructions to Bidders that are included in the Bidding Documents.

This Advertisement is issued by:

Owner: **City of Lee's Summit, Missouri**

By: **Mike Anderson, P.E.**

Title: **Deputy Director of Public Works - Operations**

Date: **January 4, 2024**

INSTRUCTIONS TO BIDDERS FOR CONSTRUCTION CONTRACT

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ARTICLE 1—DEFINED TERMS

- 1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:
- A. *Issuing Office*—The office from which the Bidding Documents are to be issued, and which registers plan holders.

ARTICLE 2—BIDDING DOCUMENTS

- 2.01 Bidder shall obtain a complete set of Bidding Requirements and proposed Contract Documents (together, the Bidding Documents). See the Agreement for a list of the Contract Documents. It is Bidder's responsibility to determine that it is using a complete set of documents in the preparation of a Bid. Bidder assumes sole responsibility for errors or misinterpretations resulting from the use of incomplete documents, by Bidder itself or by its prospective Subcontractors and Suppliers.
- 2.02 Bidding Documents are made available for the sole purpose of obtaining Bids for completion of the Project and permission to download or distribution of the Bidding Documents does not confer a license or grant permission or authorization for any other use. Authorization to download documents, or other distribution, includes the right for plan holders to print documents solely for their use, and the use of their prospective Subcontractors and Suppliers, provided the plan holder pays all costs associated with printing or reproduction. Printed documents may not be re-sold under any circumstances.
- 2.03 Owner has established a Bidding Documents Website as indicated in the Advertisement or invitation to bid. Owner recommends that Bidder register as a plan holder with the Issuing Office at such website, and obtain a complete set of the Bidding Documents from such website. Bidders may rely that sets of Bidding Documents obtained from the Bidding Documents Website are complete, unless an omission is blatant. Registered plan holders will receive Addenda issued by Owner.
- 2.04 *Electronic Documents*
- A. When the Bidding Requirements indicate that electronic (digital) copies of the Bidding Documents are available, such documents will be made available to the Bidders as Electronic Documents in the manner specified.
1. Bidding Documents will be provided in Adobe PDF (Portable Document Format) (.pdf) that is readable by Adobe Acrobat Reader Version **DC** or later. It is the intent of the Engineer and Owner that such Electronic Documents are to be exactly representative of the paper copies of the documents. However, because the Owner and Engineer cannot totally control the transmission and receipt of Electronic Documents nor the Contractor's means of reproduction of such documents, the Owner and Engineer cannot and do not guarantee that Electronic Documents and reproductions prepared from those versions are identical in every manner to the paper copies.
- B. Unless otherwise stated in the Bidding Documents, the Bidder may use and rely upon complete sets of Electronic Documents of the Bidding Documents, described in the Paragraphs above. However, Bidder assumes all risks associated with differences arising

from transmission/receipt of Electronic Documents versions of Bidding Documents and reproductions prepared from those versions and, further, assumes all risks, costs, and responsibility associated with use of the Electronic Documents versions to derive information that is not explicitly contained in printed paper versions of the documents, and for Bidder's reliance upon such derived information.

- C. After the Contract is awarded, the Owner will provide or direct the Engineer to provide for the use of the Contractor documents that were developed by Engineer as part of the Project design process, as Electronic Documents in native file formats.
 - 1. Electronic Documents that are available in native file format include:
 - a. Contract Drawings (pdf)
 - b. Project Manual (pdf)
 - 2. Release of such documents will be solely for the convenience of the Contractor. No such document is a Contract Document.
 - 3. The release of Electronic Documents will be subject to SC-2.06 of the Supplementary Conditions.
 - 4. Unless the Contract Documents explicitly identify that such information will be available to the Successful Bidder (Contractor), nothing herein will create an obligation on the part of the Owner or Engineer to provide or create such information, and the Contractor is not entitled to rely on the availability of such information in the preparation of its Bid or pricing of the Work. In all cases, the Contractor shall take appropriate measures to verify that any electronic/digital information provided in Electronic Documents is appropriate and adequate for the Contractor's specific purposes.
 - 5. In no case will the Contractor be entitled to additional compensation or time for completion due to any differences between the actual Contract Documents and any related document in native file format.

ARTICLE 3—QUALIFICATIONS OF BIDDERS

- 3.01 To demonstrate the Apparent Low Bidder's qualifications to perform the Work, after submitting its Bid and within five (5) business days of Owner's request, the Apparent Low Bidder must submit the following information:
 - A. Written evidence establishing its qualifications such as financial data, previous experience, and present commitments.
 - 1. Bidder Qualification Statement, EJCDC Section C-451, with Supporting Data
 - B. A written statement that Bidder is authorized to do business in the state where the Project is located, or a written certification that Bidder will obtain such authority prior to the Effective Date of the Contract.
 - 1. Current Missouri Secretary of State Business Filing;
 - 2. City of Lee's Summit Business License
 - C. Bidder's state or other contractor license number, SAMS and/or DUNS numbers, if applicable.

- D. Subcontractor and Supplier qualification information.
 - 1. List of Proposed Subcontractors, Section C-440;
 - 2. Schedule of Suppliers and Manufacturers, Section C-550
 - E. Affidavit of Noncollusion, Section C-480
 - F. Work Authorization Affidavit, signed and notarized
 - G. Documentation affirming enrollment and participation in a federal work authorization program. Documentation can be the electronic signature page from the E-Verify program's Memorandum of Understanding. Letters from contractors reciting compliance is not sufficient.
 - H. Other required information regarding qualifications.
- 3.02 A Bidder's failure to submit required qualification information within the times indicated may disqualify Bidder from receiving an award of the Contract.
- 3.03 No requirement in this Article 3 to submit information will prejudice the right of Owner to seek additional pertinent information regarding Bidder's qualifications.

ARTICLE 4—PRE-BID CONFERENCE

- 4.01 A non-mandatory pre-bid conference will be held at the time and location indicated in the Advertisement or invitation to bid. Representatives of Owner and Engineer will be present to discuss the Project. Bidders are encouraged to attend and participate in the conference; however, attendance at this conference is not required to submit a Bid.
- 4.02 Information presented at the pre-Bid conference does not alter the Contract Documents. Owner will issue Addenda to make any changes to the Contract Documents that result from discussions at the pre-Bid conference. Information presented, and statements made at the pre-bid conference will not be binding or legally effective unless incorporated in an Addendum.

ARTICLE 5—SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OWNER'S SAFETY PROGRAM; OTHER WORK AT THE SITE

- 5.01 *Site and Other Areas*
- A. The Site is identified in the Bidding Documents. By definition, the Site includes rights-of-way, easements, and other lands furnished by Owner for the use of the Contractor. Any additional lands required for temporary construction facilities, construction equipment, or storage of materials and equipment, and any access needed for such additional lands, are to be obtained and paid for by Contractor.
- 5.02 *Existing Site Conditions*
- A. *Subsurface and Physical Conditions; Hazardous Environmental Conditions*
 - 1. The Supplementary Conditions identify the following regarding existing conditions at or adjacent to the Site:
 - a. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data.

2. Owner will make copies of reports and drawings referenced above available to any Bidder on request. These reports and drawings are not part of the Contract Documents, but the Technical Data contained therein upon whose accuracy Bidder is entitled to rely, as provided in the General Conditions, has been identified and established in the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any Technical Data or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.
 3. If the Supplementary Conditions do not identify Technical Data, the default definition of Technical Data set forth in Article 1 of the General Conditions will apply.
- B. *Underground Facilities:* Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05 of the General Conditions, and not in the drawings referred to in Paragraph 5.02.A of these Instructions to Bidders. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.
- 5.03 *Other Site-related Documents*
- A. No other Site-related documents are available.
- 5.04 *Site Visit and Testing by Bidders*
- A. Bidder is not required to visit the Site and conduct a thorough visual examination of the Site and adjacent areas. During the visit the Bidder must not disturb any ongoing operations at the Site.
- B. Bidders visiting the Site are required to arrange their own transportation to the Site.
- C. All access to the Site other than during a regularly scheduled Site visit must be coordinated through the following Owner contact for visiting the Site: Joel Arrington Airport Manager 816.969.1181 Bidder must conduct the required Site visit during normal working hours.
- D. Bidder is not required to conduct any subsurface testing, or exhaustive investigations of Site conditions.
- E. On request, and to the extent Owner has control over the Site, and schedule permitting, the Owner will provide Bidder general access to the Site to conduct such additional examinations, investigations, explorations, tests, and studies as Bidder deems necessary for preparing and submitting a successful Bid. Owner will not have any obligation to grant such access if doing so is not practical because of existing operations, security or safety concerns, or restraints on Owner's authority regarding the Site. Bidder is responsible for establishing access needed to reach specific selected test sites.
- F. Bidder must comply with all applicable Laws and Regulations regarding excavation and location of utilities, obtain all permits, and comply with all terms and conditions established by Owner or by property owners or other entities controlling the Site with respect to schedule, access, existing operations, security, liability insurance, and applicable safety programs.
- G. Bidder must fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies.

5.05 *Owner's Safety Program*

- A. Site visits and work at the Site may be governed by an Owner safety program. If an Owner safety program exists, it will be noted in the Supplementary Conditions.

5.06 *Other Work at the Site*

- A. Reference is made to Article 8 of the Supplementary Conditions for the identification of the general nature of other work of which Owner is aware (if any) that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) and relates to the Work contemplated by these Bidding Documents. If Owner is party to a written contract for such other work, then on request, Owner will provide to each Bidder access to examine such contracts (other than portions thereof related to price and other confidential matters), if any.

ARTICLE 6—BIDDER'S REPRESENTATIONS AND CERTIFICATIONS

6.01 *Express Representations and Certifications in Bid Form, Agreement*

- A. The Bid Form that each Bidder will submit contains express representations regarding the Bidder's examination of Project documentation, Site visit, and preparation of the Bid, and certifications regarding lack of collusion or fraud in connection with the Bid. Bidder should review these representations and certifications, and assure that Bidder can make the representations and certifications in good faith, before executing and submitting its Bid.
- B. If Bidder is awarded the Contract, Bidder (as Contractor) will make similar express representations and certifications when it executes the Agreement.

ARTICLE 7—INTERPRETATIONS AND ADDENDA

- 7.01 Owner on its own initiative may issue Addenda to clarify, correct, supplement, or change the Bidding Documents.
- 7.02 Bidder shall submit all questions about the meaning or intent of the Bidding Documents to Engineer in writing. Contact information and submittal procedures for such questions are as follows. **Deadline for questions shall be Friday, January 19, 2024 at 5:00pm CT.**
 - A. Contact information: Wade Cumpton – wcumpton@cmtengr.com
 - B. Email Subject Line: LXT Hangar 2 Eastside Development – Bidding Questions/Clarifications
- 7.03 Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda delivered to all registered plan holders. Questions received after deadline for questions may not be answered.
- 7.04 Only responses set forth in an Addendum will be binding. Oral and other interpretations or clarifications will be without legal effect. Responses to questions are not part of the Contract Documents unless set forth in an Addendum that expressly modifies or supplements the Contract Documents.

ARTICLE 8—BID SECURITY

- 8.01 A Bid must be accompanied by Bid security made payable to Owner in an amount of five percent (5%) of Bidder's maximum Bid price (determined by adding the base bid and all alternates) and

in the form of a Bid bond issued by a surety meeting the requirements of Paragraph 6.01 of the General Conditions. Such Bid bond will be issued in the form included in the Bidding Documents.

- 8.02 The Bid security of the apparent Successful Bidder will be retained until Owner awards the contract to such Bidder, and such Bidder has executed the Contract, furnished the required Contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released. If the Successful Bidder fails to execute and deliver the Contract and furnish the required Contract security within 15 days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited, in whole in the case of a penal sum bid bond, and to the extent of Owner's damages in the case of a damages-form bond. Such forfeiture will be Owner's exclusive remedy if Bidder defaults.
- 8.03 The Bid security of other Bidders that Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of 7 days after the Effective Date of the Contract or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.
- 8.04 Bid security of other Bidders that Owner believes do not have a reasonable chance of receiving the award will be released within 7 days after the Bid opening.

ARTICLE 9—CONTRACT TIMES

- 9.01 The number of days within which, or the dates by which, the Work is to be (a) substantially completed and (b) ready for final payment, and (c) Milestones (if any) are to be achieved, are set forth in the Agreement.
- 9.02 Provisions for liquidated damages, if any, for failure to timely attain a Milestone, Substantial Completion, or completion of the Work in readiness for final payment, are set forth in the Agreement.

ARTICLE 10—SUBSTITUTE AND “OR EQUAL” ITEMS

- 10.01 The Contract for the Work, as awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration during the bidding and Contract award process of possible substitute or “or-equal” items. In cases in which the Contract allows the Contractor to request that Engineer authorize the use of a substitute or “or-equal” item of material or equipment, application for such acceptance may not be made to and will not be considered by Engineer until after the Effective Date of the Contract.
- 10.02 All prices that Bidder sets forth in its Bid will be based on the presumption that the Contractor will furnish the materials and equipment specified or described in the Bidding Documents, as supplemented by Addenda. Any assumptions regarding the possibility of post-Bid approvals of “or-equal” or substitution requests are made at Bidder’s sole risk.

ARTICLE 11—SUBCONTRACTORS, SUPPLIERS, AND OTHERS

- 11.01 No more than 70% of the Project Work may be performed by Subcontractors, and no second tier subcontracting is allowed. It will be the responsibility of the Contractor to insure that Subcontractors do not, in turn, subcontract any portion of the Work.
- 11.02 A Bidder must be prepared to retain specific Subcontractors and Suppliers for the performance of the Work if required to do so by the Bidding Documents or in the Specifications. If a prospective Bidder objects to retaining any such Subcontractor or Supplier and the concern is not relieved by an Addendum, then the prospective Bidder should refrain from submitting a Bid.
- 11.03 The apparent Successful Bidder, and any other Bidder so requested, must submit to Owner a list of the Subcontractors or Suppliers proposed for the following portions of the Work within five days after Bid opening:
- A. Metal Building Supplier
 - B. Metal Building Subcontractor
 - C. Hangar Door Provider
 - D. Concrete Flatwork Subcontractor
- 11.04 If requested by Owner, such list must be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor or Supplier. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor or Supplier, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit an acceptable substitute, in which case apparent Successful Bidder will submit a substitute, Bidder’s Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award.
- 11.05 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors and Suppliers. Declining to make requested substitutions will constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor or Supplier, so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to subsequent revocation of such acceptance as provided in Paragraph 7.07 of the General Conditions.

ARTICLE 12—PREPARATION OF BID

- 12.01 The Bid Form is included with the Bidding Documents.
- A. All blanks on the Bid Form must be completed in ink and the Bid Form signed in ink. Erasures or alterations must be initialed in ink by the person signing the Bid Form. A Bid price must be indicated for each section, bid item, alternate, adjustment unit price item, and unit price item listed therein on the Bid Worksheet in the Quest vBid system.
- 12.02 A Bid by a corporation must be executed in the corporate name by a corporate officer (whose title must appear under the signature), accompanied by evidence of authority to sign. The corporate address and state of incorporation must be shown.
- 12.03 A Bid by a partnership must be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership must be shown.
- 12.04 A Bid by a limited liability company must be executed in the name of the firm by a member or other authorized person and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm must be shown.
- 12.05 A Bid by an individual must show the Bidder's name and official address.
- 12.06 A Bid by a joint venture must be executed by an authorized representative of each joint venturer in the manner indicated on the Bid Form. The joint venture must have been formally established prior to submittal of a Bid, and the official address of the joint venture must be shown.
- 12.07 All names must be printed in ink below the signatures.
- 12.08 The Bid must contain an acknowledgment of receipt of all Addenda, the numbers of which must be filled in on the Bid Form.
- 12.09 Postal and e-mail addresses and telephone number for communications regarding the Bid must be shown.
- 12.10 The Bid must contain evidence of Bidder's authority to do business in the state where the Project is located, or Bidder must certify in writing that it will obtain such authority within the time for acceptance of Bids and attach such certification to the Bid.
- 12.11 If Bidder is required to be licensed to submit a Bid or perform the Work in the state where the Project is located, the Bid must contain evidence of Bidder's licensure, or Bidder must certify in writing that it will obtain such licensure within the time for acceptance of Bids and attach such certification to the Bid. Bidder's state contractor license number, if any, must also be shown on the Bid Form.

ARTICLE 13—BASIS OF BID

- 13.01 *Unit Price*
- A. Bidders must submit a Bid on a unit price basis for each item of Work listed in the unit price section of the Bid Form.
- B. The "Bid Price" (sometimes referred to as the extended price) for each unit price Bid item will be the product of the "Estimated Quantity", which Owner or its representative has set forth in the Bid Form, for the item and the corresponding "Bid Unit Price" offered by the

Bidder. The total of all unit price Bid items will be the sum of these "Bid Prices"; such total will be used by Owner for Bid comparison purposes. The final quantities and Contract Price will be determined in accordance with Paragraph 13.03 of the General Conditions.

- C. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

13.2 *Base Bid with Alternates*

- 1. Bidders must submit a Bid on a lump sum basis for the base Bid and include a separate price for each alternate described in the Bidding Documents and as provided for in the Bid Form. The price for each alternate will be the amount added to or deleted from the base Bid if Owner selects the alternate.
- 2. In the comparison of Bids, alternates will be applied in the same order of priority as listed in the Bid Form.

13.03 *Allowances*

- A. For allowances the Bid price must include such amounts as the Bidder deems proper for Contractor's overhead, costs, profit, and other expenses on account of allowances, if any, named in the Contract Documents, in accordance with Paragraph 13.02.B of the General Conditions.

ARTICLE 14—SUBMITTAL OF BID

- 14.01 The Bid Form, Bid Worksheet and the Bid Bond Form are located within the Quest vBid website. The Bid Worksheet resides on the Quest vBid system and cannot be downloaded. Bidders shall follow the Quest instructions to complete the Bid Worksheet. The Bid Form is to be completed and submitted with the Bid security (EJCDC Section C-430) and the following documents:

- A. Addendum Acknowledgement Page for each Addendum

- 14.02 Bids will be accepted only in an electronic format submitted through the Quest vBid system. Quest strongly recommends the PDF format for uploading of bid documents. Paper bids will not be accepted.
- 14.03 A Bid submitted electronically shall be submitted no later than the date and time prescribed and in the manner indicated in the advertisement or invitation to bid, and shall be accompanied by the Bid security and other required documents.
- 14.04 Bids received after the date and time prescribed for the opening of bids, or not submitted at the correct location or in the designated manner, will not be accepted.

ARTICLE 15—MODIFICATION AND WITHDRAWAL OF BID

- 15.01 An unopened Bid may be withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids. Upon receipt of such notice, the unopened Bid will be returned to the Bidder.
- 15.02 If a Bidder wishes to modify its Bid prior to Bid opening, Bidder must withdraw its initial Bid in the manner specified in Paragraph 15.01 and submit a new Bid prior to the date and time for the opening of Bids. The Bidder may have to contact QuestCDN directly before the published bid opening time to allow removal of the bid for modification.
- 15.03 If within 24 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, the Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, if the Work is rebid, the Bidder will be disqualified from further bidding on the Work.

ARTICLE 16—OPENING OF BIDS

- 16.01 Bids will be opened at the time and place indicated in the advertisement or invitation to bid and, unless obviously non-responsive, read aloud publicly. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.

ARTICLE 17—BIDS TO REMAIN SUBJECT TO ACCEPTANCE

- 17.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

ARTICLE 18—EVALUATION OF BIDS AND AWARD OF CONTRACT

- 18.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner also reserves the right to waive all minor Bid informalities not involving price, time, or changes in the Work.
- 18.02 Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible.

- 18.03 If Bidder purports to add terms or conditions to its Bid, takes exception to any provision of the Bidding Documents, or attempts to alter the contents of the Contract Documents for purposes of the Bid, whether in the Bid itself or in a separate communication to Owner or Engineer, then Owner will reject the Bid as nonresponsive.
- 18.04 If Owner awards the contract for the Work, such award will be to the responsible Bidder whose bid is in the best interests of the Project.
- 18.05 *Evaluation of Bids*
- A. In evaluating Bids, Owner will consider whether the Bids comply with the prescribed requirements, and such alternates, unit prices, and other data, as may be requested in the Bid Form or prior to the Notice of Award.
 - B. In the comparison of Bids, alternates will be applied in the same order of priority as listed in the Bid Form. To determine the Bid prices for purposes of comparison, Owner will announce to all bidders a “Base Bid plus alternates” budget after receiving all Bids, but prior to opening them. For comparison purposes alternates will be accepted, following the order of priority established in the Bid Form, until doing so would cause the budget to be exceeded. After determination of the Successful Bidder based on this comparative process and on the responsiveness, responsibility, and other factors set forth in these Instructions, the award may be made to said Successful Bidder on its base Bid and any combination of its additive alternate Bids for which Owner determines funds will be available at the time of award.
 - C. For the determination of the apparent low Bidder when unit price bids are submitted, Bids will be compared on the basis of the total of the products of the estimated quantity of each item and unit price Bid for that item, together with any lump sum items.
- 18.06 In evaluating whether a Bidder is responsible, Owner will consider the qualifications of the Bidder and may consider the qualifications and experience of Subcontractors and Suppliers proposed for those portions of the Work for which the identity of Subcontractors and Suppliers must be submitted as provided in the Bidding Documents.
- 18.07 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors or Suppliers.

ARTICLE 19—BONDS AND INSURANCE

- 19.01 Article 6 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner’s requirements as to performance and payment bonds, other required bonds (if any), and insurance. When the Successful Bidder delivers the executed Agreement to Owner, it must be accompanied by required bonds and insurance documentation.
- 19.02 Article 8, Bid Security, of these Instructions, addresses any requirements for providing bid bonds as part of the bidding process.

ARTICLE 20—SIGNING OF AGREEMENT

- 20.01 Work Authorization Affidavit: As a condition of award of any contract in excess of five thousand dollars (\$5,000), the Contractor or business entity, as defined in § 285.530, RSMo, shall provide

a sworn affidavit affirming that it does not knowingly employ any person who is an unauthorized alien with respect to the employees working in connection with this contract.

Federal Work Authorization Program: Contractor must provide documentation affirming its enrollment and participation in a federal work authorization program. The required documentation must be from the federal work authorization program provider. Letter from contractors reciting compliance is not sufficient. The Department of Homeland Security, U.S. Citizenship and Immigration Services, (USCIS) in partnership with the Social Security Administration (SSA) operate a FREE internet-based program called E-Verify that allows employers to verify the employment eligibility of their employees, regardless of citizenship. Based on information provided by employees on their Form I-9, E-Verify checks the information electronically against records contained in DHS and Social Security Administration databases. There are penalties for employing an unauthorized alien, including suspension of the contractor's business license, termination of the contract, debarment from city and State work for a period of three years or permanently, and withholding 25% of the total amount due the contractor.

- 20.02 Business License: Contractor and any Subcontractors used must obtain a City of Lee's Summit business license prior to signing agreement.
- 20.03 When Owner issues a Notice of Award to the Successful Bidder, it will be accompanied by the unexecuted counterparts of the Agreement along with the other Contract Documents as identified in the Agreement. Within 15 days thereafter, Successful Bidder must execute and deliver the required number of counterparts of the Agreement and any bonds and insurance documentation required to be delivered by the Contract Documents to Owner. Within 10 days thereafter, Owner will deliver one fully executed counterpart of the Agreement to Successful Bidder, together with printed and electronic copies of the Contract Documents as stated in Paragraph 2.02 of the General Conditions.

ARTICLE 21—SALES AND USE TAXES

- 21.01 Owner is exempt from Missouri state sales and use taxes on materials and equipment to be incorporated in the Work. Said taxes must not be included in the Bid. Refer to Paragraph SC-7.10 of the Supplementary Conditions for additional information.

ARTICLE 22—DEBARMENT

- 22.01 By submission of its bid, Bidder certifies that neither it nor its principals is presently debarred or suspended by any Federal Department or agency, including listing in the U.S. General Services Administration's List of Parties Excluded from Federal Procurement or Non-Procurement programs; or if the amount of this bid is equal to or in excess of \$100,000, that neither it nor its principals nor its subcontractors receiving sub-awards equal to or in excess of \$100,000 is presently disbarred, suspended, proposed for debarment, declared ineligible or voluntarily excluded from participation in this transaction by a Federal department, agency or provision of law. If Bidder is unable to certify any of the statements in this certification, Bidder must attach an explanation to its response.

BID FORM FOR CONSTRUCTION CONTRACT

The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 1—OWNER AND BIDDER

- 1.01 This Bid is submitted electronically via the Quest vBid system at www.QuestCDN.com for Quest Project No. 8852991 (Lee's Summit Project No. 47732472), LXT Hangar 2 and Eastside Development
- 1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2—ATTACHMENTS TO THIS BID

- 2.01 The following documents are submitted with and made a condition of this Bid:
 - A. Required Bid security (EJCDC Section C-430);
 - B. Addendum Acknowledgement Page for each Addendum.

ARTICLE 3—BASIS OF BID—UNIT PRICES

- 3.01 *Unit Price Bids*
 - A. Bidder will complete the Work in accordance with the Contract Documents for the price(s) identified in the Bid Worksheet submitted electronically via the Quest vBid system at www.QuestCDN.com.
 - B. Bidder acknowledges that:
 1. Each Bid Unit Price includes an amount considered by Bidder to be adequate to cover Contractor's overhead and profit for each separately identified item, and
 2. Estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all Unit Price Work will be based on actual quantities, determined as provided in the Contract Documents.
 - C. All specified contingency allowances are included in the price(s) set forth below, and have been computed in accordance with Paragraph 13.02 of the General Conditions.

Allowance 1: LXT Exterior Signage Allowance	\$ 75,000
Allowance 2: LSR7 Exterior Signage Allowance	\$ 25,000
Allowance 3: Evergy Allowance	\$ 120,000
Allowance 4: Spire Allowance	\$ 180,000
Total for all Lump Sum Contingency Allowances	\$ 400,000

- D. Base Bid and Alternates

Total Bid Price (Sum of Unit Prices & Allowances) for Base Bid	\$
Alternate A Deduct GSE Storage/Lean-Too from Project	\$

ARTICLE 4—TIME OF COMPLETION

- 4.01 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.
- 4.02 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 5—BIDDER'S ACKNOWLEDGEMENTS: ACCEPTANCE PERIOD, INSTRUCTIONS, AND RECEIPT OF ADDENDA

5.01 *Bid Acceptance Period*

- A. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

5.02 *Instructions to Bidders*

- A. Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security.

5.03 *Receipt of Addenda*

- A. Bidder hereby acknowledges receipt of the following Addenda:

Addendum Number	Addendum Date

ARTICLE 6—BIDDER'S REPRESENTATIONS AND CERTIFICATIONS

6.01 *Bidder's Representations*

- A. In submitting this Bid, Bidder represents the following:
1. Bidder has examined and carefully studied the Bidding Documents, including Addenda.
 2. Bidder has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
 3. Bidder is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.
 4. Bidder has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.

5. Bidder has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, with respect to Technical Data in such reports and drawings.
6. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, if selected as Contractor; and (c) Bidder's (Contractor's) safety precautions and programs.
7. Based on the information and observations referred to in the preceding paragraph, Bidder agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
8. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
9. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
10. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
11. The submission of this Bid constitutes an incontrovertible representation by Bidder that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

6.02 *Bidder's Certifications*

A. The Bidder certifies the following:

1. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation.
2. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid.
3. Bidder has not solicited or induced any individual or entity to refrain from bidding.
4. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 8.02.A:
 - a. Corrupt practice means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process.
 - b. Fraudulent practice means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at

artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition.

- c. Collusive practice means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels.
- d. Coercive practice means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

BIDDER hereby submits this Bid as set forth above:

Bidder:

(typed or printed name of organization)

By:

(individual's signature)

Name:

(typed or printed)

Title:

(typed or printed)

Date:

(typed or printed)

If Bidder is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.

Attest:

(individual's signature)

Name:

(typed or printed)

Title:

(typed or printed)

Date:

(typed or printed)

Address for giving notices:

Bidder's Contact:

Name:

(typed or printed)

Title:

(typed or printed)

Phone:

Email:

Address:

Bidder's Contractor License No.: (if applicable)

BID BOND (PENAL SUM FORM)

Bidder Name: Address <i>(principal place of business)</i> :	Surety Name: Address <i>(principal place of business)</i> :
Owner Name: City of Lee's Summit, Missouri Address <i>(principal place of business)</i> : 220 SE Green Street Lee's Summit, Missouri 64063	Bid Project <i>(name and location)</i> : LXT Hangar 2 and Eastside Development Lee's Summit Municipal Airport 2751 NE Douglas St, Lees Summit, MO 64064 Bid Due Date: January 25, 2024
Bond Penal Sum: [Amount] Date of Bond: [Date]	
Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth in this Bid Bond, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.	
Bidder	Surety
_____ <i>(Full formal name of Bidder)</i>	_____ <i>(Full formal name of Surety) (corporate seal)</i>
By: _____ <i>(Signature)</i>	By: _____ <i>(Signature) (Attach Power of Attorney)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
Attest: _____ <i>(Signature)</i>	Attest: _____ <i>(Signature)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
<i>Notes: (1) Note: Addresses are to be used for giving any required notice. (2) Provide execution by any additional parties, such as joint venturers, if necessary.</i>	

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond will be Owner's sole and exclusive remedy upon default of Bidder.
2. Default of Bidder occurs upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.
3. This obligation will be null and void if:
 - 3.1. Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
 - 3.2. All Bids are rejected by Owner, or
 - 3.3. Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions does not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.
6. No suit or action will be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety, and in no case later than one year after the Bid due date.
7. Any suit or action under this Bond will be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder must be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Postal Service registered or certified mail, return receipt requested, postage pre-paid, and will be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.
10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond will be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute governs and the remainder of this Bond that is not in conflict therewith continues in full force and effect.
11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

SECTION C-440 – LIST OF SUBCONTRACTORS

Owner	City of Lee's Summit, Missouri
Project	LXT Hangar 2 and Eastside Development
Project Number	47732472
Contractor	

Work to be Performed	Subcontractor	Address	Percent of Base Bid

SECTION C-450 – SCHEDULE OF MANUFACTURERS AND SUPPLIERS

Owner	City of Lee's Summit, Missouri
Project	LXT Hangar 2 and Eastside Development
Project Number	47732472
Contractor	

Item	Name of Manufacturer or Supplier

ARTICLE 1—GENERAL INFORMATION

1.01 Provide contact information for the Business:

Legal Name of Business:			
Corporate Office			
Name:		Phone number:	
Title:		Email address:	
Business address of corporate office:			
Local Office			
Name:		Phone number:	
Title:		Email address:	
Business address of local office:			

1.02 Provide information on the Business's organizational structure:

Form of Business:	<input type="checkbox"/> Sole Proprietorship <input type="checkbox"/> Partnership <input type="checkbox"/> Corporation		
<input type="checkbox"/> Limited Liability Company <input type="checkbox"/> Joint Venture comprised of the following companies:			
1.			
2.			
3.			
Provide a separate Qualification Statement for each Joint Venturer.			
Date Business was formed:		State in which Business was formed:	
Is this Business authorized to operate in the Project location?		<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Pending	

1.03 Identify all businesses that own Business in whole or in part (25% or greater), or that are wholly or partly (25% or greater) owned by Business:

Name of business:		Affiliation:	
Address:			
Name of business:		Affiliation:	
Address:			
Name of business:		Affiliation:	
Address:			

- 1.04 Provide information regarding the Business's officers, partners, and limits of authority.

Name:		Title:	
Authorized to sign contracts:	<input type="checkbox"/> Yes <input type="checkbox"/> No	Limit of Authority:	\$
Name:		Title:	
Authorized to sign contracts:	<input type="checkbox"/> Yes <input type="checkbox"/> No	Limit of Authority:	\$
Name:		Title:	
Authorized to sign contracts:	<input type="checkbox"/> Yes <input type="checkbox"/> No	Limit of Authority:	\$
Name:		Title:	

ARTICLE 2—LICENSING

- 2.01 Provide information regarding licensure for Business:

Name of License:			
Licensing Agency:			
License No:		Expiration Date:	
Name of License:			
Licensing Agency:			
License No:		Expiration Date:	

ARTICLE 3—DIVERSE BUSINESS CERTIFICATIONS

- 3.01 Provide information regarding Business's Diverse Business Certification, if any. Provide evidence of current certification.

Certification	Certifying Agency	Certification Date
<input type="checkbox"/> Disadvantaged Business Enterprise		
<input type="checkbox"/> Minority Business Enterprise		
<input type="checkbox"/> Woman-Owned Business Enterprise		
<input type="checkbox"/> Small Business Enterprise		
<input type="checkbox"/> Disabled Business Enterprise		
<input type="checkbox"/> Veteran-Owned Business Enterprise		
<input type="checkbox"/> Service-Disabled Veteran-Owned Business		
<input type="checkbox"/> HUBZone Business (Historically Underutilized) Business		
<input type="checkbox"/> Other		
<input type="checkbox"/> None		

ARTICLE 4—SAFETY

- 4.01 Provide information regarding Business's safety organization and safety performance.

Name of Business's Safety Officer:		
Safety Certifications		
Certification Name	Issuing Agency	Expiration

- 4.02 Provide Worker's Compensation Insurance Experience Modification Rate (EMR), Total Recordable Frequency Rate (TRFR) for incidents, and Total Number of Recorded Manhours (MH) for the last 3 years and the EMR, TRFR, and MH history for the last 3 years of any proposed Subcontractor(s) that will provide Work valued at 10% or more of the Contract Price. Provide documentation of the EMR history for Business and Subcontractor(s).

Year									
Company	EMR	TRFR	MH	EMR	TRFR	MH	EMR	TRFR	MH

ARTICLE 5—FINANCIAL

- 5.01 Provide information regarding the Business's financial stability. Provide the most recent audited financial statement, and if such audited financial statement is not current, also provide the most current financial statement.

Financial Institution:		
Business address:		
Date of Business's most recent financial statement:		<input type="checkbox"/> Attached
Date of Business's most recent audited financial statement:		<input type="checkbox"/> Attached
Financial indicators from the most recent financial statement		
Contractor's Current Ratio (Current Assets ÷ Current Liabilities)		
Contractor's Quick Ratio ((Cash and Cash Equivalents + Accounts Receivable + Short Term Investments) ÷ Current Liabilities)		

ARTICLE 6—SURETY INFORMATION

- 6.01 Provide information regarding the surety company that will issue required bonds on behalf of the Business, including but not limited to performance and payment bonds.

Surety Name:			
Surety is a corporation organized and existing under the laws of the state of:			
Is surety authorized to provide surety bonds in the Project location?	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Is surety listed in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" published in Department Circular 570 (as amended) by the Bureau of the Fiscal Service, U.S. Department of the Treasury? <input type="checkbox"/> Yes <input type="checkbox"/> No			
Mailing Address (principal place of business):			
Physical Address (principal place of business):			
Phone (main):		Phone (claims):	

ARTICLE 7—INSURANCE

- 7.01 Provide information regarding Business's insurance company(s), including but not limited to its Commercial General Liability carrier. Provide information for each provider.

Name of insurance provider, and type of policy (CLE, auto, etc.):			
Insurance Provider		Type of Policy (Coverage Provided)	
Are providers licensed or authorized to issue policies in the Project location?		<input type="checkbox"/> Yes <input type="checkbox"/> No	
Does provider have an A.M. Best Rating of A-VII or better?		<input type="checkbox"/> Yes <input type="checkbox"/> No	
Mailing Address (principal place of business):			
Physical Address (principal place of business):			
Phone (main):		Phone (claims):	

ARTICLE 8—CONSTRUCTION EXPERIENCE

8.01 Provide information that will identify the overall size and capacity of the Business.

Average number of current full-time employees:	
Estimate of revenue for the current year:	
Estimate of revenue for the previous year:	

8.02 Provide information regarding the Business's previous contracting experience.

Years of experience with projects like the proposed project:				
As a general contractor:		As a joint venturer:		
Has Business, or a predecessor in interest, or an affiliate identified in Paragraph 1.03:				
Been disqualified as a bidder by any local, state, or federal agency within the last 5 years? <input type="checkbox"/> Yes <input type="checkbox"/> No				
Been barred from contracting by any local, state, or federal agency within the last 5 years? <input type="checkbox"/> Yes <input type="checkbox"/> No				
Been released from a bid in the past 5 years? <input type="checkbox"/> Yes <input type="checkbox"/> No				
Defaulted on a project or failed to complete any contract awarded to it? <input type="checkbox"/> Yes <input type="checkbox"/> No				
Refused to construct or refused to provide materials defined in the contract documents or in a change order? <input type="checkbox"/> Yes <input type="checkbox"/> No				
Been a party to any currently pending litigation or arbitration? <input type="checkbox"/> Yes <input type="checkbox"/> No				
Provide full details in a separate attachment if the response to any of these questions is Yes.				

8.03 List all projects currently under contract in Schedule A and provide indicated information.

8.04 List a minimum of three and a maximum of six projects completed in the last 5 years in Schedule B and provide indicated information to demonstrate the Business's experience with projects similar in type and cost of construction.

8.05 In Schedule C, provide information on key individuals whom Business intends to assign to the Project. Provide resumes for those individuals included in Schedule C. Key individuals include the Project Manager, Project Superintendent, Quality Manager, and Safety Manager. Resumes may be provided for Business's key leaders as well.

ARTICLE 9—REQUIRED ATTACHMENTS

9.01 Provide the following information with the Statement of Qualifications:

- A. If Business is a Joint Venture, separate Qualifications Statements for each Joint Venturer, as required in Paragraph 1.02.
- B. Diverse Business Certifications if required by Paragraph 3.01.
- C. Certification of Business's safety performance if required by Paragraph 4.02.
- D. Financial statements as required by Paragraph 5.01.

- E. Attachments providing additional information as required by Paragraph 8.02.
- F. Schedule A (Current Projects) as required by Paragraph 8.03.
- G. Schedule B (Previous Experience with Similar Projects) as required by Paragraph 8.04.
- H. Schedule C (Key Individuals) and resumes for the key individuals listed, as required by Paragraph 8.05.
- I. Additional items as pertinent.

This Statement of Qualifications is offered by:

Business:

(typed or printed name of organization)

By:

(individual's signature)

Name:

(typed or printed)

Title:

(typed or printed)

Date:

(date signed)

(If Business is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest:

(individual's signature)

Name:

(typed or printed)

Title:

(typed or printed)

Address for giving notices:

Designated Representative:

Name:

(typed or printed)

Title:

(typed or printed)

Address:

Phone:

Email:

Schedule A—Current Projects

Name of Organization					
Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Schedule B—Previous Experience with Similar Projects

Name of Organization					
Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Schedule B—Previous Experience with Similar Projects

Name of Organization					
Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Schedule C—Key Individuals

Project Manager			
Name of individual			
Years of experience as project manager			
Years of experience with this organization			
Number of similar projects as project manager			
Number of similar projects in other positions			
Current Project Assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference Contact Information (listing names indicates approval to contact named individuals as a reference)			
Name		Name	
Title/Position		Title/Position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate's role on project		Candidate's role on project	
Project Superintendent			
Name of individual			
Years of experience as project superintendent			
Years of experience with this organization			
Number of similar projects as project superintendent			
Number of similar projects in other positions			
Current Project Assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference Contact Information (listing names indicates approval to contact named individuals as a reference)			
Name		Name	
Title/Position		Title/Position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate's role on project		Candidate's role on project	

Safety Manager			
Name of individual			
Years of experience as project manager			
Years of experience with this organization			
Number of similar projects as project manager			
Number of similar projects in other positions			
Current Project Assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference Contact Information (listing names indicates approval to contact named individuals as a reference)			
Name		Name	
Title/Position		Title/Position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate's role on project		Candidate's role on project	
Quality Control Manager			
Name of individual			
Years of experience as project superintendent			
Years of experience with this organization			
Number of similar projects as project superintendent			
Number of similar projects in other positions			
Current Project Assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference Contact Information (listing names indicates approval to contact named individuals as a reference)			
Name		Name	
Title/Position		Title/Position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate's role on project		Candidate's role on project	

SECTION C-480 NONCOLLUSION AFFIDAVIT

OWNER - CITY OF LEE'S SUMMIT, MISSOURI

WORK - LXT Hangar 2 and Eastside Development

PROJECT NO. - 47732472

Affiant, _____, being first duly sworn, deposes and says that:

(1) Affiant is (enter title) _____ of _____
 "the Bidder." Affiant has personal knowledge of the matters set forth in this Affidavit and is competent to testify about them.

(2) The Bidder has submitted to the City of Lee's Summit, Missouri ("the **City**"), a "Bid" to enter into the above referenced Contract, also referred to in this Affidavit as "the Work."

(3) This Noncollusion Affidavit is executed by Affiant for inclusion with the submission to the **City** of the Bid and may be relied upon by the **City** in considering the Bid.

(4) Affiant is fully informed about the preparation and contents of the Bid and of all pertinent circumstances surrounding the Bid, has not entered into any contract, combination, conspiracy or other act prohibited by federal, State or any other local Law. The Bid is genuine and is not a collusive or sham Bid.

(5) Neither the Bidder nor any of the Bidder's owners, officers, partners, directors, agents, representatives, employees or parties in interest, including this Affiant, have in any way entered or proposed to enter into any

combination to prevent the making of any Bid, or to fix any prices (including overhead, profit or other costs) for the Bid; or have made any agreement, or given or promised any consideration to induce any other person not to Bid for the Work, or to Bid at a specified price; or have secured, proposed or intended to secure through any agreement an unlawful advantage against the **City** or any other person interested in the Work.

(6) The Bid is not intended to secure an unfair advantage or benefit from the **City** or in favor of any person interested in the proposed Contract.

(7) The prices bid are fair and proper and are not tainted by any collusion, conspiracy, connivance, or unlawful agreement on the part of the Bidder or any other of the Bidder's owners, officers, partners, directors, agents, representatives, employees or parties in interest, including this Affiant; and neither the Bidder nor any of its owners, officers, partners, directors, agents, representatives, employees or parties in interest, including this Affiant, have divulged any information regarding the Bid or any data about the Bid to any other person.

By _____
 Title: _____

VERIFICATION

STATE OF _____)
) SS
 COUNTY OF _____)

Before me, a Notary Public commissioned, qualified and acting, personally appeared (enter name of the person signing this Affidavit) _____ to me well known to be the person described in and who signed this Affidavit, who being by me first duly sworn upon oath, says that he/she is the attorney-in-fact for (enter Bidder's name) _____, that he/she has been authorized by (enter name of individual, partnership name, or the authorized governing body of the Bidder) _____ to execute this Affidavit on behalf of the named Bidder in favor of the **CITY OF LEE'S SUMMIT, MISSOURI**, for the uses and purposes mentioned. Subscribed and sworn to before me this _____ day of _____, 20_____.

_____, Notary Public, My Commission expires: _____, 20_____

END OF SECTION C-480

SEAL

NOTICE OF AWARD

Date of Issuance:			
Owner:	City of Lee's Summit, Missouri	Owner's Project No.:	47732472
Engineer:	Crawford, Murphy, & Tilly, Inc.	Engineer's Project No.:	22001238
Project:	LXT Hangar 2 and Eastside Development		
Contract Name:	LXT Hangar 2 and Eastside Development		
Bidder:			
Bidder's Address:			

You are notified that Owner has accepted your Bid dated **[date]** for the above Contract, and that you are the Successful Bidder and are awarded a Contract for:

[Describe Work, alternates, or sections of Work awarded]

The Contract Price of the awarded Contract is \$**[Contract Price]**. Contract Price is subject to adjustment based on the provisions of the Contract, including but not limited to those governing changes, Unit Price Work, and Work performed on a cost-plus-fee basis, as applicable.

One electronic copy of the unexecuted counterparts of the Agreement accompany this Notice of Award, and one copy of the Contract Documents (except drawings) accompany this Notice of Award, or has been transmitted or made available to Bidder electronically.

☐ Drawings will be delivered separately from the other Contract Documents.

You must comply with the following conditions precedent within 15 days of the date of receipt of this Notice of Award:

1. Deliver to Owner **three** counterparts of the Agreement, signed by Bidder (as Contractor).
2. Deliver with the signed Agreement(s) the Contract security (such as required performance and payment bonds) and insurance documentation, as specified in the Instructions to Bidders and in the General Conditions, Articles 2 and 6.
3. Ensure there is a current Lee's Summit Business License for your company and all subcontractors. Contact the Construction Project Manager for more information about obtaining a business license.

Failure to comply with these conditions within the time specified will entitle Owner to consider you in default, annul this Notice of Award, and declare your Bid security forfeited.

Within 10 days after you comply with the above conditions, Owner will return to you one fully signed counterpart of the Agreement, together with any additional copies of the Contract Documents as indicated in Paragraph 2.02 of the General Conditions.

Owner: **City of Lee's Summit, Missouri**

By (signature): _____

Name (printed): **Mike Anderson**

Title: **City Engineer**

Copy: Engineer

AGREEMENT BETWEEN OWNER AND CONTRACTOR FOR CONSTRUCTION CONTRACT (STIPULATED PRICE)

This Agreement is by and between **the City of Lee's Summit, Missouri** ("Owner") and **[name of contracting entity]** ("Contractor").

Terms used in this Agreement have the meanings stated in the General Conditions and the Supplementary Conditions.

Owner and Contractor hereby agree as follows:

ARTICLE 1—WORK

1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows: LXT Hangar 2 and Eastside Development

ARTICLE 2—THE PROJECT

2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: LXT Hangar 2 and Eastside Development

ARTICLE 3—ENGINEER

3.01 The Owner has retained Crawford, Murphy, & Tilly, Inc. ("Engineer") to act as Owner's representative, assume all duties and responsibilities of Engineer, and have the rights and authority assigned to Engineer in the Contract, except as described in Paragraph 3.03 of this Agreement.

3.02 The part of the Project that pertains to the Work has been designed by Crawford, Murphy, & Tilly, Inc.

3.03 The Owner shall be responsible for handling the following matters notwithstanding the fact that certain portions of the Contract Documents may list the Engineer as having responsibility for said matters:

- A. Furnish a Resident Project Representative;
- B. Change of Working Hours;
- C. Make Determinations for Unit Price Work (determine quantities and classifications);
- D. Field orders, Work Change Directives, Change Orders;
- E. Progress Payments;
- F. Monitor Contractor's schedule, progress, schedule and conduct progress meetings;
- G. Receive in writing questions from the Contractor regarding all matters concerning the requirements of the Contract Documents (sometimes referred to as requests for information or

- interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents;
- H. The Owner will be the initial interpreter of the requirements of the Contract Documents;
 - I. The Owner will render decision regarding the requirements of the Contract Documents;
 - J. The Owner will judge of the acceptability of the Work; and
 - K. Coordinate construction services provided by the Engineer as needed.

In the event that portions of the Contract Documents indicate that the Engineer is to handle, provide input, or receive notices or filings with regard to any of the above referenced matters, this Article 3 shall prevail.

ARTICLE 4—CONTRACT TIMES

4.01 *Time is of the Essence*

- A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

4.02 *Contract Times: Days*

- A. The Work will be substantially complete within **420** days after the date when the Contract Times commence to run as provided in Paragraph 4.01 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within **90 days after Substantial Completion**.

4.03 *Milestones*

- A. Completion of the punch list attached to the Certificate of Substantial Completion shall be achieved within 30 days after Substantial Completion.
- B. Parts of the Work must be substantially completed on or before the following Milestone(s). See CAP Notes Plan Sheet for Details
 - 1. Phase 1: Facility Development: Shall be completed within the Overall Calendar Day Allotment for this project
 - 2. Phase 2: Site Work: Shall be completed in **150 calendar days** from NTP for this project
 - 3. Phase 3: Electrical Vault Work: Temporary shutdown to vault shall be completed in within **1 Calendar Day** (during daylight hours only)

4.04 *Liquidated Damages*

- A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the Contract Times, as duly modified. The parties also recognize the delays, expense, and difficulties involved in proving, in a legal or arbitration proceeding, the actual loss suffered by Owner if the Work is not completed on time.

Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):

1. *Substantial Completion:* Contractor shall pay Owner **\$500** for each day that expires after the time (as duly adjusted pursuant to the Contract) specified above for Substantial Completion, until the Work is substantially complete.
2. *Completion of Remaining Work:* After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner **\$500** for each day that expires after such time until the Work is completed and ready for final payment.

Milestones:

- a. Phase 1: Facility Development: There is no phase-specific liquidated damages for Phase 1: Facility Development however the phase shall be completed within the overall calendar day allotment for this project and is subject to the associated liquidated damages
 - b. Phase 2: Site Work: Contractor shall pay Owner **\$500** for each day that expires after the time (as duly adjusted pursuant to the Contract) specified above for Phase 2: Site Work reflected in Paragraph 4.03.B, or until the time specified for Substantial Completion is reached, at which time the rate indicated in Paragraph 4.04.A.1 will apply, rather than this Milestone rate.
 - c. Phase 3: Electrical Vault Work: Contractor shall pay Owner **\$500** for each day that expires after the time (as duly adjusted pursuant to the Contract) specified above for Phase 3: Electrical Vault Work reflected in Paragraph 4.03.B, or until the time specified for Substantial Completion is reached, at which time the rate indicated in Paragraph 4.04.A.1 will apply, rather than this Milestone rate.
3. Liquidated damages for failing to timely attain Milestones, Substantial Completion, and final completion are not additive, and will not be imposed concurrently.
- B. If Owner recovers liquidated damages for a delay in completion by Contractor, then such liquidated damages are Owner's sole and exclusive remedy for such delay, and Owner is precluded from recovering any other damages, whether actual, direct, excess, or consequential, for such delay, except for special damages (if any) specified in this Agreement.

ARTICLE 5—CONTRACT PRICE

- 5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents, the amounts that follow, subject to adjustment under the Contract:
- B. For all Unit Price Work, an amount equal to the sum of the extended prices (established for each separately identified item of Unit Price Work by multiplying the unit price times the actual quantity of that item).

Unit Price Work					
Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Bid Amount
1	Mobilization	LS	1		
2	Temporary Traffic Control	LS	1		
3	Removal of Concrete Curb and Gutter	LF	211		
4	Removal of Chain Link Fence	LF	761		
5	12" Filter Sock	LF	1,345		
6	Inlet Protection	EA	31		
7	Erosion Control Blanket	SY	23,138		
8	Turf Reinforcement Mat (Basin Emergency Spillway)	SY	500		
9	Rip Rap	SY	86		
10	Excavation - Aggregate or Soil Material Recycled On-Site	CY	36,751		
11	8' Black Vinyl Chain Link Fence with Barbed Wire	LF	1,600		
12	32' Electric Black Vinyl Bi-Directional Rolling Gate System	LS	1		
13	18' Electric Black Vinyl Bi-Directional Rolling Gate System	LS	1		
14	Cement (Soil Stabilization)	TON	382		
15	12" 6% Cement-Treated Subgrade	SY	16,057		
16	4" Compacted Aggregate Base Course	SY	11,520		
17	6" Compacted Aggregate Base Course	SY	5,674		
18	8" Portland Cement Concrete Pavement	SY	10,375		
19	11" Portland Cement Concrete Pavement	SY	1,022		
20	4" Portland Cement Concrete Sidewalk	SY	1,146		
21	Type CG-1 Concrete Curb and Gutter	LF	3,937		
22	ADA Curb Ramp	EA	9		

23	Concrete Wheel Stops	EA	4		
24	4" Double Yellow Centerline Waterborne Markings	LF	1,083		
25	4" Yellow Parking Stall Waterborne Markings	LF	1,300		
26	Yellow Parking Stall Hatch Waterborne Markings	LF	390		
27	Thermoplastic White 24" Crosswalk Markings	LF	274		
28	Thermoplastic White Stop Bar Markings	EA	8		
29	Thermoplastic ADA Accessible Parking Symbol Markings	EA	4		
30	Waterborne Fire Lane Pavement Markings	EA	2		
31	8" PVC Storm Line	LF	590		
32	15" PVC Storm Line	LF	93		
33	18" Inline Drain With Standard Grate	EA	1		
34	15" Reinforced Concrete Pipe (Class IV)	LF	113		
35	18" Reinforced Concrete Pipe (Class IV)	LF	949		
36	24" Reinforced Concrete Pipe (Class IV)	LF	697		
37	30" Reinforced Concrete Pipe (Class IV)	LF	492		
38	42" Reinforced Concrete Pipe (Class IV)	LF	572		
39	Flared End Section For Stormwater Basin	EA	1		
40	42" Flared End Section	EA	1		
41	New Junction Structure	EA	1		
42	New Curb Inlets	EA	27		
43	New Turf Inlet	EA	3		
44	Stormwater Basin Outlet Structures	EA	2		
45	Accessible Parking Stall Sign and Post	EA	4		
46	Roadway Sign with Post and Mow Pad	EA	11		
47	Seeding	AC	8.5		
48	Topsoiling (6")	SY	64,404		

49	Mulching	AC	8.5		
50	2 x #6 XLP-USE, #12 GND in 1" Conduit (New Street Lighting Circuit)	LF	1,860		
51	2 x #4 XLP-USE, 1 x #6 GND in 1" Conduit (New Apron Lighting Circuit)	LF	380		
52	Electrical Demolition	LS	1		
53	6" PVC Sanitary Sewer	LF	441		
54	8" PVC Sanitary Sewer	LF	1,491		
55	Sanitary Sewer Cleanouts	EA	4		
56	Sanitary Sewer Manholes	EA	6		
57	Proposed Oil Interceptor	LS	1		
58	2" Domestic Water Line Installation	LF	207		
59	8" Water Main Installation	LF	352		
60	10" Water Main Installation	LF	253		
61	12" Water Main Installation	LF	1,641		
62	Fire Hydrant Assembly (with New Hydrant)	EA	9		
63	Water Line Bends with Thrust Blocking	EA	16		
64	Water Line Tees with Thrust Blocking	EA	5		
65	Water Line Valves	EA	13		
66	Domestic Water Line Connection with Curb Stop	EA	1		
67	Water Meter Installation	EA	1		
68	Backflow Prevention Vault	LS	1		
69	Landscaping Improvements	LS	1		
70	Hangar 2 (excluding LSR7 Components)	LS	1		
71	LSR7 Components of Hangar 2	LS	1		
72	New Luminaire With Mast Arm on Light Pole	EA	16		

73	48" Reinforced Concrete Pipe (Class IV)	LF	140		
74	48" Flared End Section	EA	2		
Total of all Extended Prices for Unit Price Work (subject to final adjustment based on actual quantities)					\$

The extended prices for Unit Price Work set forth as of the Effective Date of the Contract are based on estimated quantities. As provided in Paragraph 13.03 of the General Conditions, estimated quantities are not guaranteed, and determinations of actual quantities and classifications are to be made by Owner.

- C. Total of Unit Price Work (subject to final Unit Price adjustment): \$
- Total of Contingency Allowances (subject to final adjustment): \$
- Total of Accepted Additive Alternates (subject to Owner approval): \$
- Total: \$

ARTICLE 6—PAYMENT PROCEDURES

6.01 Submittal and Processing of Payments

- A. Contractor shall submit Applications for Payment in accordance with Article 15 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

6.02 Progress Payments; Retainage

- A. Owner shall make progress payments on the basis of Contractor's Applications for Payment monthly during performance of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.
1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract.
 - a. 95 percent of the value of the Work completed (with the balance being retainage).
 - b. 95 percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).

- B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to 95 percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less 150 percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.

6.03 *Final Payment*

- A. Upon final completion and acceptance of the Work, Owner shall pay the remainder of the Contract Price in accordance with Paragraph 15.06 of the General Conditions.

6.04 *Consent of Surety*

- A. Owner will not make final payment, or return or release retainage at Substantial Completion or any other time, unless Contractor submits written consent of the surety to such payment, return, or release.

6.05 *Interest*

- A. All amounts not paid when due will bear interest at the rate as specified by Missouri State Statute, RSMo 8.960.

ARTICLE 7—CONTRACT DOCUMENTS

7.01 *Contents*

- A. The Contract Documents consist of all of the following:
 - 1. This Agreement.
 - 2. Bonds:
 - a. Performance bond (together with power of attorney).
 - b. Payment bond (together with power of attorney).
 - 3. General Conditions.
 - 4. Supplementary Conditions.
 - 5. Specifications as listed in the table of contents of the project manual (copy of list attached).
 - 6. Drawings (not attached but incorporated by reference) consisting of 131 sheets with each sheet bearing the following general title: LXT Hangar 2 and Eastside Development.
 - 7. Addenda (numbers _____ to _____ , inclusive).
 - 8. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
 - a. Notice to Proceed.
 - b. Work Change Directives.
 - c. Change Orders.
 - d. Field Orders.
 - e. Warranty Bond, if any.

- B. The Contract Documents listed in Paragraph 7.01.A are attached to this Agreement (except as expressly noted otherwise above).
- C. There are no Contract Documents other than those listed above in this Article 7.
- D. The Contract Documents may only be amended, modified, or supplemented as provided in the Contract.

ARTICLE 8—REPRESENTATIONS, CERTIFICATIONS, AND STIPULATIONS

8.01 Contractor's Representations

- A. In order to induce Owner to enter into this Contract, Contractor makes the following representations:
 - 1. Contractor has examined and carefully studied the Contract Documents, including Addenda.
 - 2. Contractor has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
 - 3. Contractor is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.
 - 4. Contractor has carefully studied the reports of explorations and tests of subsurface conditions, if any, at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.
 - 5. Contractor has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, with respect to Technical Data in such reports and drawings.
 - 6. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (c) Contractor's safety precautions and programs.
 - 7. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
 - 8. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.

9. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
10. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
11. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

8.02 *Contractor's Certifications*

- A. Pursuant to Section 34.600, RSMo., and to the fullest extent permitted by law, Contractor certifies that it is not engaged in a boycott of Israel as of the Effective Date of this Agreement, and agrees for the duration of this Agreement to not engage in a boycott of Israel.
- B. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 8.02:
 1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process or in the Contract execution;
 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and
 4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

8.03 *Standard General Conditions*

- A. Owner stipulates that if the General Conditions that are made a part of this Contract are EJCDC® C-700, Standard General Conditions for the Construction Contract (2018), published by the Engineers Joint Contract Documents Committee, and if Owner is the party that has furnished said General Conditions, then Owner has plainly shown all modifications to the standard wording of such published document to the Contractor, through a process such as highlighting or "track changes" (redline/strikeout), or in the Supplementary Conditions.

8.04 *Other Provisions*

- A. This Agreement and all work related to this Project shall be governed by the laws of the State of Missouri and shall be litigated and/or mediated in Jackson County, Missouri.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

This Agreement will be effective on _____ (which is the Effective Date of the Contract).

Owner:

Contractor:

(typed or printed name of organization)

By:

(individual's signature)

Date:

(date signed)

Name:

(typed or printed)

Title:

(typed or printed)

Attest:

(individual's signature)

Title:

(typed or printed)

Address for giving notices:

Designated Representative:

Name:

(typed or printed)

Title:

(typed or printed)

Address:

Phone:

Email:

(If **[Type of Entity]** is a corporation, attach evidence of authority to sign. If **[Type of Entity]** is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)

(typed or printed name of organization)

By:

(individual's signature)

Date:

(date signed)

Name:

(typed or printed)

Title:

(typed or printed)

Attest:

(individual's signature)

Title:

(typed or printed)

Address for giving notices:

Designated Representative:

Name:

(typed or printed)

Title:

(typed or printed)

Address:

Phone:

Email:

License No.:

(where applicable)

State:

NOTICE TO PROCEED

Owner:	City of Lee's Summit, Missouri	Owner's Project No.:	47732472
Engineer:	Crawford, Murphy, & Tilly, Inc.	Engineer's Project No.:	22001238
Contractor:		Contractor's Project No.:	
Project:	LXT Hangar 2 and Eastside Development		
Contract Name:	LXT Hangar 2 and Eastside Development		
Effective Date of Contract:			

Owner hereby notifies Contractor that the Contract Times under the above Contract will commence to run on _____ pursuant to Paragraph 4.01 of the General Conditions and as amended in Supplementary Conditions.

On that date, Contractor shall start performing its obligations under the Contract Documents. No Work will be done at the Site prior to such date.

In accordance with the Agreement:

The number of days to achieve Substantial Completion is _____ **Calendar Days** from the date stated above for the commencement of the Contract Times, resulting in a date for Substantial Completion of _____; and the number of days to achieve readiness for final payment is _____ **Calendar Days** from the commencement date of the Contract Times, resulting in a date for readiness for final payment of _____.

Owner: City of Lee's Summit, Missouri

By (signature): _____

Name (printed): Mike Anderson

Title: City Engineer

Date Issued: _____

Copy: Engineer

PERFORMANCE BOND

Contractor Name: Address <i>(principal place of business)</i> :	Surety Name: Address <i>(principal place of business)</i> :
Owner Name: City of Lee's Summit, Missouri Mailing address <i>(principal place of business)</i> : 220 SE Green Street Lee's Summit, Missouri 64063	Contract Description <i>(name and location)</i> : LXT Hangar 2 and Eastside Development Lee's Summit Municipal Airport 2751 NE Douglas St, Lees Summit, MO 64064 Contract Price: Effective Date of Contract:
Bond Bond Amount: Date of Bond: <i>(Date of Bond cannot be earlier than Effective Date of Contract)</i> Modifications to this Bond form: <input type="checkbox"/> None <input type="checkbox"/> See Paragraph 16	
Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Performance Bond, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.	
Contractor as Principal	Surety
<i>(Full formal name of Contractor)</i>	<i>(Full formal name of Surety) (corporate seal)</i>
By: _____ <div style="text-align: center;"><i>(Signature)</i></div>	By: _____ <div style="text-align: center;"><i>(Signature)(Attach Power of Attorney)</i></div>
Name: _____ <div style="text-align: center;"><i>(Printed or typed)</i></div>	Name: _____ <div style="text-align: center;"><i>(Printed or typed)</i></div>
Title: _____	Title: _____
Attest: _____ <div style="text-align: center;"><i>(Signature)</i></div>	Attest: _____ <div style="text-align: center;"><i>(Signature)</i></div>
Name: _____ <div style="text-align: center;"><i>(Printed or typed)</i></div>	Name: _____ <div style="text-align: center;"><i>(Printed or typed)</i></div>
Title: _____	Title: _____
<i>Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.</i>	

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.
2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.
3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond will arise after:
 - 3.1. The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice may indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 will be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement does not waive the Owner's right, if any, subsequently to declare a Contractor Default;
 - 3.2. The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and
 - 3.3. The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.
4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 does not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.
5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:
 - 5.1. Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;
 - 5.2. Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;
 - 5.3. Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or
 - 5.4. Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:

- 5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or
 - 5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.
- 6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment, or the Surety has denied liability, in whole or in part, without further notice, the Owner shall be entitled to enforce any remedy available to the Owner.
- 7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner will not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety will not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:
 - 7.1. the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;
 - 7.2. additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and
 - 7.3. liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.
- 8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.
- 9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price will not be reduced or set off on account of any such unrelated obligations. No right of action will accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.
- 10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.
- 11. Any proceeding, legal or equitable, under this Bond must be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and must be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit will be applicable.
- 12. Notice to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears.
- 13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted therefrom and provisions conforming to such

statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.

14. Definitions

- 14.1. *Balance of the Contract Price*—The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.
 - 14.2. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.
 - 14.3. *Contractor Default*—Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.
 - 14.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.
 - 14.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.
15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.
16. Modifications to this Bond are as follows: **None**

PAYMENT BOND

Contractor Name: Address <i>(principal place of business)</i> :	Surety Name: Address <i>(principal place of business)</i> :
Owner Name: City of Lee's Summit, Missouri Mailing address <i>(principal place of business)</i> : 220 SE Green Street Lee's Summit, Missouri 64063	Contract Name: LXT Hangar 2 and Eastside Development Lee's Summit Municipal Airport 2751 NE Douglas St, Lees Summit, MO 64064 Contract Price: Effective Date of Contract:
Bond Bond Amount: Date of Bond: <i>(Date of Bond cannot be earlier than Effective Date of Contract)</i> Modifications to this Bond form: <input type="checkbox"/> None <input type="checkbox"/> See Paragraph 18	
Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Payment Bond, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.	
Contractor as Principal	Surety
<i>(Full formal name of Contractor)</i>	<i>(Full formal name of Surety) (corporate seal)</i>
By: _____ <div style="text-align: center;"><i>(Signature)</i></div>	By: _____ <div style="text-align: center;"><i>(Signature)(Attach Power of Attorney)</i></div>
Name: _____ <div style="text-align: center;"><i>(Printed or typed)</i></div>	Name: _____ <div style="text-align: center;"><i>(Printed or typed)</i></div>
Title: _____	Title: _____
Attest: _____ <div style="text-align: center;"><i>(Signature)</i></div>	Attest: _____ <div style="text-align: center;"><i>(Signature)</i></div>
Name: _____ <div style="text-align: center;"><i>(Printed or typed)</i></div>	Name: _____ <div style="text-align: center;"><i>(Printed or typed)</i></div>
Title: _____	Title: _____
<i>Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.</i>	

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.
2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.
3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond will arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.
4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.
5. The Surety's obligations to a Claimant under this Bond will arise after the following:
 - 5.1. Claimants who do not have a direct contract with the Contractor
 - 5.1.1. have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and
 - 5.1.2. have sent a Claim to the Surety (at the address described in Paragraph 13).
 - 5.2. Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).
6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.
7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:
 - 7.1. Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and
 - 7.2. Pay or arrange for payment of any undisputed amounts.
 - 7.3. The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 will not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

8. The Surety's total obligation will not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond will be credited for any payments made in good faith by the Surety.
9. Amounts owed by the Owner to the Contractor under the Construction Contract will be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfying obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.
10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.
11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.
12. No suit or action will be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit will be applicable.
13. Notice and Claims to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, will be sufficient compliance as of the date received.
14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted here from and provisions conforming to such statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.
15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.
16. Definitions
 - 16.1. *Claim*—A written statement by the Claimant including at a minimum:
 - 16.1.1. The name of the Claimant;
 - 16.1.2. The name of the person for whom the labor was done, or materials or equipment furnished;
 - 16.1.3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;
 - 16.1.4. A brief description of the labor, materials, or equipment furnished;

- 16.1.5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
 - 16.1.6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
 - 16.1.7. The total amount of previous payments received by the Claimant; and
 - 16.1.8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.
- 16.2. *Claimant*—An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond is to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.
- 16.3. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.
- 16.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.
- 16.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.
17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.
18. Modifications to this Bond are as follows: **None**

CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner:	City of Lee's Summit	Owner's Project No.:	47732472
Engineer:	Crawford, Murphy, & Tilly, Inc.	Engineer's Project No.:	22001238
Contractor:		Contractor's Project No.:	
Project:	LXT Hangar 2 and Eastside Development		
Contract Name:	LXT Hangar 2 and Eastside Development		

This ☐ Preliminary ☐ Final Certificate of Substantial Completion applies to:

☐ All Work ☐ The following specified portions of the Work:

Date of Substantial Completion:

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Work or portion thereof designated above is hereby established, subject to the provisions of the Contract pertaining to Substantial Completion. The date of Substantial Completion in the final Certificate of Substantial Completion marks the commencement of the contractual correction period and applicable warranties required by the Contract.

A punch list of items to be completed or corrected is attached to this Certificate. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see Paragraph 15.03.D of the General Conditions.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance, and warranties upon Owner's use or occupancy of the Work must be as provided in the Contract, except as amended as follows:

Amendments to Owner's Responsibilities: ☐ None ☐ As follows:

Amendments to Contractor's Responsibilities: ☐ None ☐ As follows:

The following documents are attached to and made a part of this Certificate:

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents, nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract Documents.

Engineer

By (signature): _____

Name (printed): _____

Title: _____

NOTICE OF ACCEPTABILITY OF WORK

Owner:	City of Lee's Summit	Owner's Project No.:	47732472
Engineer:	Crawford, Murphy, & Tilly, Inc.	Engineer's Project No.:	22001238
Contractor:		Contractor's Project No.:	
Project:	LXT Hangar 2 and Eastside Development		
Contract Name:	LXT Hangar 2 and Eastside Development		
Notice Date:		Effective Date of the Construction Contract:	

The Engineer hereby gives notice to the Owner and Contractor that Engineer recommends final payment to Contractor, and that the Work furnished and performed by Contractor under the Construction Contract is acceptable, expressly subject to the provisions of the Construction Contract's Contract Documents ("Contract Documents") and of the Agreement between Owner and Engineer for Professional Services dated _____ ("Owner-Engineer Agreement"). This Notice of Acceptability of Work (Notice) is made expressly subject to the following terms and conditions to which all who receive and rely on said Notice agree:

1. This Notice has been prepared with the skill and care ordinarily used by members of the engineering profession practicing under similar conditions at the same time and in the same locality.
2. This Notice reflects and is an expression of the Engineer's professional opinion.
3. This Notice has been prepared to the best of Engineer's knowledge, information, and belief as of the Notice Date.
4. This Notice is based entirely on and expressly limited by the scope of services Engineer has been employed by Owner to perform or furnish during construction of the Project (including observation of the Contractor's Work) under the Owner-Engineer Agreement, and applies only to facts that are within Engineer's knowledge or could reasonably have been ascertained by Engineer as a result of carrying out the responsibilities specifically assigned to Engineer under such Owner-Engineer Agreement.
5. This Notice is not a guarantee or warranty of Contractor's performance under the Construction Contract, an acceptance of Work that is not in accordance with the Contract Documents, including but not limited to defective Work discovered after final inspection, nor an assumption of responsibility for any failure of Contractor to furnish and perform the Work thereunder in accordance with the Contract Documents, or to otherwise comply with the Contract Documents or the terms of any special guarantees specified therein.
6. This Notice does not relieve Contractor of any surviving obligations under the Construction Contract, and is subject to Owner's reservations of rights with respect to completion and final payment.

Engineer

By *(signature)*: _____

Name *(printed)*: _____

Title: _____

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared By



Endorsed By



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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

- A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids, which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
 2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.
 3. *Application for Payment*—The document prepared by Contractor, in a form acceptable to Engineer, to request progress or final payments, and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
 4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
 5. *Bidder*—An individual or entity that submits a Bid to Owner.
 6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.
 7. *Bidding Requirements*—The Advertisement or Invitation to Bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.
 8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.
 9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.
 10. *Claim*
 - a. A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment of Contract Price or Contract Times; contesting an initial decision by Engineer concerning the

requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract.

- b. A demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal, or seeking resolution of a contractual issue that Engineer has declined to address.
 - c. A demand or assertion by Owner or Contractor, duly submitted in compliance with the procedural requirements set forth herein, made pursuant to Paragraph 12.01.A.4, concerning disputes arising after Engineer has issued a recommendation of final payment.
 - d. A demand for money or services by a third party is not a Claim.
- 11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), lead-based paint (as defined by the HUD/EPA standard), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to Laws and Regulations regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.
 - 12. *Contract*—The entire and integrated written contract between Owner and Contractor concerning the Work.
 - 13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.
 - 14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents.
 - 15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.
 - 16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.
 - 17. *Cost of the Work*—See Paragraph 13.01 for definition.
 - 18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.
 - 19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.
 - 20. *Electronic Document*—Any Project-related correspondence, attachments to correspondence, data, documents, drawings, information, or graphics, including but not limited to Shop Drawings and other Submittals, that are in an electronic or digital format.
 - 21. *Electronic Means*—Electronic mail (email), upload/download from a secure Project website, or other communications methods that allow: (a) the transmission or communication of Electronic Documents; (b) the documentation of transmissions, including sending and receipt; (c) printing of the transmitted Electronic Document by the

recipient; (d) the storage and archiving of the Electronic Document by sender and recipient; and (e) the use by recipient of the Electronic Document for purposes permitted by this Contract. Electronic Means does not include the use of text messaging, or of Facebook, Twitter, Instagram, or similar social media services for transmission of Electronic Documents.

22. *Engineer*—The individual or entity named as such in the Agreement.
23. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.
24. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto.
 - a. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated into the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, is not a Hazardous Environmental Condition.
 - b. The presence of Constituents of Concern that are to be removed or remediated as part of the Work is not a Hazardous Environmental Condition.
 - c. The presence of Constituents of Concern as part of the routine, anticipated, and obvious working conditions at the Site, is not a Hazardous Environmental Condition.
25. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and binding decrees, resolutions, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
26. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.
27. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date, or by a time prior to Substantial Completion of all the Work.
28. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.
29. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.
30. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.
31. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising Contractor's plan to accomplish the Work within the Contract Times.
32. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.

33. *Resident Project Representative*—The authorized representative of ~~Engineer~~ Owner assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative (RPR) includes any assistants or field staff of Resident Project Representative.
34. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.
35. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer’s review of the submittals.
36. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor’s Applications for Payment.
37. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.
38. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands or areas furnished by Owner which are designated for the use of Contractor.
39. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.
40. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.
41. *Submittal*—A written or graphic document, prepared by or for Contractor, which the Contract Documents require Contractor to submit to Engineer, or that is indicated as a Submittal in the Schedule of Submittals accepted by Engineer. Submittals may include Shop Drawings and Samples; schedules; product data; Owner-delegated designs; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or Site quality-control testing and inspections; warranties and certifications; Suppliers’ instructions and reports; records of delivery of spare parts and tools; operations and maintenance data; Project photographic documentation; record documents; and other such documents required by the Contract Documents. Submittals, whether or not approved or accepted by Engineer, are not Contract Documents. Change Proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.
42. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion of such Work.

43. *Successful Bidder*—The Bidder to which the Owner makes an award of contract.
44. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.
45. *Supplier*—A manufacturer, fabricator, supplier, distributor, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.
46. *Technical Data*
- a. Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (1) existing subsurface conditions at or adjacent to the Site, or existing physical conditions at or adjacent to the Site including existing surface or subsurface structures (except Underground Facilities) or (2) Hazardous Environmental Conditions at the Site.
 - b. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then Technical Data is defined, with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06, as the data contained in boring logs, recorded measurements of subsurface water levels, assessments of the condition of subsurface facilities, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical, environmental, or other Site or facilities conditions report prepared for the Project and made available to Contractor.
 - c. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data, and instead Underground Facilities are shown or indicated on the Drawings.
47. *Underground Facilities*—All active or not-in-service underground lines, pipelines, conduits, ducts, encasements, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or systems at the Site, including but not limited to those facilities or systems that produce, transmit, distribute, or convey telephone or other communications, cable television, fiber optic transmissions, power, electricity, light, heat, gases, oil, crude oil products, liquid petroleum products, water, steam, waste, wastewater, storm water, other liquids or chemicals, or traffic or other control systems. An abandoned facility or system is not an Underground Facility.
48. *Unit Price Work*—Work to be paid for on the basis of unit prices.
49. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.
50. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

1.02 Terminology

- A. The words and terms discussed in Paragraphs 1.02.B, C, D, and E are not defined terms that require initial capital letters, but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.
- B. *Intent of Certain Terms or Adjectives:* The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.
- C. *Day:* The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.
- D. *Defective:* The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - 1. does not conform to the Contract Documents;
 - 2. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 - 3. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or Paragraph 15.04).
- E. *Furnish, Install, Perform, Provide*
 - 1. The word “furnish,” when used in connection with services, materials, or equipment, means to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
 - 2. The word “install,” when used in connection with services, materials, or equipment, means to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
 - 3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, means to furnish and install said services, materials, or equipment complete and ready for intended use.
 - 4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words “furnish,” “install,” “perform,” or “provide,” then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

- F. *Contract Price or Contract Times*: References to a change in “Contract Price or Contract Times” or “Contract Times or Contract Price” or similar, indicate that such change applies to (1) Contract Price, (2) Contract Times, or (3) both Contract Price and Contract Times, as warranted, even if the term “or both” is not expressed.
- G. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2—PRELIMINARY MATTERS

2.01 *Delivery of Performance and Payment Bonds; Evidence of Insurance*

- A. *Performance and Payment Bonds*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner the performance bond and payment bond (if the Contract requires Contractor to furnish such bonds).
- B. *Evidence of Contractor’s Insurance*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each additional insured (as identified in the Contract), the certificates, endorsements, and other evidence of insurance required to be provided by Contractor in accordance with Article 6, except to the extent the Supplementary Conditions expressly establish other dates for delivery of specific insurance policies.

2.02 *Copies of Documents*

- A. Owner shall furnish to Contractor two fully signed counterparts of the Contract Agreement, and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.
- B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 *Before Starting Construction*

- A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise required by the Contract Documents), Contractor shall submit to Engineer for timely review:
 - 1. a preliminary Progress Schedule (per Section 01110) indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;
 - 2. a preliminary Schedule of Submittals; and
 - 3. a preliminary Schedule of Values (as required for lump sum Bids) for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

- A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work, and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other Submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.
- B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 *Acceptance of Schedules*

- A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review the schedules submitted in accordance with Paragraph 2.03.A. No progress payment will be made to Contractor until acceptable schedules are submitted to Engineer.
 - 1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.
 - 2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
 - 3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.
 - 4. If a schedule is not acceptable, Contractor will have an additional 10 days to revise and resubmit the schedule.

2.06 *Electronic Transmittals*

- A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may send, and shall accept, Electronic Documents transmitted by Electronic Means.
- B. If the Contract does not establish protocols for Electronic Means, then Owner, Engineer, and Contractor shall jointly develop such protocols.
- C. Subject to any governing protocols for Electronic Means, when transmitting Electronic Documents by Electronic Means, the transmitting party makes no representations as to long-term compatibility, usability, or readability of the Electronic Documents resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the Electronic Documents.

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one Contract Document is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents.
- C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic versions of the Contract Documents (including any printed copies derived from such electronic versions) and the printed record version, the printed record version will govern.
- D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.
- E. ~~Engineer~~ Owner will issue clarifications and interpretations of the Contract Documents as provided herein.
- F. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation will be deemed stricken, and all remaining provisions will continue to be valid and binding upon Owner and Contractor, which agree that the Contract Documents will be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.
- G. Nothing in the Contract Documents creates:
 - 1. any contractual relationship between Owner or Engineer and any Subcontractor, Supplier, or other individual or entity performing or furnishing any of the Work, for the benefit of such Subcontractor, Supplier, or other individual or entity; or
 - 2. any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity, except as may otherwise be required by Laws and Regulations.

3.02 *Reference Standards*

- A. *Standards Specifications, Codes, Laws and Regulations*
 - 1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, means the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.
 - 2. No provision of any such standard specification, manual, reference standard, or code, and no instruction of a Supplier, will be effective to change the duties or responsibilities of Owner, Contractor, or Engineer from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner or Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility

inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies*

1. *Contractor's Verification of Figures and Field Measurements:* Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict, error, ambiguity, or discrepancy is resolved by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.
2. *Contractor's Review of Contract Documents:* If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.
3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:
 - a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or
 - b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Requirements of the Contract Documents*

- A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer in writing all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, within 30 days after such matters arise. ~~Engineer~~ Owner will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work.

- B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.
- C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly notify Owner and Contractor in writing that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

- A. Contractor and its Subcontractors and Suppliers shall not:
 - 1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media versions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or
 - 2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.
- B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein precludes Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

- A. The Contract Times will commence to run on the 30th day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. Unless mutually agreed upon in writing between Owner and Contractor then in no event will the Contract Times commence to run later than the 60th day after the day of Bid opening or the 30th day after the Effective Date of the Contract, whichever date is earlier.

4.02 *Starting the Work*

- A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work may be done at the Site prior to such date.

4.03 *Reference Points*

- A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the

established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.04 *Progress Schedule*

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.
 - 1. Contractor shall submit to ~~Engineer~~ Owner for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.
 - 2. Proposed adjustments in the Progress Schedule that will change the Contract Times must be submitted in accordance with the requirements of Article 11.
- B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work will be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

- A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times.
- B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.
- C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Such an adjustment will be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:
 - 1. Severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;
 - 2. Abnormal weather conditions as described in Supplementary Conditions;
 - 3. Acts or failures to act of third-party utility owners or other third-party entities (other than those third-party utility owners or other third-party entities performing other work at or adjacent to the Site as arranged by or under contract with Owner, as contemplated in Article 8); and
 - 4. Acts of war or terrorism.

- D. Contractor's entitlement to an adjustment of Contract Times or Contract Price is limited as follows:
1. Contractor's entitlement to an adjustment of the Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of the Work, as of the time of the delay, disruption, or interference.
 2. Contractor shall not be entitled to an adjustment in Contract Price for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor. Such a concurrent delay by Contractor shall not preclude an adjustment of Contract Times to which Contractor is otherwise entitled.
 3. Adjustments of Contract Times or Contract Price are subject to the provisions of Article 11.
- E. Each Contractor request or Change Proposal seeking an increase in Contract Times or Contract Price must be supplemented by supporting data that sets forth in detail the following:
1. The circumstances that form the basis for the requested adjustment;
 2. The date upon which each cause of delay, disruption, or interference began to affect the progress of the Work;
 3. The date upon which each cause of delay, disruption, or interference ceased to affect the progress of the Work;
 4. The number of days' increase in Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and
 5. The impact on Contract Price, in accordance with the provisions of Paragraph 11.07.
- Contractor shall also furnish such additional supporting documentation as Owner or Engineer may require including, where appropriate, a revised progress schedule indicating all the activities affected by the delay, disruption, or interference, and an explanation of the effect of the delay, disruption, or interference on the critical path to completion of the Work.
- F. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5, together with the provisions of Paragraphs 4.05.D and 4.05.E.
- G. Paragraph 8.03 addresses delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

ARTICLE 5—SITE; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor in writing of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.

~~B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.~~

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas*

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas, or to improvements, structures, utilities, or similar facilities located at such adjacent lands or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.

2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.13, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or in a court of competent jurisdiction; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

B. *Removal of Debris During Performance of the Work:* During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris will conform to applicable Laws and Regulations. Refer to Section 01145 for additional applicable information.

C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor

shall remove from the Site and adjacent areas all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents. Refer to Section 01145 for additional applicable information.

- D. *Loading of Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 *Subsurface and Physical Conditions*

- A. *Reports and Drawings:* The Supplementary Conditions identify reports and drawings that Engineer used in preparing the Bidding Documents:

- ~~1. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data;~~
- ~~2. Those drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data; and~~
- ~~3. Technical Data contained in such reports and drawings.~~

- B. *Underground Facilities:* Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05, and not in the drawings referred to in Paragraph 5.03.A. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.

- C. *Reliance by Contractor on Technical Data:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b.

- D. *Limitations of Other Data and Documents:* Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto;
2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings;
3. the contents of other Site-related documents made available to Contractor, such as record drawings from other projects at or adjacent to the Site, or Owner's archival documents concerning the Site; or
4. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.04 *Differing Subsurface or Physical Conditions*

- A. *Notice by Contractor:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site:
1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate;
 2. is of such a nature as to require a change in the Drawings or Specifications;
 3. differs materially from that shown or indicated in the Contract Documents; or
 4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

- B. *Engineer's Review:* After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine whether it is necessary for Owner to obtain additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.
- C. *Owner's Statement to Contractor Regarding Site Condition:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.
- D. *Early Resumption of Work:* If at any time Engineer determines that Work in connection with the subsurface or physical condition in question may resume prior to completion of Engineer's review or ~~Owner's issuance of its statement to Contractor~~, because the condition in question has been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.
- E. *Possible Price and Times Adjustments*
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in

Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

- a. Such condition must fall within any one or more of the categories described in Paragraph 5.04.A;
 - b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,
 - c. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E.
2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:
 - a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise;
 - b. The existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or
 - c. Contractor failed to give the written notice required by Paragraph 5.04.A.
 3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.
 4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.
- F. *Underground Facilities; Hazardous Environmental Conditions:* Paragraph 5.05 governs rights and responsibilities regarding the presence or location of Underground Facilities. Paragraph 5.06 governs rights and responsibilities regarding Hazardous Environmental Conditions. The provisions of Paragraphs 5.03 and 5.04 are not applicable to the presence or location of Underground Facilities, or to Hazardous Environmental Conditions.

5.05 *Underground Facilities*

- A. *Contractor's Responsibilities:* Unless it is otherwise expressly provided in the Supplementary Conditions, the cost of all of the following are included in the Contract Price, and Contractor shall have full responsibility for:
1. reviewing and checking all information and data regarding existing Underground Facilities at the Site;
 2. complying with applicable state and local utility damage prevention Laws and Regulations;

3. verifying the actual location of those Underground Facilities shown or indicated in the Contract Documents as being within the area affected by the Work, by exposing such Underground Facilities during the course of construction;
 4. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and
 5. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.
- B. *Notice by Contractor:* If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated on the Drawings, or was not shown or indicated on the Drawings with reasonable accuracy, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing regarding such Underground Facility.
- C. *Engineer's Review:* Engineer will:
1. promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated on the Drawings, or was not shown or indicated with reasonable accuracy;
 2. identify and communicate with the owner of the Underground Facility; prepare recommendations to Owner (and if necessary issue any preliminary instructions to Contractor) regarding the Contractor's resumption of Work in connection with the Underground Facility in question;
 3. obtain any pertinent cost or schedule information from Contractor; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and
 4. advise Owner in writing of Engineer's findings, conclusions, and recommendations.
- During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.
- D. ~~*Owner's Statement to Contractor Regarding Underground Facility:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.~~
- E. *Early Resumption of Work:* If at any time Engineer determines that Work in connection with the Underground Facility may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the Underground Facility in question and conditions affected by its presence have been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.
- F. *Possible Price and Times Adjustments*
1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, to the extent that any existing Underground Facility at the Site that was not shown

or indicated on the Drawings, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

- a. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;
 - b. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E; and
 - c. Contractor gave the notice required in Paragraph 5.05.B.
2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.
 3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.
 4. The information and data shown or indicated on the Drawings with respect to existing Underground Facilities at the Site is based on information and data (a) furnished by the owners of such Underground Facilities, or by others, (b) obtained from available records, or (c) gathered in an investigation conducted in accordance with the current edition of ASCE 38, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, by the American Society of Civil Engineers. If such information or data is incorrect or incomplete, Contractor's remedies are limited to those set forth in this Paragraph 5.05.F.

5.06 *Hazardous Environmental Conditions at Site*

- A. *Reports and Drawings:* The Supplementary Conditions identify, if any, reports or drawings that Engineer has used in preparing the Bidding Documents:
 1. those reports known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site;
 2. drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and
 3. Technical Data contained in such reports and drawings.
- B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:
 1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures

- of construction to be employed by Contractor, and safety precautions and programs incident thereto;
2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.
- C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.
- D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.
- E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.
- F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.
- G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, as a result of such Work stoppage, such special conditions under which Work is agreed to be resumed by Contractor, or any costs or expenses incurred in response to the Hazardous Environmental Condition, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off. Entitlement to any such adjustment is subject to the provisions of Paragraphs 4.05.D, 4.05.E, 11.07, and 11.08.
- H. If, after receipt of such written notice, Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special

conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.

~~I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court, arbitration, or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I obligates Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.~~

J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J obligates Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6—BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

- A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of Contractor's obligations under the Contract or otherwise required by Laws or Regulations. These bonds must remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the terms of a prescribed bond form, the Supplementary Conditions, or other provisions of the Contract.
- B. Contractor shall also furnish such other bonds (if any) as are required by the Supplementary Conditions or other provisions of the Contract.
- C. All bonds must be in the form included in the Bidding Documents or otherwise specified by Owner prior to execution of the Contract, except as provided otherwise by Laws or

- Regulations, and must be issued and signed by a surety named in “Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies” as published in Department Circular 570 (as amended and supplemented) by the Bureau of the Fiscal Service, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual’s authority to bind the surety. The evidence of authority must show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond. All sureties shall (a) hold a current Certificate of Authority as an Acceptable surety or reinsurer under 31 CFR Part 223 (and be listed on the current U.S. Department of the Treasury Circular 570) and (b) unless otherwise authorized by the Owner in writing, have at least an A.M. Best Company’s rating of A and VII or better financial size category per the current A.M. Best Company ratings.
- D. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized, in the ~~state or jurisdiction in which the Project is located~~ State of Missouri, to issue bonds in the required amounts.
 - E. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or the surety ceases to meet the requirements above, then Contractor shall (i) promptly notify Owner and Engineer in writing and (ii) shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which must comply with the bond and surety requirements above.
 - F. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner’s termination rights under Article 16.
 - G. Upon request to Owner from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Owner shall provide a copy of the payment bond to such person or entity.
 - H. Upon request to Contractor from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Contractor shall provide a copy of the payment bond to such person or entity.

6.02 Insurance—General Provisions

- A. ~~Owner and~~ Contractor shall obtain and maintain insurance as required in this article and in the Supplementary Conditions.
- B. All insurance required by the Contract to be purchased and maintained by ~~Owner or~~ Contractor shall be obtained from insurance companies that are duly licensed or authorized in the ~~state or jurisdiction in which the Project is located~~ State of Missouri to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.
- C. Alternative forms of insurance coverage, including but not limited to self-insurance and “Occupational Accident and Excess Employer’s Indemnity Policies,” are not sufficient to meet the insurance requirements of this Contract, unless expressly allowed in the Supplementary Conditions.
- D. Contractor shall deliver to Owner, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Contractor has obtained and is maintaining the policies and coverages required by the Contract. Upon

request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, full disclosure of all relevant exclusions, and evidence of insurance required to be purchased and maintained by Subcontractors or Suppliers. In any documentation furnished under this provision, Contractor, Subcontractors, and Suppliers may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those applicable to this Contract.

- ~~E. Owner shall deliver to Contractor, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Owner has obtained and is maintaining the policies and coverages required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, and full disclosure of all relevant exclusions. In any documentation furnished under this provision, Owner may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those relevant to this Contract.~~
- F. Failure of Owner ~~or Contractor~~ to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner ~~or Contractor~~ to identify a deficiency in compliance from the evidence provided, will not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.
- G. ~~In addition to the liability insurance required to be provided by Contractor,~~ The Owner, at Owner's option, may purchase and maintain Owner's own liability insurance. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.
- H. Contractor shall require:
1. Subcontractors to purchase and maintain worker's compensation, commercial general liability, and other insurance that is appropriate for their participation in the Project, and to name as additional insureds Owner and Engineer (and any other individuals or entities identified in the Supplementary Conditions as additional insureds on Contractor's liability policies) on each Subcontractor's commercial general liability insurance policy; and
 2. Suppliers to purchase and maintain insurance that is appropriate for their participation in the Project.
- I. If either party does not purchase or maintain the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.
- J. If Contractor has failed to obtain and maintain required insurance, Contractor shall be in material breach and Contractor's entitlement to enter or remain at the Site will end immediately, and Owner may impose an appropriate set-off against payment for any associated costs (including but not limited to the cost of purchasing necessary insurance coverage), and exercise Owner's termination rights under Article 16.

- K. Without prejudice to any other right or remedy, if ~~a party~~ Contractor has failed to obtain required insurance, the ~~other party~~ Owner may elect (but is in no way obligated) to obtain equivalent insurance to protect such ~~other party's~~ Owner's interests at the expense of the ~~party who was required to provide such coverage~~ Contractor, and the Contract Price will be adjusted accordingly.
- L. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests. Contractor is responsible for determining whether such coverage and limits are adequate to protect its interests, and for obtaining and maintaining any additional insurance that Contractor deems necessary. Owner reserves the right to review any and all of the insurance policies and/or endorsements cited in a Contract, but has no obligation to do so.
- M. The insurance and insurance limits required herein will not be deemed as a limitation on Contractor's liability, or that of its Subcontractors or Suppliers, under the indemnities granted to Owner and other individuals and entities in the Contract or otherwise. Nothing contained in these insurance requirements shall be construed to waive Owner's sovereign or any other immunity or defense available to Owner, its officers, employees, agents, or elected officials.
- N. All the policies of insurance required to be purchased and maintained by Contractor under this Contract will contain a provision or endorsement that the coverage afforded will not be canceled, or renewal refused, ~~until~~ without at least ~~10~~ thirty (30) days prior written notice has been given to the ~~purchasing policyholder~~ Contractor. Within three (3) days of receipt of any such written notice, the ~~purchasing policyholder~~ Contractor shall provide a copy of the notice to Owner, each other insured, and Engineer.

6.03 Contractor's Insurance

- A. *Required Insurance:* Contractor shall purchase and maintain Worker's Compensation, Commercial General Liability, Business Automobile Liability, and other insurance pursuant to the specific requirements of the Supplementary Conditions.
- B. *General Provisions:* The policies of insurance required by this Paragraph 6.03 as supplemented must:
1. include at least the specific coverages required;
 2. be written for not less than the limits provided, or those required by Laws or Regulations, whichever is greater;
 3. remain in effect at least until one year after the Work is complete (as set forth in Paragraph 15.06.D), and longer if expressly required elsewhere in this Contract, and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract;
 4. apply with respect to the performance of the Work, whether such performance is by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable; and
 5. include all necessary endorsements to support the stated requirements.

6. Additional Insured. All insurance coverage, except Workers' Compensation insurance and Professional Liability insurance, if applicable, shall name and endorse, to the fullest extent permitted by law for claims arising out of the performance of a Contract, Owner, its agents, representatives, officers, directors, officials, and employees as Additional Named Insureds.
7. Coverage Term. All insurance required herein shall be maintained in full force and effect until all work or services required to be performed under the terms of a Contract are satisfactorily performed, completed and formally accepted by Owner.
8. Primary Insurance. Contractor's insurance shall be, or endorsed to be, primary, non-contributory insurance with respect to performance of a Contract and in the protection of Owner as an Additional Insured. Such coverage shall be at least as broad as ISO CG 20 01 04 13 and include coverage for both ongoing and completed operations.
9. Waiver. To the fullest extent permitted by law, all policies, except for Professional Liability, including Workers' Compensation insurance, shall contain a waiver of rights of recovery (subrogation) against Owner, its agents, representatives, officials, officers and employees for any claims arising out of the work or services of Contractor. If necessary, Contractor shall arrange to have such subrogation waivers incorporated into each policy via formal written endorsement thereto.
10. Policy Deductibles and/or Self-Insured Retentions. The policies set forth in these requirements may provide coverage that contains deductibles or self-insured retention amounts. Such deductibles or self-insured retention shall not be applicable with respect to the policy limits provided to Owner. Contractor shall be solely responsible for any such deductible or self-insured retention amount.
11. Use of Subcontractors. If any work under a Contract is subcontracted in any way, Contractor shall execute a written agreement(s) with its subcontractors containing the indemnification provisions and insurance requirements set forth herein protecting Owner and Contractor. Contractor shall be responsible for executing any agreements with its subcontractors and obtaining certificates of insurance verifying the insurance requirements.
12. Notice of Claim. Contractor shall upon receipt of notice of any claim in connection with a Contract promptly notify Owner, providing full details thereof, including an estimate of the amount of loss or liability. Contractor shall also promptly notify Owner of any reduction in limits of protection afforded under any policy listed in the certificate(s) of insurance in excess of \$50,000.00, whether or not such impairment came about as a result of a Contract. If Owner subsequently determines that Contractor's aggregate limits of protection shall have been impaired or reduced to such extent that they are inadequate for the balance of the project, Contractor shall, upon notice from Owner, promptly reinstate the original limits of liability required hereunder and shall furnish evidence thereof to Owner.
13. Evidence of Insurance. Prior to commencing any work or services under a Contract, Contractor will provide Owner with suitable evidence of insurance in the form of certificates of insurance and, if requested by Owner, a copy of the declaration page(s) of the insurance policies as required by these requirements, issued by Contractor's insurance insurer(s) as evidence that policies are placed with acceptable insurers as

specified herein and provide the required coverages, conditions and limits of coverage specified in these requirements and that such coverage and provisions are in full force and effect. Owner shall reasonably rely upon the certificates of insurance and declaration page(s) of the insurance policies as evidence of coverage but such acceptance and reliance shall not waive or alter in any way these insurance requirements or obligations.

If any of the policies required by these requirements expire during the life of the Contract, it shall be Contractor's responsibility to forward renewal certificates and declaration page(s) to Owner 30 days prior to the expiration date. All certificates of insurance and declarations shall be identified by referencing the Contract; certificates of insurance and declaration page(s) of the insurance policies submitted without referencing the Contract, as applicable, will be subject to rejection and may be returned or discarded. Certificates of insurance and declaration page(s) shall specifically include the following provisions:

(a) Owner, its agents, representatives, officers, directors, officials and employees are Additional Insureds as follows:

(1) Commercial General Liability – Under both Insurance Services Office, Inc., ("ISO") Forms CG 20 10 03 97 and CG 20 37 10 01 or their equivalents,

(2) Auto Liability – Under ISO Form CA 20 48 or equivalent,

(3) Excess Liability – Follow Form to underlying insurance; and

(b) Contractor's insurance shall be primary, non-contributory insurance with respect to performance of the Contract; and

(c) a clear statement that all policies, except for Professional Liability, including Workers' Compensation, waive rights of recovery (subrogation) against City, its agents, representatives, officers, officials and employees for any claims arising out of work or services performed by Contractor under the Contract.

(d) ACORD certificate of insurance form 25 (2014/01) is preferred. If ACORD certificate of insurance form 25 (2001/08) is used, the phrases in the cancellation provision "endeavor to" and "but failure to mail such notice shall impose no obligation or liability of any kind upon the company, its agents or representatives" shall be deleted. Certificate forms other than ACORD form shall have similar restrictive language deleted.

All Certificates of Insurance shall name Owner as the certificate holder and send the certificate and any endorsements to:

City of Lee's Summit

Attn: Mike Anderson

220 S.E. Green Street

Lee's Summit, MO 64063 -2358

C. Commercial General Liability. Contractor shall maintain "occurrence" form Commercial General Liability insurance with unimpaired limits at least as high as those set forth in the Supplementary Conditions. The policy shall cover liability arising from premises, operations, independent contractors, products-completed operations, bodily injury, personal injury and advertising injury. . Coverage under the policy will be at least as broad as ISO policy form CG

00 01 93 or equivalent thereof, including but not limited to, separation of insured's clause. To the fullest extent allowed by law, for claims arising out of the performance of this Contract, Owner, its agents, representatives, officers, officials and employees shall be cited and endorsed as an Additional Insured under ISO, Commercial General Liability Additional Insured Endorsement forms CG 20 10 07 04 and CG 20 37 07 04, or their equivalents. The policy shall apply to additional insureds with respect to liability caused in whole or in part by Contractor's acts or omissions, or the acts and omissions of those working on Contractor's behalf, in the performance of Contractor's operations. If any Excess insurance is utilized to fulfill the requirements of this subsection, such Excess insurance shall be "follow form" equal or broader in coverage scope than underlying insurance.

D. Vehicle Liability. Contractor shall maintain Business Automobile Liability insurance with limits at least as high as those set forth in the Supplementary Conditions, and cover Contractor's owned, hired and non-owned vehicles assigned to or used in the performance of the Contractor's work or services under the Contract. Coverage will be at least as broad as ISO coverage code "1" "any auto" policy form CA 00 01 12 93 or equivalent thereof. To the fullest extent allowed by law, for claims arising out of the performance of the Contract, Owner, its agents, representatives, officers, directors, officials and employees shall be cited and endorse as an Additional Insured under ISO Business Auto policy Designated Insured Endorsement form CA 20 48 or equivalent. If any Excess insurance is utilized to fulfill the requirements of this subsection, such Excess insurance shall be "follow form" equal or broader in coverage scope than underlying insurance.

~~C. Additional Insureds: The Contractor's commercial general liability, automobile liability, employer's liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies, if required by this Contract, must:~~

- ~~1. include and list as additional insureds Owner and Engineer, and any individuals or entities identified as additional insureds in the Supplementary Conditions;~~
- ~~2. include coverage for the respective officers, directors, members, partners, employees, and consultants of all such additional insureds;~~
- ~~3. afford primary coverage to these additional insureds for all claims covered thereby (including as applicable those arising from both ongoing and completed operations);~~
- ~~4. not seek contribution from insurance maintained by the additional insured; and~~
- ~~5. as to commercial general liability insurance, apply to additional insureds with respect to liability caused in whole or in part by Contractor's acts or omissions, or the acts and omissions of those working on Contractor's behalf, in the performance of Contractor's operations.~~

6.04 *Builder's Risk and Other Property Insurance*

A. *Builder's Risk:* Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the Work's full insurable replacement cost (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). The specific requirements applicable to the builder's risk insurance are set forth in the Supplementary Conditions.

- B. *Property Insurance for Facilities of Owner Where Work Will Occur:* Owner is responsible for obtaining and maintaining property insurance covering each existing structure, building, or facility in which any part of the Work will occur, or to which any part of the Work will attach or be adjoined. Such property insurance will be written on a special perils (all risk) form, on a replacement cost basis, providing coverage consistent with that required for the builder's risk insurance, and will be maintained until the Work is complete, as set forth in Paragraph 15.06.D.
- C. ~~*Property Insurance for Substantially Complete Facilities:* Promptly after Substantial Completion, and before actual occupancy or use of the substantially completed Work, Owner will obtain property insurance for such substantially completed Work, and maintain such property insurance at least until the Work is complete, as set forth in Paragraph 15.06.D. Such property insurance will be written on a special perils (all risk) form, on a replacement cost basis, and provide coverage consistent with that required for the builder's risk insurance. The builder's risk insurance may terminate upon written confirmation of Owner's procurement of such property insurance.~~
- D. *Partial Occupancy or Use by Owner:* If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide advance notice of such occupancy or use to the builder's risk insurer, and obtain an endorsement consenting to the continuation of coverage prior to commencing such partial occupancy or use.
- E. *Insurance of Other Property; Additional Insurance:* If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, then the entity or individual owning such property item will be responsible for insuring it. If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.04, it may do so at Contractor's expense.

6.05 *Property Losses; Subrogation*

- A. The builder's risk insurance policy purchased and maintained in accordance with Paragraph 6.04 (or an installation floater policy if authorized by the Supplementary Conditions), will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors.
- 1. ~~Owner and Contractor~~ waives all rights against ~~each other~~ the Owner and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils, risks, or causes of loss covered by ~~such policies and any other~~ property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all individuals or entities identified in the Supplementary Conditions as builder's risk or installation floater insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused.

- ~~2. None of the above waivers extends to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.~~
- ~~B. Any property insurance policy maintained by Owner covering any loss, damage, or consequential loss to Owner's existing structures, buildings, or facilities in which any part of the Work will occur, or to which any part of the Work will attach or adjoin; to adjacent structures, buildings, or facilities of Owner; or to part or all of the completed or substantially completed Work, during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06, will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them, and that the insured is allowed to waive the insurer's rights of subrogation in a written contract executed prior to the loss, damage, or consequential loss.~~
- ~~1. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from fire or any of the perils, risks, or causes of loss covered by such policies.~~
- C. The waivers in this Paragraph 6.05 include the waiver of rights due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other insured peril, risk, or cause of loss.
- D. Contractor shall be responsible for assuring that each Subcontract contains provisions whereby the Subcontractor waives all rights against Owner, ~~Contractor~~, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from fire or other peril, risk, or cause of loss covered by builder's risk insurance, installation floater, and any other property insurance applicable to the Work.

6.06 *Receipt and Application of Property Insurance Proceeds*

- ~~A. Any insured loss under the builder's risk and other policies of property insurance required by Paragraph 6.04 will be adjusted and settled with the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.~~
- ~~B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.04 shall maintain such proceeds in a segregated account, and distribute such proceeds in accordance with such agreement as the parties in interest may~~

~~reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.~~

- C. If no other special agreement is reached, Contractor shall repair or replace the damaged Work, using allocated insurance proceeds.

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.01 Contractor's Means and Methods of Construction

- A. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.
- B. If the Contract Documents note, or Contractor determines, that professional engineering or other design services are needed to carry out Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures, or for Site safety, then Contractor shall cause such services to be provided by a properly licensed design professional, at Contractor's expense. Such services are not Owner-delegated professional design services under this Contract, and neither Owner nor Engineer has any responsibility with respect to (1) Contractor's determination of the need for such services, (2) the qualifications or licensing of the design professionals retained or employed by Contractor, (3) the performance of such services, or (4) any errors, omissions, or defects in such services.

7.02 Supervision and Superintendence

- A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who will not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.03 Labor; Working Hours

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall maintain good discipline and order at the Site.
- B. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of Contractor's employees; of Suppliers and Subcontractors, and their employees; and of any other individuals or entities performing or furnishing any of the Work, just as Contractor is responsible for Contractor's own acts and omissions.
- C. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site will be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.04 *Services, Materials, and Equipment*

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents. Refer to Sections 01210, 01215, 01220, and 01225 for additional applicable information.
- B. All materials and equipment incorporated into the Work must be new and of good quality, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications will expressly run to the benefit of Owner. If required by Engineer or Owner, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.
- C. All materials and equipment must be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents. Refer to Section 01205 for additional applicable information.

7.05 *“Or Equals”*

- A. *Contractor’s Request; Governing Criteria:* Whenever an item of equipment or material is specified or described in the Contract Documents by using the names of one or more proprietary items or specific Suppliers, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or “or equal” item is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material, or items from other proposed Suppliers, under the circumstances described below.
 - 1. If Engineer in its sole discretion determines that an item of equipment or material proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer will deem it an “or equal” item. For the purposes of this paragraph, a proposed item of equipment or material will be considered functionally equal to an item so named if:
 - a. in the exercise of reasonable judgment Engineer determines that the proposed item:
 - 1) is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
 - 2) will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;
 - 3) has a proven record of performance and availability of responsive service; and
 - 4) is not objectionable to Owner.
 - b. Contractor certifies that, if the proposed item is approved and incorporated into the Work:
 - 1) there will be no increase in cost to the Owner or increase in Contract Times; and

- 2) the item will conform substantially to the detailed requirements of the item named in the Contract Documents.
- B. *Contractor's Expense*: Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.
- C. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal," which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.
- D. *Effect of Engineer's Determination*: Neither approval nor denial of an "or-equal" request will result in any change in Contract Price. The Engineer's denial of an "or-equal" request will be final and binding, and may not be reversed through an appeal under any provision of the Contract.
- E. *Treatment as a Substitution Request*: If Engineer determines that an item of equipment or material proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer consider the item a proposed substitute pursuant to Paragraph 7.06.

7.06 Substitutes

- A. *Contractor's Request; Governing Criteria*: Unless the specification or description of an item of equipment or material required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material under the circumstances described below. To the extent possible such requests must be made before commencement of related construction at the Site.
1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of equipment or material from anyone other than Contractor.
 2. The requirements for review by Engineer will be as set forth in Paragraph 7.06.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.
 3. Contractor shall make written application to Engineer for review of a proposed substitute item of equipment or material that Contractor seeks to furnish or use. The application:
 - a. will certify that the proposed substitute item will:
 - 1) perform adequately the functions and achieve the results called for by the general design;
 - 2) be similar in substance to the item specified; and
 - 3) be suited to the same use as the item specified.

- b. will state:
 - 1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times;
 - 2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item; and
 - 3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.
 - c. will identify:
 - 1) all variations of the proposed substitute item from the item specified; and
 - 2) available engineering, sales, maintenance, repair, and replacement services.
 - d. will contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.
- B. *Engineer's Evaluation and Determination:* Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.
- C. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- D. *Reimbursement of Engineer's Cost:* Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.
- E. *Contractor's Expense:* Contractor shall provide all data in support of any proposed substitute at Contractor's expense.
- F. *Effect of Engineer's Determination:* If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request will be final and binding, and may not be reversed through an appeal under any provision of the Contract. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.06.D, by timely submittal of a Change Proposal.

7.07 *Concerning Subcontractors and Suppliers*

- A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner. The Contractor's retention of a Subcontractor or Supplier for the performance of parts of the Work will not relieve Contractor's obligation to Owner to perform and complete the Work in accordance with the Contract Documents.
- B. Contractor shall retain specific Subcontractors and Suppliers for the performance of designated parts of the Work if required by the Contract to do so.
- C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor or Supplier to furnish or perform any of the Work against which Contractor has reasonable objection.
- D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within 5 days.
- E. Owner may require the replacement of any Subcontractor or Supplier. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors or Suppliers for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor or Supplier so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor or Supplier.
- F. If Owner requires the replacement of any Subcontractor or Supplier retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.
- G. No acceptance by Owner of any such Subcontractor or Supplier, whether initially or as a replacement, will constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.
- H. On a monthly basis, Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.
- I. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors and Suppliers.
- J. The divisions and sections of the Specifications and the identifications of any Drawings do not control Contractor in dividing the Work among Subcontractors or Suppliers, or in delineating the Work to be performed by any specific trade.

- K. All Work performed for Contractor by a Subcontractor or Supplier must be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract for the benefit of Owner and Engineer.
- L. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor for Work performed for Contractor by the Subcontractor or Supplier. The furnishing of such information shall not create a contractual or other legal relationship between any such Subcontractor or Supplier and Owner or Engineer.
- M. Contractor shall restrict all Subcontractors and Suppliers from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly agreed to by the Owner and Contractor.

7.08 *Patent Fees and Royalties*

- A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If an invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights will be disclosed in the Contract Documents.
- ~~B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.~~
- C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.09 *Permits*

- A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits, licenses, and certificates of occupancy. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a

negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work. Refer to Section 01010 for additional applicable information.

7.10 *Taxes*

- A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

7.11 *Laws and Regulations*

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It is not Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this does not relieve Contractor of its obligations under Paragraph 3.03.
- C. Owner or Contractor may give written notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such written notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.12 *Record Documents*

- A. Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer and Owner for reference. Upon completion of the Work, Contractor shall deliver these record documents to Engineer and Owner.

7.13 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations.

- B. Contractor shall designate a qualified and experienced safety representative whose duties and responsibilities are the prevention of Work-related accidents and the maintenance and supervision of safety precautions and programs.
- C. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:
 - 1. all persons on the Site or who may be affected by the Work;
 - 2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 - 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- D. All damage, injury, or loss to any property referred to in Paragraph 7.13.C.2 or 7.13.C.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).
- E. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection.
- F. Contractor shall notify Owner; the owners of adjacent property; the owners of Underground Facilities and other utilities (if the identity of such owners is known to Contractor); and other contractors and utility owners performing work at or adjacent to the Site, in writing, when Contractor knows that prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.
- G. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. Any Owner's safety programs that are applicable to the Work are identified or included in the Supplementary Conditions or Specifications.
- H. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.
- I. Contractor's duties and responsibilities for safety and protection will continue until all the Work is completed, Engineer has issued a written notice to Owner and Contractor in accordance with Paragraph 15.06.C that the Work is acceptable, and Contractor has left the Site (except as otherwise expressly provided in connection with Substantial Completion).
- J. Contractor's duties and responsibilities for safety and protection will resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.14 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of safety data sheets (formerly known as material safety data sheets) or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 *Emergencies*

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused by an emergency, or are required as a result of Contractor's response to an emergency. If Engineer determines that a change in the Contract Documents is required because of an emergency or Contractor's response, a Work Change Directive or Change Order will be issued. Refer to Section 01135 for additional applicable information.

7.16 *Submittals*

A. *Shop Drawing and Sample Requirements*

1. Before submitting a Shop Drawing or Sample, Contractor shall:
 - a. review and coordinate the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
 - b. determine and verify:
 - 1) all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect to the Submittal;
 - 2) the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - 3) all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto;
 - c. confirm that the Submittal is complete with respect to all related data included in the Submittal.
2. Each Shop Drawing or Sample must bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that Submittal, and that Contractor approves the Submittal.
3. With each Shop Drawing or Sample, Contractor shall give Engineer specific written notice of any variations that the Submittal may have from the requirements of the Contract Documents. This notice must be set forth in a written communication separate from the Submittal; and, in addition, in the case of a Shop Drawing by a specific notation made on the Shop Drawing itself.

- B. *Submittal Procedures for Shop Drawings and Samples:* Contractor shall label and submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals.
1. *Shop Drawings*
 - a. Contractor shall submit ~~the number of copies required in the Specifications in accordance with the requirements of Section 01115.~~
 - b. Data shown on the Shop Drawings must be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide, and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.C.
 2. *Samples*
 - a. Contractor shall submit the number of Samples required in the Specifications.
 - b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the Submittal for the limited purposes required by Paragraph 7.16.C.
 3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.
- C. *Engineer's Review of Shop Drawings and Samples*
1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the accepted Schedule of Submittals. Engineer's review and approval will be only to determine if the items covered by the Submittals will, after installation or incorporation in the Work, comply with the requirements of the Contract Documents, and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
 2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction, or to safety precautions or programs incident thereto.
 3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
 4. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such approved variation from the requirements of the Contract Documents in a Field Order or other appropriate Contract modification.
 5. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for complying with the requirements of Paragraphs 7.16.A and B.

6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, will not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.
7. Neither Engineer's receipt, review, acceptance, or approval of a Shop Drawing or Sample will result in such item becoming a Contract Document.
8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.C.4.

D. Resubmittal Procedures for Shop Drawings and Samples

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous Submittals.
2. Contractor shall furnish required Shop Drawing and Sample submittals with sufficient information and accuracy to obtain required approval of an item with no more than two resubmittals. Engineer will record Engineer's time for reviewing a third or subsequent resubmittal of a Shop Drawing or Sample, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges.
3. If Contractor requests a change of a previously approved Shop Drawing or Sample, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

E. Submittals Other than Shop Drawings, Samples, and Owner-Delegated Designs

1. The following provisions apply to all Submittals other than Shop Drawings, Samples, and Owner-delegated designs:
 - a. Contractor shall submit all such Submittals to the Engineer in accordance with the Schedule of Submittals and pursuant to the applicable terms of the Contract Documents.
 - b. Engineer will provide timely review of all such Submittals in accordance with the Schedule of Submittals and return such Submittals with a notation of either Accepted or Not Accepted. Any such Submittal that is not returned within the time established in the Schedule of Submittals will be deemed accepted.
 - c. Engineer's review will be only to determine if the Submittal is acceptable under the requirements of the Contract Documents as to general form and content of the Submittal.
 - d. If any such Submittal is not accepted, Contractor shall confer with Engineer regarding the reason for the non-acceptance, and resubmit an acceptable document.
2. Procedures for the submittal and acceptance of the Progress Schedule, the Schedule of Submittals, and the Schedule of Values are set forth in Paragraphs 2.03, 2.04, and 2.05.

- F. Owner-delegated Designs: Submittals pursuant to Owner-delegated designs are governed by the provisions of Paragraph 7.19.

7.17 Contractor's General Warranty and Guarantee

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective in any manner according to construction industry standards. Engineer is entitled to rely on Contractor's warranty and guarantee.
- B. Owner's rights under this warranty and guarantee are in addition to, and are not limited by, Owner's rights under the correction period provisions of Paragraph 15.08. The time in which Owner may enforce its warranty and guarantee rights under this Paragraph 7.17 is limited only by applicable Laws and Regulations restricting actions to enforce such rights; provided, however, that after the end of the correction period under Paragraph 15.08:
1. Owner shall give Contractor written notice of any defective Work within 60 days of the discovery that such Work is defective; and
 2. Such notice will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the notice.
- C. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
1. abuse, or improper modification, maintenance, or operation, by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 2. normal wear and tear under normal usage.
- D. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents is absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents, a release of Contractor's obligation to perform the Work in accordance with the Contract Documents, or a release of Owner's warranty and guarantee rights under this Paragraph 7.17:
1. Observations by Engineer;
 2. Recommendation by Engineer or payment by Owner of any progress or final payment;
 3. The issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
 4. Use or occupancy of the Work or any part thereof by Owner;
 5. Any review and approval of a Shop Drawing or Sample submittal;
 6. The issuance of a notice of acceptability by Engineer;
 7. The end of the correction period established in Paragraph 15.08;
 8. Any inspection, test, or approval by others; or
 9. Any correction of defective Work by Owner.
- E. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the

assigned contract will govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 Indemnification

- A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from losses, damages, costs, and judgments (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising from third-party claims or actions relating to or resulting from the performance or furnishing of the Work, ~~provided that any such claim, action, loss, cost, judgment or damage is attributable to bodily injury, sickness, disease, or death, or to damage to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable.~~
- B. In any and all claims against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A will not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

7.19 Delegation of Professional Design Services

- A. Owner may require Contractor to provide professional design services for a portion of the Work by express delegation in the Contract Documents. Such delegation will specify the performance and design criteria that such services must satisfy, and the Submittals that Contractor must furnish to Engineer with respect to the Owner-delegated design.
- B. Contractor shall cause such Owner-delegated professional design services to be provided pursuant to the professional standard of care by a properly licensed design professional, whose signature and seal must appear on all drawings, calculations, specifications, certifications, and Submittals prepared by such design professional. Such design professional must issue all certifications of design required by Laws and Regulations.
- C. If a Shop Drawing or other Submittal related to the Owner-delegated design is prepared by Contractor, a Subcontractor, or others for submittal to Engineer, then such Shop Drawing or other Submittal must bear the written approval of Contractor's design professional when submitted by Contractor to Engineer.
- D. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, and approvals performed or provided by the design professionals retained or employed by Contractor under an Owner-delegated design, subject

to the professional standard of care and the performance and design criteria stated in the Contract Documents.

- E. Pursuant to this Paragraph 7.19, Engineer's review, approval, and other determinations regarding design drawings, calculations, specifications, certifications, and other Submittals furnished by Contractor pursuant to an Owner-delegated design will be only for the following limited purposes:
 - 1. Checking for conformance with the requirements of this Paragraph 7.19;
 - 2. Confirming that Contractor (through its design professionals) has used the performance and design criteria specified in the Contract Documents; and
 - 3. Establishing that the design furnished by Contractor is consistent with the design concept expressed in the Contract Documents.
- F. ~~Contractor shall not be responsible for the adequacy of performance or design criteria specified by Owner or Engineer.~~
- G. Contractor is not required to provide professional services in violation of applicable Laws and Regulations.

ARTICLE 8—OTHER WORK AT THE SITE

8.01 *Other Work*

- A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.
- B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any third-party utility work that Owner has arranged to take place at or adjacent to the Site, Owner shall provide such information to Contractor.
- C. Contractor shall afford proper and safe access to the Site to each contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work.
- D. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.
- E. If the proper execution or results of any part of Contractor's Work depends upon work performed by others, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it

unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

- F. The provisions of this article are not applicable to work that is performed by third-party utilities or other third-party entities without a contract with Owner, or that is performed without having been arranged by Owner. If such work occurs, then any related delay, disruption, or interference incurred by Contractor is governed by the provisions of Paragraph 4.05.C.3.

8.02 *Coordination*

- A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the ~~Supplementary Conditions~~ Section 01105 or provided to Contractor prior to the start of any such other work:
 - 1. The identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;
 - 2. An itemization of the specific matters to be covered by such authority and responsibility; and
 - 3. The extent of such authority and responsibilities.
- B. Unless otherwise provided in the ~~Supplementary Conditions~~ Section 01105, Owner shall have sole authority and responsibility for such coordination.

8.03 *Legal Relationships*

- A. If, in the course of performing other work for Owner at or adjacent to the Site, the Owner's employees, any other contractor working for Owner, or any utility owner that Owner has arranged to perform work, causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment will take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract, and any remedies available to Contractor under Laws or Regulations concerning utility action or inaction. When applicable, any such equitable adjustment in Contract Price will be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times or Contract Price is subject to the provisions of Paragraphs 4.05.D and 4.05.E.
- B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site.

1. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this Paragraph 8.03.B.
 2. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due Contractor.
- C. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9—OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

- A. Except as otherwise provided in these General Conditions, Owner may issue communications directly to the Contractor. ~~shall issue all communications to Contractor through Engineer.~~

9.02 *Replacement of Engineer*

- A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents will be that of the former Engineer.

9.03 *Furnish Data*

- A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

9.04 *Pay When Due*

- A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

9.05 *Lands and Easements; Reports, Tests, and Drawings*

- A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.

- B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.
- C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *Insurance*

- A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.07 *Change Orders*

- A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.

9.08 *Inspections, Tests, and Approvals*

- A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 *Limitations on Owner's Responsibilities*

- A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

9.10 *Undisclosed Hazardous Environmental Condition*

- A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 *Evidence of Financial Arrangements*

- A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract (including obligations under proposed changes in the Work).

9.12 *Safety Programs*

- A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.
- B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

- A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract.

10.02 *Visits to Site*

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe, as an experienced and qualified design professional, the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.
- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.07. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 *Resident Project Representative*

- A. ~~If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in the Supplementary Conditions and in Paragraph 10.07. The Owner will provide the RPR to act as Owner's as defined Section 520.~~
- B. ~~If Owner designates an individual or entity who is not Engineer's consultant, agent, or employee to represent Owner at the Site, then the responsibilities and authority of such individual or entity will be as provided in the Supplementary Conditions.~~

10.04 *Engineer's Owner's Authority*

- A. Engineer Owner has the authority to reject Work in accordance with Article 14.
- B. Engineer's Owner's authority as to Submittals is set forth in Paragraph 7.16.
- C. Engineer's authority as to design drawings, calculations, specifications, certifications and other Submittals from Contractor in response to Owner's delegation (if any) to Contractor of professional design services, is set forth in Paragraph 7.19.
- D. Engineer's Owner's authority as to changes in the Work is set forth in Article 11.
- E. Engineer's Owner's authority as to Applications for Payment is set forth in Article 15.

10.05 *Determinations for Unit Price Work*

- A. Engineer Owner will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

10.06 *Decisions on Requirements of Contract Documents and Acceptability of Work*

- A. ~~Engineer~~ Owner will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.07 *Limitations on Engineer's Authority and Responsibilities*

- A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, will create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.
- B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. ~~Engineer's~~ Owner's review of the final Application for Payment and accompanying documentation, and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Contractor under Paragraph 15.06.A, will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.
- E. The limitations upon authority and responsibility set forth in this Paragraph 10.07 also apply to the Resident Project Representative, if any.

10.08 *Compliance with Safety Program*

- A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs of which Engineer has been informed.

ARTICLE 11—CHANGES TO THE CONTRACT

11.01 *Amending and Supplementing the Contract*

- A. The Contract may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
- B. If an amendment or supplement to the Contract includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order.

- C. All changes to the Contract that involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, must be supported by Engineer's recommendation. Owner and Contractor may amend other terms and conditions of the Contract without the recommendation of the Engineer.

11.02 *Change Orders*

- A. Owner and Contractor shall execute appropriate Change Orders covering:
 - 1. Changes in Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;
 - 2. Changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;
 - 3. Changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.05, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters; and
 - 4. Changes that embody the substance of any final and binding results under: Paragraph 11.03.B, resolving the impact of a Work Change Directive; Paragraph 11.09, concerning Change Proposals; Article 12, Claims; Paragraph 13.02.D, final adjustments resulting from allowances; Paragraph 13.03.D, final adjustments relating to determination of quantities for Unit Price Work; and similar provisions.
- B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of Paragraph 11.02.A, it will be deemed to be of full force and effect, as if fully executed.

11.03 *Work Change Directives*

- A. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.07 regarding change of Contract Price.
- B. If Owner has issued a Work Change Directive and:
 - 1. Contractor believes that an adjustment in Contract Times or Contract Price is necessary, then Contractor shall submit any Change Proposal seeking such an adjustment no later than 30 days after the completion of the Work set out in the Work Change Directive.
 - 2. Owner believes that an adjustment in Contract Times or Contract Price is necessary, then Owner shall submit any Claim seeking such an adjustment no later than 60 days after issuance of the Work Change Directive.

11.04 *Field Orders*

- A. Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly.
- B. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.05 *Owner-Authorized Changes in the Work*

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Changes involving the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters will be supported by Engineer's recommendation.
- B. Such changes in the Work may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work must be performed under the applicable conditions of the Contract Documents.
- C. Nothing in this Paragraph 11.05 obligates Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.06 *Unauthorized Changes in the Work*

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.C.2.

11.07 *Change of Contract Price*

- A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment of Contract Price must comply with the provisions of Article 12.
- B. An adjustment in the Contract Price will be determined as follows:
 - 1. Where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03);
 - 2. Where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.07.C.2); or

3. Where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.07.C).
- C. *Contractor's Fee:* When applicable, the Contractor's fee for overhead and profit will be determined as follows:
1. A mutually acceptable fixed fee; or
 2. If a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. For costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee will be 15 percent;
 - b. For costs incurred under Paragraph 13.01.B.3, the Contractor's fee will be 5 percent;
 - c. Where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.07.C.2.a and 11.07.C.2.b is that the Contractor's fee will be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of 5 percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted Work the maximum total fee to be paid by Owner will be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the Work;
 - d. No fee will be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;
 - e. The amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in Cost of the Work will be the amount of the actual net decrease in Cost of the Work and a deduction of an additional amount equal to 5 percent of such actual net decrease in Cost of the Work; and
 - f. When both additions and credits are involved in any one change or Change Proposal, the adjustment in Contractor's fee will be computed by determining the sum of the costs in each of the cost categories in Paragraph 13.01.B (specifically, payroll costs, Paragraph 13.01.B.1; incorporated materials and equipment costs, Paragraph 13.01.B.2; Subcontract costs, Paragraph 13.01.B.3; special consultants costs, Paragraph 13.01.B.4; and other costs, Paragraph 13.01.B.5) and applying to each such cost category sum the appropriate fee from Paragraphs 11.07.C.2.a through 11.07.C.2.e, inclusive.

11.08 *Change of Contract Times*

- A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment in the Contract Times must comply with the provisions of Article 12.

- B. Delay, disruption, and interference in the Work, and any related changes in Contract Times, are addressed in and governed by Paragraph 4.05.

11.09 *Change Proposals*

- A. *Purpose and Content:* Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; contest an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; challenge a set-off against payment due; or seek other relief under the Contract. The Change Proposal will specify any proposed change in Contract Times or Contract Price, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents. Each Change Proposal will address only one issue, or a set of closely related issues.

- B. *Change Proposal Procedures*

1. *Submittal:* Contractor shall submit each Change Proposal in writing to Engineer and Owner within 30 days after the start of the event giving rise thereto, or after such initial decision.
2. *Supporting Data:* The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal.
 - a. Change Proposals based on or related to delay, interruption, or interference must comply with the provisions of Paragraphs 4.05.D and 4.05.E.
 - b. Change proposals related to a change of Contract Price must include full and detailed accounts of materials incorporated into the Work and labor and equipment used for the subject Work.

The supporting data must be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event.

3. *Engineer's Initial Review:* Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal. If in its discretion Engineer concludes that additional supporting data is needed before conducting a full review and making a decision regarding the Change Proposal, then Engineer may request that Contractor submit such additional supporting data by a date specified by Engineer, prior to Engineer beginning its full review of the Change Proposal.
4. *Engineer's Full Review and Action on the Change Proposal:* Upon receipt of Contractor's supporting data (including any additional data requested by Engineer), Engineer will conduct a full review of each Change Proposal and, within 30 days after such receipt of the Contractor's supporting data, either approve the Change Proposal in whole, deny it in whole, or approve it in part and deny it in part. Such actions must be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.

- 5. *Binding Decision*: Engineer's decision is final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.
- C. *Resolution of Certain Change Proposals*: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties in writing that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice will be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.
- D. *Post-Completion*: Contractor shall not submit any Change Proposals after Engineer issues a written recommendation of final payment pursuant to Paragraph 15.06.B.

11.10 *Notification to Surety*

- A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

ARTICLE 12—CLAIMS

12.01 *Claims*

- A. *Claims Process*: The following disputes between Owner and Contractor are subject to the Claims process set forth in this article:
 - 1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;
 - 2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents;
 - 3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters; and
 - 4. Subject to the waiver provisions of Paragraph 15.07, any dispute arising after Engineer has issued a written recommendation of final payment pursuant to Paragraph 15.06.B.
- B. *Submittal of Claim*: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim rests with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.
- C. *Review and Resolution*: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for

resolving the Claim by mutual agreement. All actions taken on a Claim will be stated in writing and submitted to the other party, with a copy to Engineer.

D. *Mediation*

1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate will stay the Claim submittal and response process.
 2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process will resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process will resume as of the date of the conclusion of the mediation, as determined by the mediator.
 3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.
- E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action will be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.
- F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim will be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.
- G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim will be incorporated in a Change Order or other written document to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13—COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 *Cost of the Work*

- A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:
1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or
 2. When needed to determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.

- B. *Costs Included:* Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work will be in amounts no higher than those commonly incurred in the locality of the Project, will not include any of the costs itemized in Paragraph 13.01.C, and will include only the following items:
1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor in advance of the subject Work. Such employees include, without limitation, superintendents, foremen, safety managers, safety representatives, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work will be apportioned on the basis of their time spent on the Work. Payroll costs include, but are not limited to, salaries and wages plus the cost of fringe benefits, which include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, will be included in the above to the extent authorized by Owner.
 2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts will accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment will accrue to Owner, and Contractor shall make provisions so that they may be obtained.
 3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, which will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee will be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.
 4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed or retained for services specifically related to the Work.
 5. Other costs consisting of the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
 - 1) In establishing included costs for materials such as scaffolding, plating, or sheeting, consideration will be given to the actual or the estimated life of the material for use on other projects; or rental rates may be established on the basis of purchase or salvage value of such items, whichever is less. Contractor will not

be eligible for compensation for such items in an amount that exceeds the purchase cost of such item.

c. *Construction Equipment Rental*

- 1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner as to price (including any surcharge or special rates applicable to overtime use of the construction equipment or machinery), and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs will be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts must cease when the use thereof is no longer necessary for the Work.
 - 2) Costs for equipment and machinery owned by Contractor or a Contractor-related entity will be paid at a rate shown for such equipment in the equipment rental rate book specified in the Supplementary Conditions. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs.
 - 2) With respect to Work that is the result of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price ("changed Work"), included costs will be based on the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, must cease to accrue when the use thereof is no longer necessary for the changed Work.
- d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
- e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
- f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of builder's risk or other property insurance established in accordance with Paragraph 6.04), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses will be included in the Cost of the Work for the purpose of determining Contractor's fee.
- g. The cost of utilities, fuel, and sanitary facilities at the Site.
- h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.
- i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

C. *Costs Excluded:* The term Cost of the Work does not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals, general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.
2. The cost of purchasing, renting, or furnishing small tools and hand tools.
3. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
4. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
5. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.
6. Expenses incurred in preparing and advancing Claims.
7. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

D. *Contractor's Fee*

1. When the Work as a whole is performed on the basis of cost-plus-a-fee, then:
 - a. Contractor's fee for the Work set forth in the Contract Documents as of the Effective Date of the Contract will be determined as set forth in the Agreement.
 - b. for any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work, Contractor's fee will be determined as follows:
 - 1) When the fee for the Work as a whole is a percentage of the Cost of the Work, the fee will automatically adjust as the Cost of the Work changes.
 - 2) When the fee for the Work as a whole is a fixed fee, the fee for any additions or deletions will be determined in accordance with Paragraph 11.07.C.2.
2. When the Work as a whole is performed on the basis of a stipulated sum, or any other basis other than cost-plus-a-fee, then Contractor's fee for any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work will be determined in accordance with Paragraph 11.07.C.2.

E. *Documentation and Audit:* Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor and pertinent Subcontractors will establish and maintain records of the costs in accordance with generally accepted accounting practices. Subject to prior written notice, Owner will be afforded reasonable access, during normal business hours, to all Contractor's accounts, records, books, correspondence, instructions,

drawings, receipts, vouchers, memoranda, and similar data relating to the Cost of the Work and Contractor's fee. Contractor shall preserve all such documents for a period of three years after the final payment by Owner. Pertinent Subcontractors will afford such access to Owner, and preserve such documents, to the same extent required of Contractor.

13.02 Allowances

- A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.
- B. *Cash Allowances*: Contractor agrees that:
 - 1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
 - 2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment for any of the foregoing will be valid.
- C. *Owner's Contingency Allowance*: Contractor agrees that an Owner's contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor for Work covered by allowances, and the Contract Price will be correspondingly adjusted.

13.03 Unit Price Work

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.
- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, and the final adjustment of Contract Price will be set forth in a Change Order, subject to the provisions of the following paragraph.

~~E. Adjustments in Unit Price~~

~~This section is removed and replaced by C800 Supplementary Conditions~~

- ~~1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:
 - ~~a. the quantity of the item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and~~
 - ~~c. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.~~~~
- ~~2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.~~
- ~~3. Adjusted unit prices will apply to all units of that item.~~

ARTICLE 14—TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK

14.01 Access to Work

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply with such procedures and programs as applicable.

14.02 Tests, Inspections, and Approvals

- A. Contractor shall give Engineer and Owner timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.
- B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work will be governed by the provisions of Paragraph 14.05. Refer to Sections 01305 and 01306 for additional applicable information.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.
- D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:
 1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;

2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;
3. by manufacturers of equipment furnished under the Contract Documents;
4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests will be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

- E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.
- F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering will be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

- A. *Contractor's Obligation*: It is Contractor's obligation to assure that the Work is not defective.
- B. *Engineer's Authority*: Engineer has the authority to determine whether Work is defective, and to reject defective Work.
- C. *Notice of Defects*: Prompt written notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.
- D. *Correction, or Removal and Replacement*: Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.
- E. *Preservation of Warranties*: When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.
- F. *Costs and Damages*: In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs, losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work will be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 *Uncovering Work*

- A. Engineer has the authority to require additional inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.
- B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.
- C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.
 - 1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.
 - 2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 *Owner May Stop the Work*

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work will not give rise to any duty on the part of Owner to exercise this

right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 Owner May Correct Defective Work

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace defective Work as required by Engineer, then Owner may, after 7 days' written notice to Contractor, correct or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.
- C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.
- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15—PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 Progress Payments

- A. *Basis for Progress Payments:* The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments for Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.
- B. *Applications for Payments*
 - 1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall review then approve or reject the Applications for Payment as directed in Section 1121. submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by Contractor shall provide such supporting documentation as is required by the Contract Documents.
 - 2. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment must also be accompanied by: (a) a bill of sale, invoice, copies of subcontract or purchase order payments, or other documentation establishing full payment by Contractor for the materials and equipment; (b) at Owner's

request, documentation warranting that Owner has received the materials and equipment free and clear of all Liens; and (c) evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

3. Beginning with the second Application for Payment, each Application must include an affidavit of Contractor stating that all previous progress payments received by Contractor have been applied to discharge Contractor's legitimate obligations associated with prior Applications for Payment. This affidavit statement is included on the Owner's Pay Application form. By signing and submitting the Pay Application, the Contractor acknowledges a written waiver of claims for such previously received progress payments. The waiver of claims shall be binding upon contractor, and all subcontractors and suppliers on the Project.
4. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

C. *Review of Applications*

1. ~~Engineer~~ Contractor will, within 10 days after receipt of each Application for Payment, including each resubmittal, either approve or reject the Application for Payment per the directions in Section 1121. indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case of a rejection, Contractor Owner may make the necessary corrections and resubmit the Application.
2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:
 - a. the Work has progressed to the point indicated;
 - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and
 - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
 - a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or

- b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.
- 4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
 - a. to supervise, direct, or control the Work;
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto;
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work;
 - d. to make any examination to ascertain how or for what purposes Contractor has used the money paid by Owner; or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
- 5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.
- 6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:
 - a. the Work is defective, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or
 - e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.
- D. *Payment Becomes Due*
 - 1. Fifteen (15) days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.
- E. *Reductions in Payment by Owner*
 - 1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:
 - a. Claims have been made against Owner based on Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages resulting from Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace

- injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;
- b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;
 - c. Contractor has failed to provide and maintain required bonds or insurance;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;
 - e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;
 - f. The Work is defective, requiring correction or replacement;
 - g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - h. The Contract Price has been reduced by Change Orders;
 - i. An event has occurred that would constitute a default by Contractor and therefore justify a termination for cause;
 - j. Liquidated or other damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;
 - k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens; or
 - l. Other items entitle Owner to a set-off against the amount recommended.
- 2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed will be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.
 - 3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld will be treated as an amount due as determined by Paragraph 15.01.D.1 and subject to interest as provided in the Agreement.
 - 4. The Contractor shall request partial progress payments by submitting a signed "Contractor's Application for Payment" form, EJCDC Form No. C-620. The phrase "receipt of Application for Payment" shall be defined as receiving the signed originals, and all of the necessary attachments. Pay requests that are incomplete forms or missing attachments will be returned to the Contractor without payment. Incomplete pay requests will not be subject to the 10-day review period described in 15.01.D. Refer to Division 1, Section 01121 for additional applicable information.

15.02 *Contractor's Warranty of Title*

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than 7 days after the time of payment by Owner.

15.03 *Substantial Completion*

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.
- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which will fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have 7 days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy, if applicable, with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's ~~use or occupancy~~ Final Acceptance of the Work.
- E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.

- F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:
 - 1. At any time, Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through 15.03.E for that part of the Work.
 - 2. At any time, Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
 - 3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
 - 4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.04 regarding builder's risk or other property insurance.

15.05 *Final Inspection*

- A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 *Final Payment*

A. *Application for Payment*

- 1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in Paragraph 7.12), and other documents, Contractor may make application for final payment.

2. The final Application for Payment must be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents;
 - b. consent of the surety, if any, to final payment;
 - c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.
 - d. a list of all duly pending Change Proposals and Claims; and
 - e. complete and legally effective releases ~~or~~ and waivers (satisfactory to Owner) of all claims, Lien rights arising out of the Work, and of Liens filed in connection with the Work, and all claims by third parties.
3. ~~In lieu of~~ in addition to the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor ~~may~~ shall furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.
- B. *Engineer's Review of Final Application and Recommendation of Payment:* If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within 10 days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the final Application for Payment to Owner for payment. Such recommendation will account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.
- C. *Notice of Acceptability:* In support of its recommendation of payment of the final Application for Payment, Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to stated limitations in the notice and to the provisions of Paragraph 15.07.
- D. *Completion of Work:* The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment and issuance of notice of the acceptability of the Work.

- E. *Final Payment Becomes Due*: Upon receipt from Engineer of the final Application for Payment and accompanying documentation, Owner shall set off against the amount recommended by Engineer for final payment any further sum to which Owner is entitled, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions of this Contract with respect to progress payments. Owner shall pay the resulting balance due to Contractor within 30 days of Owner's receipt of the final Application for Payment from Engineer.

15.07 *Waiver of Claims*

- A. By making final payment, Owner waives its claim or right to liquidated damages or other damages for late completion by Contractor, except as set forth in an outstanding Claim, appeal under the provisions of Article 17, set-off, or express reservation of rights by Owner. Owner reserves all other claims or rights after final payment.
- B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted as a Claim, or appealed under the provisions of Article 17.

15.08 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the Supplementary Conditions or the terms of any applicable special guarantee required by the Contract Documents), Owner gives Contractor written notice that any Work has been found to be defective, or that Contractor's repair of any damages to the Site or adjacent areas has been found to be defective, then after receipt of such notice of defect Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
1. correct the defective repairs to the Site or such adjacent areas;
 2. correct such defective Work;
 3. remove the defective Work from the Project and replace it with Work that is not defective, if the defective Work has been rejected by Owner, and
 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting from the corrective measures.
- B. Owner shall give any such notice of defect within 60 days of the discovery that such Work or repairs is defective. If such notice is given within such 60 days but after the end of the correction period, the notice will be deemed a notice of defective Work under Paragraph 7.17.B.
- C. If, after receipt of a notice of defect within 60 days and within the correction period, Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others). Contractor's failure to pay such costs, losses, and damages within 10 days of invoice from Owner will be deemed the start of an event giving rise to a Claim under

Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the failure to pay.

- D. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- E. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.
- F. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph are not to be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

- A. At any time and without cause, Owner may suspend the Work or any portion thereof ~~for a period of not more than 90 consecutive days~~ by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times directly attributable to any such suspension. Any Change Proposal seeking such adjustments must be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 *Owner May Terminate for Cause*

- A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:
 - 1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment, or failure to adhere to the Progress Schedule);
 - 2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;
 - 3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or
 - 4. Contractor's repeated disregard of the authority of Owner or Engineer.
- B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) 10 days' written notice that Owner is considering a declaration that Contractor is in default and termination of the Contract, Owner may proceed to:
 - 1. declare Contractor to be in default, and give Contractor (and any surety) written notice that the Contract is terminated; and
 - 2. enforce the rights available to Owner under any applicable performance bond.
- C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the

Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.

- D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within 7 days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.
- E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.
- F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.
- G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond will govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate for Convenience*

- A. Upon 7 days' written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
 - 1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
 - 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and
 - 3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.
- B. Contractor shall not be paid for any loss of anticipated profits or revenue, post-termination overhead costs, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

- A. If, through no act or fault of Contractor, (1) ~~the Work is suspended for more than 90 consecutive days by Owner, or~~ under an order of court or other public authority, or (2)

Engineer or Owner fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon 7 days' written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.

- B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, 7 days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17—FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

- A. *Disputes Subject to Final Resolution:* The following disputed matters are subject to final resolution under the provisions of this article:
1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full, pursuant to Article 12; and
 2. Disputes between Owner and Contractor concerning the Work, or obligations under the Contract Documents, that arise after final payment has been made.
- B. *Final Resolution of Disputes:* For any dispute subject to resolution under this article, Owner or Contractor may:
1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions;
 2. agree with the other party to submit the dispute to another dispute resolution process; or
 3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18—MISCELLANEOUS

18.01 *Giving Notice*

- A. Whenever any provision of the Contract requires the giving of written notice to Owner, Engineer, or Contractor, it will be deemed to have been validly given only if delivered:
1. in person, by a commercial courier service or otherwise, to the recipient's place of business;
 2. by registered or certified mail, postage prepaid, to the recipient's place of business; or

3. by e-mail to the recipient, with the words "Formal Notice" or similar in the e-mail's subject line.

18.02 *Computation of Times*

- A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

18.03 *Cumulative Remedies*

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 *Limitation of Damages*

- A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 *No Waiver*

- A. A party's non-enforcement of any provision will not constitute a waiver of that provision, nor will it affect the enforceability of that provision or of the remainder of this Contract.

18.06 *Survival of Obligations*

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination of the Contract or of the services of Contractor.

18.07 *Controlling Law*

- A. ~~This Contract is to be governed by the law of the state in which the Project is located. This Agreement and all work related to this Project shall be governed by the laws of the State of Missouri and shall be litigated in Jackson County, Missouri.~~

18.08 *Assignment of Contract*

- A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party to this Contract of any rights under or interests in the Contract will be binding on the other party without the written consent of the party sought to be bound; and, specifically but without limitation, money that may become due and money that is due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no

assignment will release or discharge the assignor from any duty or responsibility under the Contract.

18.09 *Successors and Assigns*

- A. Owner and Contractor each binds itself, its successors, assigns, and legal representatives to the other party hereto, its successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

18.10 *Headings*

- A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

SUPPLEMENTARY CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared By



Endorsed By



SUPPLEMENTARY CONDITIONS OF THE CONSTRUCTION CONTRACT

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SUPPLEMENTARY CONDITIONS OF THE CONSTRUCTION CONTRACT

These Supplementary Conditions amend or supplement EJCDC® C-700, Standard General Conditions of the Construction Contract (2018). The General Conditions remain in full force and effect except as amended.

The terms used in these Supplementary Conditions have the meanings stated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to both the singular and plural thereof.

The address system used in these Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix "SC" added—for example, "Paragraph SC-4.05."

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

SC-1.01 Add the following Defined Terms

- SC-D1 *Abnormal Weather Conditions* – Describes any weather condition that deviate more than one standard deviation from the mean. Nowdata for the Kansas City area, available through the National Weather Service, will be used in any claim for Abnormal Weather Conditions. For claims regarding rain events, only rain events exceeding 0.1 inch in a 24 hour period will be considered in any analysis and/or days in which the reported low outdoor air temperature is equal to or less than 20 degrees Fahrenheit.
- SC-D2 *EJCDC C-700 Standard General Conditions* – *The EJCDC Standard General Conditions may be abbreviated to GC-700 or C-700.*
- SC-D3 *Re-start or Startup* – *The terms "re-start" or "startup" means the placement of that component or facility back into service. The sequencing shall provide for periods when new facilities are started up and trial operations completed prior to their commissioning for full-time service.*
- SC-D4 *Shutdown or Shut down* – *The terms "shutdown" or "shut down" means the component or facility in question is not in active service. It is off-line and not performing its intended function. However, it is not necessarily drained, dismantled or unusable.*
- SC-D5 *Subsidiary* – *Subsidiary work is incidental work done in the performance of the items listed in the Agreement. There is no payment for subsidiary work.*

ARTICLE 2—PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

SC-2.01 Delete Paragraphs 2.01.B. and C. in their entirety and insert the following in their place:

- B. *Evidence of Contractor's Insurance:* When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner copies of the policies (including all endorsements, and identification of applicable self-insured retentions and deductibles) of insurance required to be provided by Contractor in this Contract. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

- C. *Evidence of Owner's Insurance:* After receipt from Contractor of the signed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor copies of the policies of insurance to be provided by Owner in this Contract (if any). Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

2.02 *Copies of Documents*

SC-2.02 Remove Paragraph 2.02.B in its entirety and replace with the following new paragraphs immediately after Paragraph 2.02.A:

- B. Contractor shall not modify, alter or change the electronic format of the Contract Documents and shall not use any portions thereof for any other use whatsoever.
- C. Owner shall maintain and safeguard at least one original printed electronic record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

SC-2.02 Delete Paragraph 2.02.A in its entirety and insert the following new paragraph in its place:

- A. Owner shall furnish to Contractor **1** printed copy of conformed Contract Documents incorporating and integrating all Addenda and any amendments negotiated prior to the Effective Date of the Contract (including one fully signed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies of the conformed Contract Documents will be furnished upon request at the cost of reproduction.

2.06 *Electronic Transmittals*

SC-2.06 Delete Paragraphs 2.06.B and 2.06.C in their entirety and insert the following in their place:

- B. *Electronic Documents Protocol:* The parties shall conform to the following provisions in Paragraphs 2.06.B and 2.06.C, together referred to as the Electronic Documents Protocol ("EDP" or "Protocol") for exchange of electronic transmittals.

1. *Basic Requirements*

- a. To the fullest extent practical, the parties agree to and will transmit and accept Electronic Documents in an electronic or digital format using the procedures described in this Protocol. Use of the Electronic Documents and any information contained therein is subject to the requirements of this Protocol and other provisions of the Contract.
- b. The contents of the information in any Electronic Document will be the responsibility of the transmitting party.
- c. Electronic Documents as exchanged by this Protocol may be used in the same manner as the printed versions of the same documents that are exchanged using non-electronic format and methods, subject to the same governing requirements, limitations, and restrictions, set forth in the Contract Documents.
- d. Except as otherwise explicitly stated herein, the terms of this Protocol will be incorporated into any other agreement or subcontract between a party and any

third party for any portion of the Work on the Project, or any Project-related services, where that third party is, either directly or indirectly, required to exchange Electronic Documents with a party or with Engineer. Nothing herein will modify the requirements of the Contract regarding communications between and among the parties and their subcontractors and consultants.

- e. When transmitting Electronic Documents, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items resulting from the receiving party's use of software application packages, operating systems, or computer hardware differing from those established in this Protocol.
- f. Nothing herein negates any obligation 1) in the Contract to create, provide, or maintain an original printed record version of Drawings and Specifications, signed and sealed according to applicable Laws and Regulations; 2) to comply with any applicable Law or Regulation governing the signing and sealing of design documents or the signing and electronic transmission of any other documents; or 3) to comply with the notice requirements of Paragraph 18.01 of the General Conditions.

2. *System Infrastructure for Electronic Document Exchange*

- a. Each party will provide hardware, operating system(s) software, internet, e-mail, and large file transfer functions ("System Infrastructure") at its own cost and sufficient for complying with the EDP requirements. With the exception of minimum standards set forth in this EDP, and any explicit system requirements specified by attachment to this EDP, it is the obligation of each party to determine, for itself, its own System Infrastructure.
 - 1) The maximum size of an email attachment for exchange of Electronic Documents under this EDP is 10 MB. Attachments larger than that may be exchanged using large file transfer functions or physical media.
 - 2) Each Party assumes full and complete responsibility for any and all of its own costs, delays, deficiencies, and errors associated with converting, translating, updating, verifying, licensing, or otherwise enabling its System Infrastructure, including operating systems and software, for use with respect to this EDP.
- b. Each party is responsible for its own system operations, security, back-up, archiving, audits, printing resources, and other Information Technology ("IT") for maintaining operations of its System Infrastructure during the Project, including coordination with the party's individual(s) or entity responsible for managing its System Infrastructure and capable of addressing routine communications and other IT issues affecting the exchange of Electronic Documents.
- c. Each party will operate and maintain industry-standard, industry-accepted, ISO-standard, commercial-grade security software and systems that are intended to protect the other party from: software viruses and other malicious software like worms, trojans, adware; data breaches; loss of confidentiality; and other threats in the transmission to or storage of information from the other parties, including transmission of Electronic Documents by physical media such as CD/DVD/flash drive/hard drive. To the extent that a party maintains and operates such security

software and systems, it shall not be liable to the other party for any breach of system security.

- d. In the case of disputes, conflicts, or modifications to the EDP required to address issues affecting System Infrastructure, the parties shall cooperatively resolve the issues; but, failing resolution, the Owner is authorized to make and require reasonable and necessary changes to the EDP to effectuate its original intent. If the changes cause additional cost or time to Contractor, not reasonably anticipated under the original EDP, Contractor may seek an adjustment in price or time under the appropriate process in the Contract.
- e. Each party is responsible for its own back-up and archive of documents sent and received during the term of the contract under this EDP, unless this EDP establishes a Project document archive, either as part of a mandatory Project website or other communications protocol, upon which the parties may rely for document archiving during the specified term of operation of such Project document archive. Further, each party remains solely responsible for its own post-Project back-up and archive of Project documents after the term of the Contract, or after termination of the Project document archive, if one is established, for as long as required by the Contract and as each party deems necessary for its own purposes.
- f. If a receiving party receives an obviously corrupted, damaged, or unreadable Electronic Document, the receiving party will advise the sending party of the incomplete transmission.
- g. The parties will bring any non-conforming Electronic Documents into compliance with the EDP. The parties will attempt to complete a successful transmission of the Electronic Document or use an alternative delivery method to complete the communication.
- h. The Owner will operate a Project information management system (also referred to in this EDP as "Project Website") for use of Owner, Engineer and Contractor during the Project for exchange and storage of Project-related communications and information. Except as otherwise provided in this EDP or the General Conditions, use of the Project Website by the parties as described in this Paragraph will be mandatory for exchange of Project documents, communications, submittals, and other Project-related information. The following conditions and standards will govern use of the Project Website:
 - 1) The project website, called DocEx, will be active from the Notice of Award date through the issuance of final payment and release of retainage.
 - 2) Google Chrome is the recommend web browser for using DocEx. Software licensing will be obtained by the Owner. Contractor and Engineer will have access to the site by creating individual user accounts with the software as service provider.
 - 3) DocEx will be the primary document management tool. Types of documents include submittals, pay applications, change orders, certified payroll forms, and all other documents requested by the Owner. DocEx will be the primary tool for routing submittals, RFIs, or other documents requiring review and approval by the Owner, Engineer, Contractor, or all three.

C. *Software Requirements for Electronic Document Exchange; Limitations*

1. Each party will acquire the software and software licenses necessary to create and transmit Electronic Documents and to read and to use any Electronic Documents received from the other party (and if relevant from third parties), using the software formats required in this section of the EDP.
 - a. Prior to using any updated version of the software required in this section for sending Electronic Documents to the other party, the originating party will first notify and receive concurrence from the other party for use of the updated version or adjust its transmission to comply with this EDP.
2. The parties agree not to intentionally edit, reverse engineer, decrypt, remove security or encryption features, or convert to another format for modification purposes any Electronic Document or information contained therein that was transmitted in a software data format, including Portable Document Format (PDF), intended by sender not to be modified, unless the receiving party obtains the permission of the sending party or is citing or quoting excerpts of the Electronic Document for Project purposes.
3. Software and data formats for exchange of Electronic Documents will conform to the requirements set forth in Exhibit A to this EDP, including software versions, if listed.

SC-2.06 Supplement Paragraph 2.06 of the General Conditions by adding the following paragraph:

D. *Requests by Contractor for Electronic Documents in Other Formats*

1. Release of any Electronic Document versions of the Project documents in formats other than those identified in the Electronic Documents Protocol (if any) or elsewhere in the Contract will be at the sole discretion of the Owner.
2. To extent determined by Owner, in its sole discretion, to be prudent and necessary, release of Electronic Documents versions of Project documents and other Project information requested by Contractor ("Request") in formats other than those identified in the Electronic Documents Protocol (if any) or elsewhere in the Contract will be subject to the provisions of the Owner's response to the Request, and to the following conditions to which Contractor agrees:
 - a. The content included in the Electronic Documents created by Engineer and covered by the Request was prepared by Engineer as an internal working document for Engineer's purposes solely, and is being provided to Contractor on an "AS IS" basis without any warranties of any kind, including, but not limited to any implied warranties of fitness for any purpose. As such, Contractor is advised and acknowledges that the content may not be suitable for Contractor's application, or may require substantial modification and independent verification by Contractor. The content may include limited resolution of models, not-to-scale schematic representations and symbols, use of notes to convey design concepts in lieu of accurate graphics, approximations, graphical simplifications, undocumented intermediate revisions, and other devices that may affect subsequent reuse.
 - b. Electronic Documents containing text, graphics, metadata, or other types of data that are provided by Engineer to Contractor under the request are only for convenience of Contractor. Any conclusion or information obtained or derived from such data will be at the Contractor's sole risk and the Contractor waives any

claims against Engineer or Owner arising from use of data in Electronic Documents covered by the Request.

- c. Contractor shall indemnify and hold harmless Owner and Engineer and their subconsultants from all claims, damages, losses, and expenses, including attorneys' fees and defense costs arising out of or resulting from Contractor's use, adaptation, or distribution of any Electronic Documents provided under the Request.
 - d. Contractor agrees not to sell, copy, transfer, forward, give away or otherwise distribute this information (in source or modified file format) to any third party without the direct written authorization of Engineer, unless such distribution is specifically identified in the Request and is limited to Contractor's subcontractors. Contractor warrants that subsequent use by Contractor's subcontractors complies with all terms of the Contract Documents and Owner's response to Request.
 - e. Release of Electronic Documents by Engineer requires Contractor to execute a media release agreement with the Engineer.
3. In the event that Owner elects to provide or directs the Engineer to provide to Contractor any Contractor-requested Electronic Document versions of Project information that is not explicitly identified in the Contract Documents as being available to Contractor, the Owner shall be reimbursed by Contractor on an hourly basis (at **\$200** per hour) for any engineering costs necessary to create or otherwise prepare the data in a manner deemed appropriate by Engineer.

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

No changes to Article 3.

SC-3.01 Delete Paragraph 3.01.C in its entirety.

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

4.05 *Delays in Contractor's Progress*

SC-4.05 Amend Paragraph 4.05.C by adding the following subparagraphs:

5. *Weather-Related Delays*
- a. If "abnormal weather conditions" as set forth in Paragraph 4.05.C.2 of the General Conditions and as defined in Paragraph 1.01 of the Supplementary Conditions are the basis for a request for an equitable adjustment in the Contract Times, such request must be documented by data substantiating each of the following: 1) that weather conditions were abnormal for the period of time in which the delay occurred, 2) that such weather conditions could not have been reasonably anticipated, and 3) that such weather conditions had an adverse effect on the Work as scheduled.
 - b. The existence of abnormal weather conditions will be determined on a month-by-month basis in accordance with the following:
 - 1) Every calendar day on which one or more of the following conditions exist will be considered a "bad weather day":

- i) Total precipitation (as rain equivalent): rain events reported by the National Weather Service (NWS) Nowdata for the Kansas City area exceeding 0.1 inch in a 24 hour period will be considered in any analysis. (as rain equivalent, based on the snow/rain conversion indicated in the table entitled Foreseeable Bad Weather Days; such table is hereby incorporated in this SC-4.05.C by reference.
 - ii) The reported low outdoor air temperature reported by the NWS Nowdata for the Kansas City area, is equal to or less than the following low temperature threshold: 20 degrees Fahrenheit;
- 2) Determination of actual bad weather days during performance of the Work will be based on the weather records measured and recorded by National Weather Service (NWS) Nowdata for the Kansas City area.
 - 3) Contractor shall anticipate the number of foreseeable bad weather days per month indicated in the table in Exhibit B—Foreseeable Bad Weather Days.
 - 4) In each month, every bad weather day exceeding the number of foreseeable bad weather days established in the table in Exhibit B—Foreseeable Bad Weather Days will be considered as “abnormal weather conditions.”

ARTICLE 5—SITE, SUBSURFACE AND PHYSICAL CONDITIONS, HAZARDOUS ENVIRONMENTAL CONDITIONS

5.03 *Subsurface and Physical Conditions*

SC-5.03 Add the following new paragraphs immediately after Paragraph 5.03.D:

- E. The following table lists the reports of explorations and tests of subsurface conditions at or adjacent to the Site that reports and drawings that Engineer used in preparing the Bidding Documents:

Report Title	Date of Report	Prepared by:
Appendix I Boring Logs from Report of Geotechnical Investigation	July 18, 2023	KTI

- F. Contractor may examine copies of reports and drawings identified in SC-5.03.E that were not included with the Bidding Documents may request electronic copies from the Owner during regular business hours, or may request copies from the Engineer.

5.06 *Hazardous Environmental Conditions*

SC-5.06 Add the following new paragraphs immediately after Paragraph 5.06.A.3:

- 4. The following table lists the reports of explorations and tests related to hazardous environmental conditions at or adjacent to the Site that reports and drawings that Engineer used in preparing the Bidding Documents:

Report Title	Date of Report	Prepared by:
No such reports		

ARTICLE 6—BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

SC-6.01 Add the following paragraphs immediately after Paragraph 6.01.A:

1. *Required Performance Bond Form:* The performance bond that Contractor furnishes will be in the form of EJCDC® C-610, Performance Bond (2010, 2013, or 2018 edition).
2. *Required Payment Bond Form:* The payment bond that Contractor furnishes will be in the form of EJCDC® C-615, Payment Bond (2010, 2013, or 2018 edition).

SC-6.01 Add the following paragraphs immediately after Paragraph 6.01.B:

1. After Substantial Completion, Contractor shall furnish a warranty bond issued in the form of EJCDC® C-612, Warranty Bond (2018). The warranty bond must be in a bond amount of **10** percent of the final Contract Price. The warranty bond period will extend to a date **1** year after Substantial Completion of the Work. Contractor shall deliver the fully executed warranty bond to Owner prior to or with the final application for payment, and in any event no later than 11 months after Substantial Completion.
2. The warranty bond must be issued by the same surety that issues the performance bond required under Paragraph 6.01.A of the General Conditions.

6.02 *Insurance—General Provisions*

SC-6.02 Add the following paragraph immediately after Paragraph 6.02.B:

1. Contractor may obtain worker's compensation insurance from an insurance company that has not been rated by A.M. Best, provided that such company (a) is domiciled in the state in which the Project is located, (b) is certified or authorized as a worker's compensation insurance provider by the appropriate state agency, and (c) has been accepted to provide worker's compensation insurance for similar projects by the state within the last 12 months.

SC-6.02 Add the following paragraph immediately after Paragraph 6.02.H.2 of the General Conditions:

3. If any work of the Project is subcontracted in anyway, Contractor shall execute a written agreement(s) with its subcontractors containing the indemnification provisions and insurance requirements set forth herein protecting the Owner and Contractor. Contractor shall be responsible for executing any agreements with its subcontractors and obtaining certificates of insurance verifying the insurance.

6.03 *Contractor's Insurance*

SC-6.03 Supplement Paragraph 6.03 with the following provisions after Paragraph 6.03.D:

- E. *Other Additional Insureds:* As a supplement to the provisions of Paragraph 6.03.D of the General Conditions, the commercial general liability, automobile liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies must include as additional insureds (in addition to Owner and Engineer) the following: **No additional insureds.**
- F. *Workers' Compensation and Employer's Liability:* To the fullest extent permitted by law, Contractor shall purchase and maintain workers' compensation and employer's liability insurance, including, as applicable, United States Longshoreman and Harbor Workers'

Compensation Act, and foreign voluntary workers' compensation (from available sources, notwithstanding the jurisdictional requirement of Paragraph 6.02.B of the General Conditions).

Workers' Compensation and Related Policies	Policy limits of not less than:
Workers' Compensation	
State	Statutory
Applicable Federal (e.g., Longshoreman's)	Statutory
Foreign voluntary workers' compensation (employer's responsibility coverage), if applicable	Statutory
Employer's Liability	
Each accident	\$1,000,000
Each employee	\$1,000,000
Policy limit	\$1,000,000

- G. *Commercial General Liability—Claims Covered:* Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against claims for:
1. damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees,
 2. damages insured by reasonably available personal injury liability coverage, and
 3. damages because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.
- H. *Commercial General Liability—Form and Content:* Contractor's commercial liability policy must be written on a 1996 (or later) Insurance Services Organization, Inc. (ISO) commercial general liability form (occurrence form) and include the following coverages and endorsements:
1. Products and completed operations coverage.
 - a. Such insurance must be maintained for three years after final payment.
 - b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.
 2. Blanket contractual liability coverage, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
 3. Severability of interests and no insured-versus-insured or cross-liability exclusions.
 4. Underground, explosion, and collapse coverage.

5. Personal and Advertising injury coverage.
 6. Bodily injury coverage
 7. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together). If Contractor demonstrates to Owner that the specified ISO endorsements are not commercially available, then Contractor may satisfy this requirement by providing equivalent endorsements.
 8. For design professional additional insureds, ISO Endorsement CG 20 32 07 04 "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.
- I. *Commercial General Liability—Excluded Content:* The commercial general liability insurance policy, including its coverages, endorsements, and incorporated provisions, must not include any of the following:
1. Any modification of the standard definition of "insured contract" (except to delete the railroad protective liability exclusion if Contractor is required to indemnify a railroad or others with respect to Work within 50 feet of railroad property).
 2. Any exclusion for water intrusion or water damage.
 3. Any provisions resulting in the erosion of insurance limits by defense costs other than those already incorporated in ISO form CG 00 01.
 4. Any exclusion of coverage relating to earth subsidence or movement.
 5. Any exclusion for the insured's vicarious liability, strict liability, or statutory liability (other than worker's compensation).
 6. Any limitation or exclusion based on the nature of Contractor's work.
 7. Any professional liability exclusion broader in effect than the most recent edition of ISO form CG 22 79.
- J. *Commercial General Liability—Minimum Policy Limits*

Commercial General Liability	Policy limits of not less than:
General Aggregate	\$3,000,000
Products—Completed Operations Aggregate	\$3,000,000
Personal and Advertising Injury	\$1,000,000
Bodily Injury and Property Damage—Each Occurrence	\$3,000,000

- K. *Automobile Liability:* Contractor shall purchase and maintain automobile liability insurance for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle. The automobile liability policy must be at least as broad as ISO coverage code "1" "any auto" policy form CA 00 01 12 93 or equivalent thereof and must be written on an occurrence basis. If the Work involves the transportation of hazardous materials or waste, as defined by the Clean Water Act, as amended, Contractor's automobile liability policy shall be endorsed to contain Transportation Pollution Liability insurance covering materials to be transported by

Contractor pursuant to this Contract and such coverage shall be at least as broad as policy form CA 99 48 03 06. This coverage may also be provided on the Contractor's Pollution Liability policy. Owner, its agents, representatives, officers, directors, officials and employees shall be cited and endorsed as an Additional Insured under ISO Business Auto policy Designated Insured Endorsement form CA 20 48 or equivalent.

Automobile Liability	Policy limits of not less than:
Bodily Injury	
Each Person	\$3,000,000
Each Accident	\$3,000,000
Property Damage	
Each Accident	\$3,000,000
[or]	
Combined Single Limit	
Combined Single Limit (Bodily Injury and Property Damage)	\$3,000,000

- L. *Umbrella or Excess Liability:* Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the Paragraphs above. The coverage afforded must be at least as broad as that of each and every one of the underlying policies.

Excess or Umbrella Liability	Policy limits of not less than:
Each Occurrence	\$2,000,000
General Aggregate	\$2,000,000

- M. *Using Umbrella or Excess Liability Insurance to Meet CGL and Other Policy Limit Requirements:* Contractor may meet the policy limits specified for employer's liability, commercial general liability, and automobile liability through the primary policies alone, or through combinations of the primary insurance policy's policy limits and partial attribution of the policy limits of an umbrella or excess liability policy that is at least as broad in coverage as that of the underlying policy, as specified herein. If such umbrella or excess liability policy was required under this Contract, at a specified minimum policy limit, such umbrella or excess policy must retain a minimum limit of \$2,000,000 after accounting for partial attribution of its limits to underlying policies, as allowed above.
- N. *Contractor's Pollution Liability Insurance:* If the Work involves hazardous materials or waste, as defined by the Clean Water Act, as amended, Contractor shall purchase and maintain a policy covering third-party injury and property damage, including cleanup costs, as a result of pollution conditions arising from Contractor's operations and completed operations. This insurance must be maintained for no less than six years after final completion.

Contractor's Pollution Liability	Policy limits of not less than:
Each Occurrence/Claim	\$3,000,000
General Aggregate	\$3,000,000

- O. *Contractor's Professional Liability Insurance:* If Contractor will provide or furnish professional services under this *Contract*, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance must cover negligent acts, errors, or omissions in the performance of professional design or related services by the insured or others for whom the insured is legally liable. The insurance must be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. The retroactive date on the policy must pre-date the commencement of furnishing services on the Project.

Contractor's Professional Liability	Policy limits of not less than:
Each Claim	\$3,000,000
Annual Aggregate	\$3,000,000

- P. *Railroad Protective Liability Insurance:* Prior to commencing any Work within 50 feet of railroad-owned and controlled property, Contractor shall (1) endorse its commercial general liability policy with ISO CG 24 17, removing the contractual liability exclusion for work within 50 feet of a railroad, (2) purchase and maintain railroad protective liability insurance meeting the following requirements, (3) furnish a copy of the endorsement to Owner, and (4) submit a copy of the railroad protective policy and other railroad-required documentation to the railroad, and notify Owner of such submittal.

Railroad Protective Liability Insurance	Policy limits of not less than:
Each Claim	\$3,000,000
Aggregate	\$3,000,000

- Q. *Unmanned Aerial Vehicle Liability Insurance:* If Contractor uses unmanned aerial vehicles (UAV—commonly *referred* to as drones) at the Site or in support of any aspect of the Work, Contractor shall obtain UAV liability insurance in the amounts stated; name Owner, Engineer, and all individuals and entities identified in the Supplementary Conditions as additional insureds; and provide a certificate to Owner confirming Contractor's compliance with this requirement. Such insurance will provide coverage for property damage, bodily injury or death, and invasion of privacy.

Unmanned Aerial Vehicle Liability Insurance	Policy limits of not less than:
Each Claim	\$3,000,000
General Aggregate	\$3,000,000

- R. *Other Required Insurance:* **None**

6.04 *Builder's Risk and Other Property Insurance*

SC-6.04 Supplement Paragraph 6.04 of the General Conditions with the following provisions:

F. *Builder's Risk Requirements:* The builder's risk insurance must:

1. be written on a builder's risk "all risk" policy form that at a minimum includes insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment stored and in transit, and must not exclude the coverage of the following risks: fire; windstorm; hail; flood; earthquake, volcanic activity, and other earth movement; lightning; testing, riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; and water damage (other than that caused by flood).
 - a. Such policy will include an exception that results in coverage for ensuing losses from physical damage or loss with respect to any defective workmanship, methods, design, or materials exclusions.
 - b. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake, volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance will be provided through other insurance policies acceptable to Owner and Contractor.
2. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.
3. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of contractors, engineers, and architects).
4. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier). If this coverage is subject to a sublimit, such sublimit shall provide for the full cost of replacement for the entire Project at the time of any loss.
5. extend to cover damage or loss to insured property while in transit. If this coverage is subject to a sublimit, such sublimit shall provide for the full cost of replacement for the entire Project at the time of any loss.
6. allow for the waiver of the insurer's subrogation rights, as set forth in this Contract.
7. allow for partial occupancy or use by Owner by endorsement, and without cancellation or lapse of coverage.

8. include performance/hot testing and start-up, if applicable.
9. be maintained in effect until the Work is complete, as set forth in Paragraph 15.06.D of the General Conditions, or until written confirmation of Owner's procurement of property insurance following Substantial Completion, whichever occurs first.
10. include as named insureds the Owner, Contractor, Subcontractors (of every tier), and any other individuals or entities required by this Contract to be insured under such builder's risk policy. For purposes of Paragraphs 6.04, 6.05, and 6.06 of the General Conditions, and this and all other corresponding Supplementary Conditions, the parties required to be insured will be referred to collectively as "insureds."
11. include, in addition to the Contract Price amount, the value of the following equipment and materials to be installed by the Contractor but furnished by the Owner or third parties:
 - a. **None**
12. If debris removal in connection with repair or replacement of insured property is subject to a coverage sublimit, such sublimit shall provide for the full cost of replacement for the entire Project at the time of any loss.
13. name the City as a loss payee as its interest may appear.

SC-6.04 Supplement Paragraph 6.04 of the General Conditions with the following provisions:

- H. *Builder's Risk and Other Property Insurance Deductibles:* The purchaser of any required builder's risk, installation floater, or other property insurance will be responsible for costs not covered because of the application of a policy deductible.
 1. The builder's risk policy (or if applicable the installation floater) will be subject to a deductible amount shall provide for the full cost of replacement for the entire Project at the time of any loss for direct physical loss in any one occurrence.

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.03 *Labor; Working Hours*

SC-7.03.C Add the following new subparagraphs immediately after Paragraph 7.03.C:

1. Per Code of Ordinances Section 17-254, working hours within the City of Lee's Summit are 7:00 a.m. to 10:00 p.m. Requests to work beyond these hours must be filed with the Owner 7 calendar days in advance, and a special variance may be issued per Ordinance 17-255.1. If the request is justified, Owner will then request a special variance from the Chief of Police.
2. Owner's 10 legal holidays are New Year's Day, Martin Luther King Jr. Holiday, Presidents Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving, Christmas Day, and either December 24 or 26.
3. Work on weekends or on holidays must be approved by the Owner 72 hours in advance.

SC-7.03 Add the following new paragraph immediately after Paragraph 7.03.C:

- D. Owner shall be responsible for the cost of any overtime pay or other expense incurred by the Owner for Engineer's services (including those of the Resident Project Representative, if any), Owner's representative, and construction observation services, occasioned by the performance of Work on Saturday, Sunday, any legal holiday, or as overtime on any regular work day. If Contractor is responsible but does not pay, or if the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under Article 15.

SC-7.03 SC-7.04 Add the following new paragraphs immediately after Paragraph 7.04.C

D. Field Offices and Sheds.

1. General Requirements Included:

- a. As required for the Work, Contractor shall furnish, install and maintain field offices, storage and work sheds. All offices, trailers or sheds shall be subject to the Owner's approval.
- b. If a Contractor's field office is established, it shall be the headquarters of their representative who is authorized to receive drawings, instructions, or other communication or articles. Any communication given to the said representative or delivered at Contractor's field office, in their absence, shall be deemed to have been delivered to Contractor.

2. Requirements for Field Offices

- a. Field Office for Owner (or their Representative) is not required. The Owner's representative will use existing office space at the City of Lee's Summit City Hall, 220 SE Green Street.
- b. Field Offices (whether for Contractor or Owner) shall be:
 - i. In good condition, structurally sound and weathertight with floors raised above ground.
 - ii. All utilities shall be in service when the office has been placed on site.
 - iii. Automatic heating and mechanical cooling equipment shall be able to maintain appropriate conditions for occupants and/or storage requirements.
 - iv. All offices shall remain on site, with all utilities in service, until the work is complete, or the Contractor is notified by the Owner.

3. Requirements for Storage Sheds

- a. Appropriate to the trade, with dimensions adequate for storage and handling of products.
- b. Ventilation, heating and cooling shall comply with specified codes, temperatures and requirements for the products stored.

E. Temporary Electricity, Heat, Telephone, and Data.

1. The Contractor shall provide all temporary utilities required for construction and shall remove all such facilities at end of Work.
2. Contractor shall clean and repair damage caused by installation or use of temporary facilities. Restore existing facilities used during construction to original (or specified) condition.
3. Except as specifically noted herein, all costs of temporary utilities and controls are considered incidental to the Contract and shall be included in the Contract Price.
4. Contractor shall make all arrangements, pay all costs, install meters, schedule building permit inspections and other work as necessary to provide electricity as required for construction.
5. Contractor shall provide temporary lighting for construction operations.
6. Owner will furnish electrical power for startup and testing of equipment to be permanently incorporated into this Project. The Owner will pay the utility bill for such electrical power furnished by the Owner.
7. Electric meters that will become permanent following final acceptance will be in the name of the Owner. Temporary electric meters necessary for construction will be in the name of the Contractor.
8. Contractor is responsible for obtaining the owner's building permit from the City's Codes Administration Department before electrical service can be delivered to a power supply. The Contractor shall contact the City's Codes Administration Division for an electrical inspection when a power supply is ready for operation. The City Inspector will obtain an address for the power supply, which the Contractor shall use when dealing with the electrical utility company.
9. Contractor shall make all arrangements, pay all costs and provide heat and ventilation as required to maintain specified conditions for construction operations, and to protect materials and finishes from damage due to temperature or humidity.
10. Contractor shall provide ventilation of enclosed areas to cure materials to disperse humidity and to prevent accumulations of dust, fumes, vapors or gases.

SC-7.07 Add the following new paragraph immediately after Paragraph 7.07.M8.06.B

- N. Second tier subcontracting will not be allowed. Second tier subcontracting refers to the hiring or use of subcontractors by the Contractor's Subcontractors. It will be the responsibility of the Contractor to ensure that Subcontractors do not subcontract any portion of their Work.
- O. Contractor must perform at least 30% of the Work itself.

7.10 Taxes

SC-7.10 Add a new paragraph immediately after Paragraph 7.10.A:

- B. Owner is exempt from payment of sales and compensating use taxes of the State of Missouri and of cities and counties thereof on all materials to be incorporated into the Work.
 - 1. Owner will furnish the required certificates of tax exemption to Contractor for use in the purchase of supplies and materials to be incorporated into the Work.
 - 2. Owner's exemption does not apply to construction tools, machinery, equipment or other property purchased by or leased by Contractor, or to supplies or materials not incorporated into the Work.

7.13 *Safety and Protection*

SC-7.13 Insert the following new paragraphs immediately after Paragraph 7.13.J:

- K. Safety Training
 - 1. In accordance with Section 292.675 RSMo, Contractor shall provide a ten (10) hour Occupational Safety and Health Administration (OSHA) construction safety program for all employees who will be on-site at the Project. The construction safety program shall include a course in construction safety and health that is approved by OSHA or a similar program approved the Missouri Department of Labor and Industrial Relations, which is at least as stringent as an approved OSHA program, as required by Section 292.675 RSMo.
 - 2. Contractor shall require its on-site employees to complete a construction safety program within 60 days after the work on the Project commences.
 - 3. Contractor acknowledges and agrees that any of Contractor's employees found on the Project site without documentation of successful completion of a construction safety program shall be required to produce such documentation within 20 days, or will be subject to removal from the Project.
 - 4. Contractor shall require all of its Subcontractors to comply with the requirements of this Section and Section 292.675 RSMo.
- L. Notice of Penalties for Failure to Provide Safety Training
 - 1. Pursuant to Section 292.675 RSMo, contractor shall forfeit to Owner as a penalty two thousand five hundred dollars (\$2,500.00), plus one hundred dollars (\$100.00) for each on-site employee employed by the Contractor or its Subcontractor, for each calendar day, or portion thereof, such on-site employee is employed without the construction safety training required in Section 7.13.K.
 - 2. The penalty described in 7.13.L.1 shall not begin to accrue until the time periods described in Section 7.13.k. 2 and K.3 have elapsed.
 - 3. Violations of Section 7.13.K and imposition of the penalty described in the Section shall be investigated and determined by the Missouri Department of Labor and Industrial Relations.

ARTICLE 8—OTHER WORK AT THE SITE

8.02 *Coordination*

SC-8.04 Add the following new Paragraph 8.04 immediately after Paragraph 8.03:

8.04 *Claims Between Contractors*

- A. Should Contractor cause damage to the work or property of any other contractor at the Site, or should any claim arising out of Contractor's performance of the Work at the Site be made by any other contractor against Contractor, Owner, or Engineer, Contractor shall promptly attempt to settle with such other contractor by agreement, or to otherwise resolve the dispute exclusively with such other contractor by arbitration or at law.
- B. Contractor shall, to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner, Engineer and the officers, directors, members, partners, employees, agents and other consultants and subcontractors of each and any of them from and against all claims, costs, losses and damages (including, but not limited to, fees and charges of engineers, architects, attorneys, and other professionals and court and arbitration costs) arising directly, indirectly or consequentially out of any action, legal or equitable, brought by any other contractor against Owner or Engineer to the extent said claim is based on or arises out of Contractor's performance of the Work. Should another contractor cause damage to the Work or property of Contractor or should the performance of work by any other contractor at the Site give rise to any other Claim, Contractor shall not institute any action, legal or equitable, against Owner or Engineer or permit any action against any of them to be maintained and continued in its name or for its benefit in any court or before any arbiter which seeks to impose liability on or to recover damages from Owner or Engineer on account of any such damage or Claim.
- C. If Contractor is delayed at any time in performing or furnishing Work by any act or neglect of another contractor, and Owner and Contractor are unable to agree as to the extent of any adjustment in Contract Times attributable thereto, Contractor may make a Claim for an extension of times in accordance with Article 11. An extension of the Contract Times shall be Contractor's exclusive remedy with respect to Owner and Engineer for any delay, disruption, interference, or hindrance caused by any other contractor.

ARTICLE 9—OWNER'S RESPONSIBILITIES

9.13 *Owner's Site Representative*

SC-9.13 Add the following new paragraph immediately after Paragraph 9.12 of the General Conditions:

9.13 *Owner's Site Representative*

SC-9.13 Add the following new paragraph immediately after Paragraph 9.12 of the General Conditions:

9.13 *Owner's Site Representative*

- A. Owner will furnish an "Owner's Site Representative," who will also serve as the "Resident Project Representative," (RPR) to represent Owner at the Site and assist Owner in observing the progress and quality of the Work. The Owner's Site Representative is not Engineer's

consultant, agent, or employee. Owner's Site Representative will be the City of Lee's Summit Public Works Department. The authority and responsibilities of Owner's Site Representative follow:

1. Furnish a Resident Project Representative.
 2. Change of Working Hours.
 3. Field orders, Work Change Directives, Change Orders.
 5. Monitor Contractor's schedule, progress, schedule and conduct progress meetings.
 6. Coordinate Contractor's schedule, work and access as needed with the Owner's Cedar Creek Interceptor project work occurring in the same vicinity and at the time as this project.
 7. Coordinate construction services provided by the Engineer as needed.
 8. In the event that portions of the Contract Documents indicate that the Engineer is to handle, provide input, or receive notices or filings with regard to any of the above referenced matters, this Supplementary Condition 9.13 shall prevail.
- B. The RPR will be Owner's representative at the Site. RPR's dealings in matters pertaining to the Work in general will be with Owner, Engineer and Contractor. RPR's dealings with Subcontractors or subconsultants will only be through or with the full knowledge or approval of Contractor or the Engineer. The RPR will:
1. *Conferences and Meetings:* Attend meetings with Contractor and Engineer, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings (but not including Contractor's safety meetings), and as appropriate prepare and circulate copies of minutes thereof.
 2. *Safety Compliance:* Comply with Site safety programs, as they apply to RPR, and if required to do so by such safety programs, receive safety training specifically related to RPR's own personal safety while at the Site.
 3. *Liaison*
 - a. Serve as Owner's liaison with Contractor. Working principally through Contractor's authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.
 - b. Serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on-Site operations.
 - c. Assist in obtaining from Engineer additional details or information, when required for Contractor's proper execution of the Work.
 4. *Review of Work; Defective Work*
 - a. Conduct on-Site observations of the Work to assist Owner in determining, to the extent set forth in Paragraph 10.02, if the Work is in general proceeding in accordance with the Contract Documents.
 - b. Observe whether any Work in place appears to be defective.
 - c. Observe whether any Work in place should be uncovered for observation, or requires special testing, inspection or approval.

5. *Inspections and Tests*
 - a. Observe Contractor-arranged inspections required by Laws and Regulations, including but not limited to those performed by public or other agencies having jurisdiction over the Work.
 - b. Accompany visiting inspectors representing public or other agencies having jurisdiction over the Work.
 6. *Payment Requests: Review Applications for Payment with Contractor.*
 7. *Completion*
 - a. Participate in Engineer's visits regarding Substantial Completion.
 - b. Assist in the preparation of a punch list of items to be completed or corrected.
 - c. Participate in Engineer's visit to the Site in the company of Owner and Contractor regarding completion of the Work, and prepare a final punch list of items to be completed or corrected by Contractor.
 - d. Observe whether items on the final punch list have been completed or corrected.
- C. The RPR will not:
1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including "or-equal" items).
 2. Exceed limitations of Engineer's authority as set forth in the Contract Documents.
 3. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.
 4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of construction.
 5. Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.
 6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.
 7. In consultation with the Engineer, Authorize Owner to occupy the Project in whole or in part.

ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

10.03 *Resident Project Representative*

SC-10.03 Add the following new subparagraph immediately after Paragraph 10.03.A:

1. On this Project, by agreement with the Owner, the Engineer will not furnish a Resident Project Representative to represent Engineer at the Site or assist Engineer in observing the progress and quality of the Work.

ARTICLE 11—CHANGES TO THE CONTRACT

SC-11.02 Add the following Paragraphs immediately following Paragraph 11.02.B:

B. *Change Order Procedures*

1. Requests for Change Orders shall be initiated through the Change Proposal process in Paragraph 11.09. Projects with federal funding will require MoDOT's concurrence to the Change Proposal before processing a Change Order.
2. Owner shall generate a draft Change Order utilizing the Owner's construction project management software. The draft Change Order will be uploaded into the appropriate folder for the Contractor's review and concurrence. If the contractor concurs with the draft Change Order, the Contractor shall approve and electronically sign the Change Order.
3. Owner's change order approval process is determined by the scope of the Change Order.
 - a. Change Orders which can be approved via the Owner's administrative process may be executed within five working days.
 - b. Change Orders which cannot be approved via the Owner's administrative process are submitted through the Owner's Committee and Council process. Initial Change Order approval is sought at Owner's Public Works Committee (PWC) meeting, and final approval is confirmed at Owner's City Council Meeting. Unless requested, Contractor's presence is not required at either meeting. This process requires all change order materials to be submitted 14 calendar days prior to the PWC meeting.
4. Federally funded projects require MoDOT approval of the change order before processed by the Owner. Following MoDOT's approval the Change Order follows the Owner's process describe above based on scope of the Change Order.

ARTICLE 12—CLAIMS

No changes to this Article.

ARTICLE 13—COST OF WORK; ALLOWANCES, UNIT PRICE WORK

13.01 *Cost of the Work*

SC-13.01 Delete Paragraph 13.01.B.5.c. in its entirety and insert the following in its place:

c. *Construction Equipment Rental*

- 1) Rentals of all construction equipment and machinery, and the parts thereof in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. However, in no event shall the hourly rates for hourly operating costs exceed those in the reference material cited the Supplementary Conditions All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

- 2) With respect to Work that is the result of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price (“changed Work”), included costs will be based on the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, must cease to accrue when the use thereof is no longer necessary for the changed Work.
- 3) Equipment or machinery with a value of less than \$1,000 will be considered small tools.

SC-13.01 Supplement Paragraph 13.01.C.2 by adding the following definition of small tools and hand tools:

- a. For purposes of this paragraph, “small tools and hand tools” means any tool or equipment whose current price if it were purchased new at retail would be less than \$500.

13.03 Unit Price Work

SC-13.03 Delete Paragraph 13.03.E in its entirety and insert the following in its place:

E. *Adjustments in Unit Price*

1. The unit price of an item of Unit Price Work may be subject to reevaluation and adjust under the following conditions:
 - a. If the Bid price of a particular item of Unit Price Work amounts to 15 percent or more of the Contract Price; and
 - b. the variation in the quantity of that particular item of Unit Price Work performed by the Contractor differs by more than 25 percent from the estimated quantity of such item indicated in the Agreement; and
 - c. Contractor’s unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.
 - d. If Contractor believes that Contractor has incurred additional expense as a result thereof or if Owner believes that the quantity variation entitles Owner to an adjustment in the unit price, either Owner or Contractor may make a claim for an adjustment in the Contract Price in accordance with Article 11 if the parties are unable to agree as to the effect of any such variations in the quantity of Unit Price Work.
2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor’s costs to perform such

other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.

3. Adjusted unit prices will apply to all units of that item.

ARTICLE 14—TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK

No suggested Supplementary Conditions in this Article.

ARTICLE 15—PAYMENTS TO CONTRACTOR, SET OFFS; COMPLETIONS; CORRECTION PERIOD

15.03 Substantial Completion

SC-15.03 Add the following new subparagraph to Paragraph 15.03.B:

1. If some or all of the Work has been determined not to be at a point of Substantial Completion and will require re-inspection or re-testing by Engineer, the cost of such re-inspection or re-testing, including the cost of time, travel and living expenses, will be paid by Contractor to Owner. If Contractor does not pay, or the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under this Article 15.

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

No suggested Supplementary Conditions in this Article.

ARTICLE 17—FINAL RESOLUTIONS OF DISPUTES

17.01 Methods and Procedures

- A. Either Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 10.05.E.
- B. Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.
- C. If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraph 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within the time period, Owner or Contractor gives written notice to the other party of the intent to submit the Claim to a court of competent jurisdiction.
- D. These General and Supplementary Conditions, all work related to and performed under these General Conditions and the Contract Documents, and all disputes shall be governed by the

EJCDC® C-800, Supplementary Conditions of the Construction Contract.

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laws of the State of Missouri and shall be mediated and/or litigated in Jackson County, Missouri.

17.02 *Arbitration*

SC-17.02 Add the following new paragraph immediately after Paragraph 17.01.

17.02 *Arbitration*

- A. All matters subject to final resolution under this Article will be settled by arbitration administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules (subject to the conditions and limitations of this Paragraph SC-17.02). Any controversy or claim in the amount of \$100,000 or less will be settled in accordance with the American Arbitration Association's supplemental rules for Fixed Time and Cost Construction Arbitration. This agreement to arbitrate will be specifically enforceable under the prevailing law of any court having jurisdiction.
- B. The demand for arbitration will be filed in writing with the other party to the Contract and with the selected arbitration administrator, and a copy will be sent to Engineer for information. The demand for arbitration will be made within the specific time required in Article 17, or if no specified time is applicable within a reasonable time after the matter in question has arisen, and in no event will any such demand be made after the date when institution of legal or equitable proceedings based on such matter in question would be barred by the applicable statute of limitations.
- C. The arbitrator(s) must be licensed engineers, contractors, attorneys, or construction managers. Hearings will take place pursuant to the standard procedures of the Construction Arbitration Rules that contemplate in-person hearings. The arbitrators will have no authority to award punitive or other damages not measured by the prevailing party's actual damages, except as may be required by statute or the Contract. Any award in an arbitration initiated under this clause will be limited to monetary damages and include no injunction or direction to any party other than the direction to pay a monetary amount.
- D. The Arbitrators will have the authority to allocate the costs of the arbitration process among the parties, but will only have the authority to allocate attorneys' fees if a specific Law or Regulation or this Contract permits them to do so.
- E. The award of the arbitrators must be accompanied by a reasoned written opinion and a concise breakdown of the award. The written opinion will cite the Contract provisions deemed applicable and relied on in making the award.
- F. The parties agree that failure or refusal of a party to pay its required share of the deposits for arbitrator compensation or administrative charges will constitute a waiver by that party to present evidence or cross-examine witness. In such event, the other party shall be required to present evidence and legal argument as the arbitrator(s) may require for the making of an award. Such waiver will not allow for a default judgment against the non-paying party in the absence of evidence presented as provided for above.
- G. No arbitration arising out of or relating to the Contract will include by consolidation, joinder, or in any other manner any other individual or entity (including Engineer, and Engineer's consultants and the officers, directors, partners, agents, employees or consultants of any of them) who is not a party to this Contract unless:

1. the inclusion of such other individual or entity will allow complete relief to be afforded among those who are already parties to the arbitration;
 2. such other individual or entity is substantially involved in a question of law or fact which is common to those who are already parties to the arbitration, and which will arise in such proceedings;
 3. such other individual or entity is subject to arbitration under a contract with either Owner or Contractor, or consents to being joined in the arbitration; and
 4. the consolidation or joinder is in compliance with the arbitration administrator's procedural rules.
- H. The award will be final. Judgment may be entered upon it in any court having jurisdiction thereof, and it will not be subject to modification or appeal, subject to provisions of the Laws and Regulations relating to vacating or modifying an arbitral award.
- I. Except as may be required by Laws or Regulations, neither party nor an arbitrator may disclose the existence, content, or results of any arbitration hereunder without the prior written consent of both parties, with the exception of any disclosure required by Laws and Regulations or the Contract. To the extent any disclosure is allowed pursuant to the exception, the disclosure must be strictly and narrowly limited to maintain confidentiality to the extent possible.

17.03 *Attorneys' Fees*

SC-17.03 Add the following new paragraph immediately after Paragraph 17.02. [Note: If there is no Paragraph 17.02, because neither arbitration nor any other dispute resolution process has been specified here in the Supplementary Conditions, then revise this to state "Add the following new Paragraph immediately after Paragraph 17.01" and revise the numbering accordingly].

17.03 *Attorneys' Fees*

- A. For any matter subject to final resolution under this Article, the prevailing party shall be entitled to an award of its attorneys' fees incurred in the final resolution proceedings, in an equitable amount to be determined in the discretion of the court, arbitrator, arbitration panel, or other arbiter of the matter subject to final resolution, taking into account the parties' initial demand or defense positions in comparison with the final result.

EXHIBIT A—SOFTWARE REQUIREMENTS FOR ELECTRONIC DOCUMENT EXCHANGE

Item	Electronic Documents	Transmittal Means	Data Format	Note (1)
a.1	General communications, transmittal covers, meeting notices and responses to general information requests for which there is no specific prescribed form.	Email	Email	
a.2	Meeting agendas, meeting minutes, RFI's and responses to RFI's, and Contract forms.	Email w/ Attachment	PDF	(2)
a.3	Contractors Submittals (Shop Drawings, "or equal" requests, substitution requests, documentation accompanying Sample submittals and other submittals) to Owner and Engineer, and Owner's and Engineer's responses to Contractor's Submittals, Shop Drawings, correspondence, and Applications for Payment.	Upload to DocEx	PDF	
a.4	Correspondence; milestone and final version Submittals of reports, layouts, Drawings, maps, calculations and spreadsheets, Specifications, Drawings and other Submittals from Contractor to Owner or Engineer and for responses from Engineer and Owner to Contractor regarding Submittals.	Email w/ Attachment or LFE	PDF	
a.5	Layouts and drawings to be submitted to Owner for future use and modification.	Upload to DocEx or LFE	DWG	
a.6	Correspondence, reports and Specifications to be submitted to Owner for future word processing use and modification.	Email w/ Attachment or LFE	DOC	
a.7	Spreadsheets and data to be submitted to Owner for future data processing use and modification.	Email w/ Attachment or LFE	EXC	
a.8	Database files and data to be submitted to Owner for future data processing use and modification.	Email w/ Attachment or LFE	DB	
Notes				
(1)	All exchanges and uses of transmitted data are subject to the appropriate provisions of Contract Documents.			
(2)	Transmittal of written notices is governed by Paragraph 18.01 of the General Conditions.			
Key				
Email	Standard Email formats (.htm, .rtf, or .txt). Do not use stationery formatting or other features that impair legibility of content on screen or in printed copies			
LFE	Agreed upon Large File Exchange method (FTP, CD, DVD, hard drive)			
PDF	Portable Document Format readable by Adobe® Acrobat Reader (<u>Latest Version</u>)			
DWG	Autodesk® AutoCAD .dwg format (<u>Latest Version</u>)			
DOC	Microsoft® Word .docx format (<u>Latest Version</u>)			
EXC	Microsoft® Excel .xls or .xml format (<u>Latest Version</u>)			
DocEx	InfoTech Document Express system (web based service)			

EXHIBIT B—FORESEEABLE BAD WEATHER DAYS

Month	Precipitation Within 24-hour period from midnight to midnight (\geq 0.1 inches)	Ambient Outdoor Air Temperature (\leq 20° F)
	Number of Foreseeable Bad Weather Days in Month Based on Precipitation as Rain Equivalent (inches) (1)	Number of Foreseeable Bad Weather Days in Month Based on Low Temperature
January	5	17
February	5	20
March	7	5
April	10	2
May	15	0
June	10	0
July	9	0
August	10	0
September	7	0
October	7	0
November	7	8
December	5	12
Notes: 1. The NWS data reports all types of precipitation as rain equivalent.		

Missouri

Division of Labor Standards

WAGE AND HOUR SECTION



MICHAEL L. PARSON, Governor

Annual Wage Order No. 30

Section 048
JACKSON COUNTY

In accordance with Section 290.262 RSMo 2000, within thirty (30) days after a certified copy of this Annual Wage Order has been filed with the Secretary of State as indicated below, any person who may be affected by this Annual Wage Order may object by filing an objection in triplicate with the Labor and Industrial Relations Commission, P.O. Box 599, Jefferson City, MO 65102-0599. Such objections must set forth in writing the specific grounds of objection. Each objection shall certify that a copy has been furnished to the Division of Labor Standards, P.O. Box 449, Jefferson City, MO 65102-0449 pursuant to 8 CSR 20-5.010(1). A certified copy of the Annual Wage Order has been filed with the Secretary of State of Missouri.

Original Signed by

Todd Smith, Director
Division of Labor Standards

Filed With Secretary of State: March 10, 2023

Last Date Objections May Be Filed: April 10, 2023

Prepared by Missouri Department of Labor and Industrial Relations

OCCUPATIONAL TITLE	**Prevailing Hourly Rate
Asbestos Worker	\$68.67
Boilermaker	\$38.37*
Bricklayer	\$60.27
Carpenter	\$61.82
Lather	
Linoleum Layer	
Millwright	
Pile Driver	
Cement Mason	\$55.22
Plasterer	
Communications Technician	\$60.34
Electrician (Inside Wireman)	\$69.22
Electrician Outside Lineman	\$59.91
Lineman Operator	
Lineman - Tree Trimmer	
Groundman	
Groundman - Tree Trimmer	
Elevator Constructor	\$102.69
Glazier	\$58.17
Ironworker	\$68.53
Laborer	\$49.56
General Laborer	
First Semi-Skilled	
Second Semi-Skilled	
Mason	\$54.80
Marble Mason	
Marble Finisher	
Terrazzo Worker	
Terrazzo Finisher	
Tile Setter	
Tile Finisher	
Operating Engineer	\$61.54
Group I	
Group II	
Group III	
Group III-A	
Group IV	
Group V	
Painter	\$50.40
Plumber	\$76.04
Pipe Fitter	
Roofer	\$59.33
Sheet Metal Worker	\$72.78
Sprinkler Fitter	\$75.09
Truck Driver	\$52.39
Truck Control Service Driver	
Group I	
Group II	
Group III	
Group IV	

*The Division of Labor Standards received fewer than 1,000 reportable hours for this occupational title. The public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center.

**The Prevailing Hourly Rate includes any applicable fringe benefit amounts for each occupational title as defined in RSMO Section 290.210.

Heavy Construction Rates for
JACKSON County

Section 048

OCCUPATIONAL TITLE	**Prevailing Hourly Rate
Carpenter	\$61.98
Millwright	
Pile Driver	
Electrician (Outside Lineman)	\$87.19
Lineman Operator	
Lineman - Tree Trimmer	
Groundman	
Groundman - Tree Trimmer	
Laborer	\$50.25
General Laborer	
Skilled Laborer	
Operating Engineer	\$58.85
Group I	
Group II	
Group III	
Group IV	
Truck Driver	\$50.18
Truck Control Service Driver	
Group I	
Group II	
Group III	
Group IV	

Use Heavy Construction Rates on Highway and Heavy construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(3).

Use Building Construction Rates on Building construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(2).

If a worker is performing work on a heavy construction project within an occupational title that is not listed on the Heavy Construction Rate Sheet, use the rate for that occupational title as shown on the Building Construction Rate Sheet.

*The Division of Labor Standards received fewer than 1,000 reportable hours for this occupational title. Public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center.

**The Prevailing Hourly Rate includes any applicable fringe benefit amounts for each occupational title.

OVERTIME and HOLIDAYS

OVERTIME

For all work performed on a Sunday or a holiday, not less than twice (2x) the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed or the public works contracting minimum wage, whichever is applicable, shall be paid to all workers employed by or on behalf of any public body engaged in the construction of public works, exclusive of maintenance work.

For all overtime work performed, not less than one and one-half (1½) the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed or the public works contracting minimum wage, whichever is applicable, shall be paid to all workers employed by or on behalf of any public body engaged in the construction of public works, exclusive of maintenance work or contractual obligation. For purposes of this subdivision, **"overtime work"** shall include work that exceeds ten hours in one day and work in excess of forty hours in one calendar week; and

A thirty-minute lunch period on each calendar day shall be allowed for each worker on a public works project, provided that such time shall not be considered as time worked.

HOLIDAYS

January first;
The last Monday in May;
July fourth;
The first Monday in September;
November eleventh;
The fourth Thursday in November; and
December twenty-fifth;

If any holiday falls on a Sunday, the following Monday shall be considered a holiday.



MISSOURI DEPARTMENT OF LABOR AND INDUSTRIAL RELATIONS
AFFIDAVIT
COMPLIANCE WITH THE PREVAILING WAGE LAW

I, _____, upon being duly sworn upon my oath state that: (1) I am the
(Name)
_____ of _____; (2) all requirements of
(Title) (Name of Company)
§§ 290.210 to 290.340, RSMo, pertaining to the payment of wages to workers employed on public works projects
have been fully satisfied with regard to this company's work on _____;
(Name of Project)
(3) I have reviewed and am familiar with the prevailing wage rules in 8 CSR 30-3.010 to 8 CSR 30-3.060; (4) based
upon my knowledge of these rules, including the occupational titles set out in 8 CSR 30-3.060, I have completed full
and accurate records clearly indicating (a) the names, occupations, and crafts of every worker employed by this
company in connection with this project together with an accurate record of the number of hours worked by each
worker and the actual wages paid for each class or type of work performed, (b) the payroll deductions that have been
made for each worker, and (c) the amounts paid to provide fringe benefits, if any, for each worker; (5) the amounts
paid to provide fringe benefits, if any, were irrevocably made to a fund, plan, or program on behalf of the workers;
(6) these payroll records are kept and have been provided for inspection to the authorized representative of the
contracting public body and will be available, as often as may be necessary, to such body and the Missouri
Department of Labor and Industrial Relations; (7) such records shall not be destroyed or removed from the state for
one year following the completion of this company's work on this project; and (8) there has been no exception to the
full and complete compliance with the provisions and requirements of Annual Wage Order No. _____ Section
_____ issued by the Missouri Division of Labor Standards and applicable to this project located in
_____ County, Missouri, and completed on the _____ day of _____, _____.

The matters stated herein are true to the best of my information, knowledge, and belief. I acknowledge that
the falsification of any information set out above may subject me to criminal prosecution pursuant to §§290.340,
570.090, 575.040, 575.050, or 575.060, RSMo.

Signature

Subscribed and sworn to me this _____ day of _____, _____.

My commission expires _____, _____.

Notary Public

Receipt by Authorized Public Representative

CONTRACTOR'S FINAL WAIVER OF LIEN AND RELEASE OF CLAIMS

To: City of Lee's Summit, Missouri, the "Owner", or lender(s) having any loans secured by the property of the Owner and other parties, if any, having any interest in the Realty identified below (hereinafter collectively the "Beneficiaries").

"Contractor": _____

"Project": LXT Hangar 2 and Eastside Development

"Realty": _____

"Contract": Contract between Owner and Contractor for the Project, Project No. 47732472, dated _____, along with authorized change orders.

Payment Requested: \$_____

Certificate

The undersigned, contingent upon the issuance, final clearance and payment of a valuable consideration of \$_____, which is currently due and payable, and being familiar with the penalties for false certification, does hereby certify to the Beneficiaries that:

1. The amount requested for labor performed and equipment and material supplied on this Project or in connection with the Realty, represent the actual value of work accomplished under the terms of the Contract.
2. No labor, equipment or materials have been supplied under contracts or agreement with the undersigned, either verbal or written, or any arrangements of any type whatsoever, other than under the Contract.
3. Payment in full has been made by the undersigned through the period covered by all prior payments (a) to all of the undersigned's sub-subcontractors, equipment providers, materialmen and laborers, and (b) for all materials and labor used or furnished by the undersigned in connection with the performance of the Contract. The undersigned represents and warrants that it owes no monies or other things of value to any sub-subcontractor, materialman, person or entity for work performed or material supplied through the date of the most recent payment by Owner, and that the payments that have been or will be made out of this final payment to such persons or firms will fully and completely compensate them for all work in connection with the Project.
4. The undersigned has complied with Federal, State and Local tax laws, including, without limitation, Income Tax Withholding, Sales Tax, Social Security, Unemployment Compensation and Worker's Compensation laws, insofar as applicable to the performance of the Contract.

5. The undersigned acknowledges and agrees that it is receiving the funds paid in consideration of this document as a trustee, and said funds will be held in trust for the benefit of all sub-subcontractors, materialman, suppliers and laborers who supplied work for which the Beneficiaries may be liable, and that the undersigned shall have no interest in such funds until all these obligations have been satisfied in full.

Final Waiver and Release of Claims

NOW, THEREFORE, effective as of receipt of the payment referenced in this document, the undersigned irrevocably and unconditionally releases and waives any and all mechanic's liens or other liens or right to claim any and all mechanic's liens or other liens against the Realty. Additionally, the undersigned waives and releases any claims against, or in connection with, the Owner, the Contract, the Project, and the Realty. The undersigned shall indemnify and hold the Beneficiaries and their respective successors and assigns harmless against any lien, bond, claims, or suits in connection with the materials, labor and everything else in connection with the Contract.

Contractor

By: _____

Its: _____

CORPORATION ACKNOWLEDGMENT

STATE OF MISSOURI
COUNTY OF JACKSON

ON THIS THE _____ day of _____, 20____, before me, a Notary Public, personally appeared _____ and proved to me on the basis of satisfactory evidence to be the person who executed the within instrument as President or on behalf of the Corporation therein named, and acknowledged to me that the Corporation executed it.

WITNESS my hand and official seal in the County and State aforesaid, the day and year first above written.

/s/ _____
Notary Public Signature

Printed or Typed Name

(Seal)

My Commission Expires:

CONTRACTOR'S FINAL WAIVER OF LIEN AND RELEASE OF CLAIMS

To: City of Lee's Summit, Missouri, the "Owner", or lender(s) having any loans secured by the property of the Owner and other parties, if any, having any interest in the Realty identified below (hereinafter collectively the "Beneficiaries").

"Contractor": _____

"Project": LXT Hangar 2 and Eastside Development

"Realty": _____

"Contract": Contract between Owner and Contractor for the Project, Project No. 47732472, dated _____, along with authorized change orders.

Payment Requested: \$ _____

Certificate

The undersigned, contingent upon the issuance, final clearance and payment of a valuable consideration of \$ _____, which is currently due and payable, and being familiar with the penalties for false certification, does hereby certify to the Beneficiaries that:

1. The amount requested for labor performed and equipment and material supplied on this Project or in connection with the Realty, represent the actual value of work accomplished under the terms of the Contract.
2. No labor, equipment or materials have been supplied under contracts or agreement with the undersigned, either verbal or written, or any arrangements of any type whatsoever, other than under the Contract.
3. Payment in full has been made by the undersigned through the period covered by all prior payments (a) to all of the undersigned's sub-subcontractors, equipment providers, materialmen and laborers, and (b) for all materials and labor used or furnished by the undersigned in connection with the performance of the Contract. The undersigned represents and warrants that it owes no monies or other things of value to any sub-subcontractor, materialman, person or entity for work performed or material supplied through the date of the most recent payment by Owner, and that the payments that have been or will be made out of this final payment to such persons or firms will fully and completely compensate them for all work in connection with the Project.
4. The undersigned has complied with Federal, State and Local tax laws, including, without limitation, Income Tax Withholding, Sales Tax, Social Security, Unemployment Compensation and Worker's Compensation laws, insofar as applicable to the performance of the Contract.

5. The undersigned acknowledges and agrees that it is receiving the funds paid in consideration of this document as a trustee, and said funds will be held in trust for the benefit of all sub-subcontractors, materialman, suppliers and laborers who supplied work for which the Beneficiaries may be liable, and that the undersigned shall have no interest in such funds until all these obligations have been satisfied in full.

Final Waiver and Release of Claims

NOW, THEREFORE, effective as of receipt of the payment referenced in this document, the undersigned irrevocably and unconditionally releases and waives any and all mechanic's liens or other liens or right to claim any and all mechanic's liens or other liens against the Realty. Additionally, the undersigned waives and releases any claims against, or in connection with, the Owner, the Contract, the Project, and the Realty. The undersigned shall indemnify and hold the Beneficiaries and their respective successors and assigns harmless against any lien, bond, claims, or suits in connection with the materials, labor and everything else in connection with the Contract.

Contractor

By: _____

Its: _____

CORPORATION ACKNOWLEDGMENT

STATE OF MISSOURI
COUNTY OF JACKSON

ON THIS THE _____ day of _____, 20____, before me, a Notary Public, personally appeared _____ and proved to me on the basis of satisfactory evidence to be the person who executed the within instrument as President or on behalf of the Corporation therein named, and acknowledged to me that the Corporation executed it.

WITNESS my hand and official seal in the County and State aforesaid, the day and year first above written.

/s/ _____
Notary Public Signature

Printed or Typed Name

(Seal)

My Commission Expires:



STATE OF MISSOURI
OFFICE OF ADMINISTRATION
DIVISION OF FACILITIES MANAGEMENT, DESIGN AND CONSTRUCTION
CONSENT OF SURETY TO FINAL PAYMENT

PROJECT NUMBER

47732472

TO OWNER:

City of Lee's Summit, Missouri
220 SE Green Street
Lee's Summit, MO 64063

PROJECT TITLE AND LOCATION

LXT Hangar 2 and Eastside Development

Lee's Summit Municipal Airport

2751 NE Douglas St, Lees Summit MO 64064

CONTRACT DATED

BOND NUMBER

In accordance with the provisions of the Contract between the Owner and the Contractor as indicated above, the

_____, SURETY,
(NAME OF SURETY)

(ADDRESS OF SURETY)

on bond of

_____, CONTRACTOR,

hereby approves of the final payment to the Contractor and agrees that final payment to the Contractor shall not relieve the Surety of any of its obligations to the State of Missouri, OWNER, as set forth in said Surety's bond.

IN WITNESS WHEREOF, the Surety has hereunto set its hand on this date _____
(INSERT IN WRITING THE MONTH FOLLOWED BY THE NUMERIC DATE AND YEAR)

SURETY

SIGNATURE OF AUTHORIZED REPRESENTATIVE

PRINTED NAME & TITLE

ATTEST (SEAL)

WORK CHANGE DIRECTIVE NO.:

Owner:	City of Lee's Summit	Owner's Project No.:	47732472
Engineer:	Crawford, Murphy, &Tilly, Inc.	Engineer's Project No.:	22001238
Contractor:		Contractor's Project No.:	
Project:	LXT Hangar 2 and Eastside Development		
Contract Name:	LXT Hangar 2 and Eastside Development		
Date Issued:		Effective Date of Work Change Directive:	

Contractor is directed to proceed promptly with the following change(s):

Description:

Attachments:

Purpose for the Work Change Directive:

Directive to proceed promptly with the Work described herein, prior to agreeing to change in Contract Price and Contract Time, is issued due to:

Notes to User—Check one or both of the following

☐ Non-agreement on pricing of proposed change. ☐ Necessity to proceed for schedule or other reasons.

Estimated Change in Contract Price and Contract Times (non-binding, preliminary):

Contract Price: \$ _____ **[increase] [decrease] [not yet estimated].**

Contract Time: _____ days **[increase] [decrease] [not yet estimated].**

Basis of estimated change in Contract Price:

☐ Lump Sum ☐ Unit Price ☐ Cost of the Work ☐ Other

Recommended by Engineer

Authorized by Owner

By:

Title:

Date:

CHANGE ORDER NO.: [Number of Change Order]

Owner:	City of Lee's Summit	Owner's Project No.:	47732472
Engineer:	Crawford, Murphy, & Tilly, Inc.	Engineer's Project No.:	22001238
Contractor:		Contractor's Project No.:	
Project:	LXT Hangar 2 and Eastside Development		
Contract Name:	LXT Hangar 2 and Eastside Development		
Date Issued:		Effective Date of Change Order:	

The Contract is modified as follows upon execution of this Change Order:

Description:

Attachments:

Change in Contract Price	Change in Contract Times
Original Contract Price: \$ _____	Original Contract Times: Substantial Completion: _____ Ready for final payment: _____
[Increase] [Decrease] from previously approved Change Orders No. 1 to No. [Number of previous Change Order] : \$ _____	[Increase] [Decrease] from previously approved Change Orders No.1 to No. [Number of previous Change Order] : Substantial Completion: _____ Ready for final payment: _____
Contract Price prior to this Change Order: \$ _____	Contract Times prior to this Change Order: Substantial Completion: _____ Ready for final payment: _____
[Increase] [Decrease] this Change Order: \$ _____	[Increase] [Decrease] this Change Order: Substantial Completion: _____ Ready for final payment: _____
Contract Price incorporating this Change Order: \$ _____	Contract Times with all approved Change Orders: Substantial Completion: _____ Ready for final payment: _____

Recommended by Engineer (if required)	Accepted by Contractor
By: _____	_____
Title: _____	_____
Date: _____	_____
Authorized by Owner	Approved by Funding Agency (if applicable)
By: _____	_____
Title: _____	_____
Date: _____	_____

FIELD ORDER NO.:

Owner:	City of Lee's Summit	Owner's Project No.:	477432472
Engineer:	Crawford, Murphy, & Tilly, Inc.	Engineer's Project No.:	22001238
Contractor:		Contractor's Project No.:	
Project:	LXT Hangar 2 and Eastside Development		
Contract Name:	LXT Hangar 2 and Eastside Development		
Date Issued:		Effective Date of Field Order:	

Contractor is hereby directed to promptly perform the Work described in this Field Order, issued in accordance with Paragraph 11.04 of the General Conditions, for minor changes in the Work without changes in Contract Price or Contract Times. If Contractor considers that a change in Contract Price or Contract Times is required, submit a Change Proposal before proceeding with this Work.

Reference:

Specification Section(s):

Drawing(s) / Details (s):

Description:**Attachments:****Issued by Engineer**

By: _____

Title: _____

Date: _____

SECTION 01010

PERMIT REQUIREMENTS

PART 1 GENERAL

1.01 PERMITS

- A. Compliance with Paragraph 7.09 of GC-700 will require the following permits. Any permits being waived shall be so indicated. The party responsible for obtaining and making payment for each permit shall be listed. Unless noted below, or on the actual permit, the Contractor is responsible for maintaining and fulfilling the permit requirements.
1. The Owner's Land Disturbance Permit is required and will be obtained by the Owner. The permit fee is waived for the Work.
 2. The Owner's Right-of-Way Permit is waived for the Work.
 3. The Owner's Traffic Control Permit is waived for the Work.
 4. The Owner's Building Permit is required for the Work and will be obtained by the Owner.
 5. A Blasting Permit is not applicable for the Work. No blasting is allowed.
 6. An MDNR Land Disturbance Permit is required and will be obtained by the Owner.
 7. The SWPPP (Stormwater Pollution Prevention Plan) shall be maintained and updated by the Contractor.
 8. A MoDOT Permit is not required for the Work.
 9. Access or work on railroad property is not required for the Work:
 10. Though not a permit, the Contractor and all Subcontractors are required to obtain or have:
 - a. current Lee's Summit business license;
 - b. an active and in good standing Missouri Secretary of State business registration.
 11. A 7460 FAA Airspace Study has been obtained for this project by the Owner assuming a maximum equipment height of 100-ft. If contractor intends to use equipment with a height greater than 100-ft this must be communicated with the Owner as soon as possible so that the FAA Airspace Study can be amended.

END OF SECTION

SECTION 01015

POINTS OF CONTACT

PART 1 GENERAL

1.01 The intent of this table is not to bypass any contractual lines of communication but to have concise, 24 hour contact information.

Primary Design Firm & Contact			
E-Mail:			
Office Phone Number:			
City's Construction Manager			
E-Mail:			
Office Phone Number:			
City's Construction Inspector			
E-Mail:			
Office Phone Number:		Cell Phone:	
Contractor's Project Manager			
E-Mail:			
Office Phone Number:		Cell Phone:	
Contractor's Superintendent			
E-Mail:			
Office Phone Number:		Cell Phone:	
Traffic Control Company			
E-Mail:			
Office Phone Number:		Cell Phone:	
Erosion Control Company			
E-Mail:			
Office Phone Number:		Cell Phone:	

END OF SECTION

SECTION 01020

PRELIMINARY MATTERS

PART 1 GENERAL

1.01 SCOPE

- A. This Section is a non-exclusive list of various preliminary requirements that the Contractor shall comply with. This list does not include all contractual requirements, and it is important that the Contractor be familiar with all of the Contract Documents in order to ensure that all applicable requirements are met.

1.02 CONTRACTOR

- A. In accordance with Article 2 of GC-700, and additional items as required by the Owner, the following items shall be accomplished prior to the start of the Work:
 - 1. Have an established account with the Owner's construction management software for the submittal and processing of construction documents.
 - 2. Submit preliminary schedules in accordance with Article 2.03 of GC-700, and refer to Section 1110 (Progress Schedule), Section 1115 (Submittal Procedures) and Section 1116 (Submittal Checklist) for additional information.
 - 3. Acquire permits or licenses per Section 1010.
 - 4. Meet coordination timelines and requirements per Section 1105.
 - 5. Submit points of contact per Section 1015.
 - 6. Attend preconstruction meetings per Section 1125.
 - 7. Perform preconstruction documentation per Section 1130.
 - 8. Obtain Owner and/or Engineer's approval of installed traffic control devices.
 - 9. At a suitable place on the job site (i.e. easy access to and easy to see) post the DNR permit, prevailing wage documents, equal opportunity letter and emergency contacts. Documents must have protection from the elements. Note: Federal jobs will require additional posters, which are routinely supplied by MoDOT.
 - 10. List additional items.

1.03 PRIORITY OF CONTRACT DOCUMENTS

- A. The Contract Documents are complementary; what is required by one Contract Document is as binding as if required by all.
- B. If there is a discrepancy among plans, specification, drawings, or other components of the Contract Documents, the order of precedence is listed below:

1. Project-specific plans.
2. Project specific specifications and provisions.
3. Standard specifications
4. Standard drawings and details

END OF SECTION

SECTION 01105

SEQUENCING AND COORDINATION

PART 1 GENERAL

1.01 CONSTRUCTION SEQUENCE OR PHASING – GENERAL REQUIREMENTS

- A. The Contract Documents or Drawings may set forth a specific sequence or phasing for the Work or a portion of the Work, and Contractor's adherence to this sequence or phasing is mandatory. The specific sequence or phasing does not purport to include each and every item, task or activity required for completion. The Contractor shall be responsible for identifying and executing all components or tasks in order to accomplish the sequencing or phasing.

1.02 CONSTRUCTION SEQUENCE OR PHASING – SPECIFIC REQUIREMENTS

- A. See Article 4 of Section C-520 and the CAP Notes sheet in the Drawings.

1.03 WORK UNDER THIS CONTRACT

- A. Contractor shall sequence the construction and coordinate all activities in order to eliminate potential conflicts and minimize disruptions to the activities of the Owner and the public.
- B. Continuous operation and access to all existing components, facilities, streets, driveways and entrances will be maintained except as directed in the Drawings, Contract Documents or by the Owner.
- C. All shutdowns or startups will require the approval and direct involvement of Owner.
- D. The Contractor shall not demolish any structure or facility without the Owner's prior approval.

1.04 OTHER WORK AT SITE

- A. During the period of this contract work by others (contracted or not) may concurrently occur at various locations within the Site. Unless specified below or at the pre-bid conference, the Owner will initiate coordination between its own forces, various contractors, utility owners and adjacent property owners. The ongoing coordination, extent of authority and division of responsibilities will be determined with Contractor based on the scope of the other work. Work of this type includes, but is not limited to:
 - 1. Owner's forces may be required to perform various maintenance or support activities.
 - 2. Owner's on-call services may be required to perform unscheduled or unforeseen maintenance or support activities.
 - 3. Utility owners having interest in the project may perform work.
 - 4. Adjacent property owners may perform various maintenance or support activities.
 - 5. The Owner will contract with independent testing labs to conduct Quality Assurance Testing and Stormwater Quality sampling and testing on site. The Owner will coordinate

with the testing firms. The testing firms are authorized to coordinate direct with the Contractor's onsite supervisor to access the work area, testing locations, safety protocols, re-scheduling, and other coordination necessary to complete the testing.

- B. In lieu of written notification, Owner will discuss any direct contracts at the pre-bid conference and will discuss coordination requirements, authority, responsibilities, legal relationships and any adjustments (whether price or time) per Article 8 of GC-700.

1.05 COORDINATION AND NOTIFICATION REQUIREMENTS – GENERAL REQUIREMENTS

- A. The following timeframes are minimum requirements though Owner may grant waivers.
- B. During construction, the Contractor may be required to notify affected residents, business owners or the general public of certain construction activities. The timeframe for notification will be determined by the type of closure, operation or coordination requirement. Water shutoffs and driveway closures are the primary concerns. Owner prefers face to face contact with the impacted party, though Owner supplied door hangers can be effective.
 - 1. Contractor shall notify Owner at least 14 calendar days, but no more than 30 calendar days, prior to starting construction activities in the project area.
 - i. Owner will notify affected residents, business owners and/or the general public of the start of the project, the construction activities and how it might impact them.
 - 2. If Contractor is required to submit a traffic control plan or intends to submit a plan that differs from the Engineer's, the Contractor shall submit their traffic control plan 14 calendar days prior to its proposed implementation. The plan approval date is the date on which any other notification requirements are based off of.
 - 3. Contractor shall notify Owner 14 calendar days prior to any street closures.
 - 4. Contractor shall notify Owner 14 calendar days prior to altering any traffic signals.
 - 5. Contractor shall submit a written plan detailing steps involved in performance testing or startup of equipment, system or facility 14 calendar days prior to startup or testing.
 - 6. Contractor shall notify a respective property owner 14 calendar days prior to performing any initial removal work, excluding driveways or entrances. This notification is intended to cover removal of trees, shrubs, sheds or other fixtures located on the private property.
 - 7. Contractor shall notify Owner 7 calendar days prior to any water main shutdown.
 - 8. Contractor shall notify a respective property owner 7 calendar days prior to removing any fence or installing any temporary fence.
 - 9. Contractor shall notify Owner 2 working days prior to any water service shutdown.
 - 10. Contractor shall notify Owner 2 working days prior to any lane closures or temporary traffic control conditions.

11. Contractor shall notify Owner 2 working days prior to closing public driveways or entrances.
 12. Contractor shall notify Owner and impacted party(s) 2 working days prior to closing private driveways or entrances.
 13. Water services shall not be out of service longer than 4 hours, except for customers whom the Owner has determined cannot be out of service. When a customer cannot be without water service, the contractor shall make provisions to provide temporary service. In general this rule will apply to medical or emergency services.
- C. Owner will notify the public, emergency services and school bus service.
- D. Owner shall approve Contractor generated notifications and the distribution list.
- 1.06 COORDINATION AND NOTIFICATION REQUIREMENTS – SPECIFIC REQUIREMENTS
- A. Contractor shall notify Owner 48-hours prior to any temporary shutdowns of the Airport Electrical Vault (temporary shutdowns may only be allowed during daylight hours, and are subject to cancellation by the Owner at any time in case of inclement weather).

END OF SECTION

SECTION 01110

PROGRESS SCHEDULE

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. The Progress Schedule (Schedule) shall be based on the period of time within which this contract is to be completed (contract completion time), as set forth in the Agreement. Refer to Paragraphs 2.05 and 4.04 in GC-700 for additional information.
- B. Schedule is the Contractor's schedule. It is prepared by the Contractor, and they remain solely responsible for adherence thereto. Schedule is to be considered and used as a working tool and will not become part of the contract or contract documents.
- C. Acceptance of Schedule will not relieve Contractor from compliance with all conditions of the contract. Errors and omissions in accepted Schedule will not be cause for future claims by Contractor for extra costs or increased contract time.
- D. Any changes to the Schedule that result in an adjustment to the contract time require such changes to be submitted in accordance with Article 11 of GC-700.
- E. Owner shall have right to withhold progress payments due Contractor in the event that Schedules are not maintained current or submitted as specified.
- F. Contractor's failure to comply with this Section shall be a material breach of contract.

1.02 FORM OF PROGRESS SCHEDULE

- A. Schedule shall ensure compliance with the contract dates, specific milestones and / or specific sequences of construction.
- B. Schedule shall include work done by all subcontractors, submittal review, critical material deliveries, utility shutdowns, road closures and other items pertinent to completing the Work.
- C. Schedule shall utilize a bar chart format, similar to Microsoft Project. Alternate methods may be approved by Owner.
- D. Schedule shall identify the activities of the Work, the interdependence between activities and show an orderly progression of the Work.
- E. Schedule shall show the following for each activity:
 - 1. Concise description of work represented by activity.
 - 2. Anticipated duration in calendar days, working days or by completion date.
 - 3. Anticipated start and finish dates.
 - 4. Actual start and finish dates.

5. Percent complete.

- F. Supporting information included with the Schedule submittal shall include anticipated holidays to be observed, anticipated work days within a week (i.e. Monday – Friday) and anticipated working hours (i.e. 7 am to 5 pm). It is understood that conditions encountered during the Work may require changes to the days worked and the working hours.
- G. Electronic or paper submittal is acceptable. Paper submittals shall be limited to 11-in x 17-in.

1.03 UPDATING THE SCHEDULE

- A. Contractor shall review progress of the Work and provide updates to each activity, reflecting actual start and finish dates, percent complete and anticipated start and finish dates for activities not begun. All updated schedules will also carry the original start and finish dates.
- B. An updated Schedule shall be submitted with each pay application. However, Owner reserves the right to ask for more frequent submissions.

1.04 SUBMITTAL OF SCHEDULES

- A. Schedule submittal shall be in accordance with Paragraph 2.03 of GC-700 and this Section. Contractor shall submit a complete Schedule at the Pre-Construction Meeting.
- B. All Schedules shall be sent electronically using the Owner's construction management software specifically set up for the project. Project Schedules shall be uploaded into the folder labeled 2.0 Project Schedules.
- C. Project Schedules shall be uploaded in pdf format. If multiple items are uploaded in a single submittal, each schedule will either be accepted or rejected as a whole.
- D. Review of the Schedule shall be per Paragraph 2.05 of GC-700 and will be performed by:
 - 1. Owner
- E. Resubmittals will be reviewed as stated in GC-700.

END OF SECTION

SECTION 01115

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SCOPE

- A. Paragraph 7.16 of the General Conditions and this Section specify the general methods and requirements of submissions applicable to Shop Drawings, Samples or Product Data.
- B. Prepare and transmit each submittal sufficiently in advance so that the installation will not be delayed by processing times (including disapproval and re-submittal (if required), coordination with other submittals, testing, purchasing, fabrication, delivery and similar sequenced activities). No extension of time will be authorized because of the Contractor's failure to transmit submittals sufficiently in advance of the Work.

1.02 SUBMISSION REQUIREMENTS

- A. All Submittals shall be sent electronically using the Owner's construction management software. Administrative Submittals shall be uploaded into the folder labeled *3.1 Administrative Submittals*. Material Submittals shall be uploaded into the folder labeled *3.2 Submittals in Progress*. See Section 1116 for a list of Submittals for the Work.
- B. Submittals and Shop Drawings shall be uploaded in pdf format. If multiple items are uploaded in a single submittal, they shall be grouped according to Section 1116. Each submittal will either be accepted or rejected as a whole. Time sensitive items should be submitted individually to avoid potential delays. Once approved, material submittals will be moved into the folder labeled *3.3 Approved Submittals*. The standard naming nomenclature shall be *Submittal x, Type, mm-dd-yyyy*. See Section 1116 for submittal folder types.
- C. A Certification Statement (per 7.16.2 of GC-700) shall be provided on the cover sheet. The cover sheet shall describe packaged data and include a listing of all items within the package.
- D. Submittals shall contain:
 - 1. The date of submission and the dates of any previous submissions.
 - 2. Project title and number.
 - 3. The names of Contractor, Subcontractor, Supplier and/or Manufacturer.
 - 4. Identification of the product or material, including reference to the Specification Number.
 - 5. Field dimensions, if used, shall be clearly identified.
 - 6. Applicable standards, such as ASTM or Federal Standards numbers.
 - 7. Identification of deviations from Contract Documents.
 - 8. Identification of revisions on re-submittals.
 - 9. A blank space suitably sized for Contractor and/or Engineer stamps.

END OF SECTION

SECTION 01116

SUBMITTAL CHECKLIST

PART 1 GENERAL

1.01 USE OF SCHEDULE

- A. Additional submittals (not listed in this checklist) may be required to complete the Work.
- B. It is intended that submittals are made for all types of a listed item, per the plans and specifications. For instance, if multiples sizes and types of pipe are used for the sanitary sewer portion of the project, then each type of pipe will need an appropriate submittal. Similarly, if the contractor intends to use different mix designs for the PCC pavement (due to desired strength or cure rate) then all mix designs must be submitted. Regarding the Miscellaneous category, geotextile is a material that has a number of uses, and each use of geotextile (retaining wall, subgrade, underdrain, etc) would require a submittal.

Project Name or Number		Schedule Updated As Of	
CPM = City's Construction Project Mgr. CST = Consultant. LAW = City's Law Department			
Description	Required Submittal	Who Reviews	Folder Type
PRELIMINARY MATTERS			
Business License	License	CPM	3.1, Business License
Bonds	Bonds	LAW	3.1, Bonds
Finalized List of Subcontractors	List	CPM	3.1, List of Subcontractors
Insurance	Insurance	LAW	3.1, Insurance
Preconstruction Video	Video	CPM	Direct to CPM
Preliminary Progress Schedule	Schedule	CPM / CST	2.0, Project Schedules
Preliminary Schedule of Values	Schedule	CPM	3.1, Schedule of Values
CURB AND GUTTER			
Concrete	Mix Designs		3.2, Concrete Mix Designs
Curing Compound	Catalog Cuts		3.2, concrete Paving
Dowel Bars	Certifications		3.2, concrete Paving
Expansion Material	Catalog Cuts		3.2, concrete Paving
DRIVEWAYS OR ENTRANCES			
Aggregate	Certifications		3.2, Aggregate
See Pavement – Concrete			3.2, Aggregate
EROSION (SEDIMENT) CONTROL DEVICES			
Erosion Control Blanket	Catalog Cuts		3.2, Erosion Control
Silt Fence	Catalog Cuts		3.2, Erosion Control
FENCE			

Fence Material	Catalog Cuts		3.2, Guardrail/Fence
LANDSCAPING			
Fertilizer	Certifications		3.2, Landscaping
Mulch	Certifications		3.2, Landscaping
Plantings	Certifications		3.2, Landscaping
Seed	Certifications		3.2, Landscaping
Sod	Certifications		3.2, Landscaping
Turf Reinforcement Mat	Catalog Cuts		3.2, Landscaping
Trees	Certifications		3.2, Landscaping
MISCELLANEOUS			
Anchor Bolts (not signal or lighting)	Certifications		3.2, Structures
Epoxy	Catalog Cuts		3.2, Concrete Paving
Geotextile	Catalog Cuts		3.2, Subgrade
Grout	Catalog Cuts		3.2, Concrete Mix Designs
QC Plan (if different than 1306)	Plan		3.2, Aggregate
Traffic Control Plan	Drawings		3.2, Temporary Traffic Control
MULTI USE PATH – CONCRETE			
See Sidewalk and Ramps			
PAVEMENT – CONCRETE			
Aggregate	Certifications		3.,2 Aggregate
Concrete	Mix Designs		3.2, Concrete Mix Designs
Curing Compound	Catalog Cuts		3.,2 Concrete Paving
Expansion Material	Catalog Cuts		3.2, Concrete Paving
Joint Layout	Drawings		3.2, Concrete Paving
Joint Sealer	Catalog Cuts		3.2, Concrete Paving
Reinforcing Steel (for Joints)	Certifications		3.2, Concrete Paving
PAVEMENT MARKING			
Glass Beads	Certifications		3.2, Pavement Marking
Paint	Certifications		3.2, Pavement Marking
Tape	Certifications		3.2,, Pavement Marking
Thermoplastic	Certifications		3.2 Pavement Marking
RAMPS			
Detectable Warning Surface	Catalog Cuts		3.2, Sidewalk
Concrete	Mix Designs		3.2, Concrete Mix Designs
Curing Compound	Catalog Cuts		3.2, Concrete Paving
Dowel Bars	Certifications		3.2, Concrete Paving
Expansion Material	Catalog Cuts		3.2, Concrete Paving
RIP RAP			
Rip Rap	Certifications		3.2, Stormwater
SANITARY SEWER			
Encasement	Shop Dwg		3.2, Sanitary
Fittings (Angles, Reducers, Sleeves)	Shop Dwg		3.2, Sanitary

Manhole – Pre Cast	Shop Dwg		3.2, Sanitary
Manhole – Cast in Place	Shop Dwg		3.2, Sanitary
Pipe	Shop Dwg		3.2, Sanitary
Ring and Lid Assembly	Shop Dwg		3.2, Sanitary
Steps	Shop Dwg		3.2, Sanitary
Wye	Shop Dwg		3.2, Sanitary
SEWERS			
Concrete	Mix Designs		3.2, Concrete Mix Designs
Curing Compound	Catalog Cuts		3.2, Concrete Paving
Dowel Bars	Certifications		3.2, Concrete Paving
Expansion Material	Catalog Cuts		3.2, Concrete Paving
SIGNS (PERMANENT)			
Anchors	Catalog Cuts		3.2, Signing
Banding	Catalog Cuts		3.2, Signing
Brackets	Catalog Cuts		3.2, Signing
Posts	Catalog Cuts		3.2, Signing
Sleeves	Catalog Cuts		3.2, Signing
Sign Blanks	Certifications		3.2, Signing
Sign Sheeting	Certifications		3.2, Signing
Signs	Catalog Cuts		3.2, Signing
STORM SEWERS			
Concrete	Mix Designs		3.2, Concrete Mix Designs
End Section	Catalog Cuts		3.2, Stormwater
Pipe	Catalog Cuts		3.2, Stormwater
Pipe Joint Material	Catalog Cuts		3.2, Stormwater
Reinforcing Steel	Certifications		3.2, Stormwater
Ring and Lid Assembly	Catalog Cuts		3.2, Stormwater
Steps	Catalog Cuts		3.2, Stormwater
Structures	Shop Dwg		3.2, Stormwater
SOIL			
Contractor Furnished Borrow	Testing prior to acceptance		3.2, Subgrade
STREET LIGHTS			
Anchor Bolts	Catalog Cuts		3.2, Signal and Lighting
Base – Screw In	Shop Dwg		3.2, Signal and Lighting
Bracket Arms	Catalog Cuts		3.2, Signal and Lighting
Breakaway Base	Catalog Cuts		3.2, Signal and Lighting
Cable – Electrical	Catalog Cuts		3.2, Signal and Lighting
Concrete	Mix Designs		3.2, Signal and Lighting
Conduit (Pipe & Fittings)	Catalog Cuts		3.2, Signal and Lighting
Conduit Markers	Catalog Cuts		3.2, Signal and Lighting
Connector Kits	Catalog Cuts		3.2, Signal and Lighting
Fuses	Catalog Cuts		3.2, Signal and Lighting

Ground Clamp	Catalog Cuts		3.2, Signal and Lighting
Ground Rod	Catalog Cuts		3.2, Signal and Lighting
Junction Boxes	Catalog Cuts		3.2, Signal and Lighting
Lamps	Catalog Cuts		3.2, Signal and Lighting
Luminaires	Catalog Cuts		3.2, Signal and Lighting
Photocells	Catalog Cuts		3.2, Signal and Lighting
Poles	Catalog Cuts		3.2, Signal and Lighting
Power Supply Assembly	Shop Dwg		3.2, Signal and Lighting
Pull Boxes	Catalog Cuts		3.2, Signal and Lighting
Reinforcing Steel	Certifications		3.2, Signal and Lighting
Splice Kit	Catalog Cuts		3.2, Signal and Lighting
SUBGRADE			
Drainable Base	Certifications		3.2, Asphalt Mix Designs
Cement Stabilization	Certifications		3.2, Subgrade
MoDOT Base Courses	Certifications		3.2, Aggregate
Underdrain Filter Fabric	Certifications		3.2, Subgrade
Underdrain Pipe	Catalog Cuts		3.2, Subgrade
TEMPORARY SURFACING (if necessary)			
Aggregate	Certifications		3.2, Aggregate
Asphaltic Concrete	Mix Designs		3.2, Asphalt Mix Designs
WATER LINE			
Air Relief Assembly	Catalog Cuts		3.2, Water
Concrete	Mix Designs		3.2, Concrete Mix Designs
Encasement	Catalog Cuts		3.2, Water
Fire Hydrant	Catalog Cuts		3.2, Water
Fittings (Angles, Reducers, Sleeves)	Catalog Cuts		3.2, Water
Meter Well	Catalog Cuts		3.2, Water
Pipe	Catalog Cuts		3.2, Water
Polyethylene Wrap	Catalog Cuts		3.2, Water
Ring and Lid Assembly	Catalog Cuts		3.2, Water
Valves < 12"	Catalog Cuts		3.2, Water
Valves 12" and greater	Performance Tests		3.2, Water
HANGAR 2	<u>Refer to Action Submittals for each technical specification</u>		

END OF SECTION

SECTION 01120

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED AND DEFINITIONS

- A. The term “all costs”, as used in the payment descriptions within Part 2, is defined as full compensation for all equipment, labor, material and incidental costs.
- B. The Work of this Contract (and subsequent payment) consists of furnishing all equipment, labor, material and incidentals, as well as performing all construction, installation and testing of all improvements, modifications and additions, all as shown on the Drawings and detailed in the Specifications.
- C. All work shown on the Drawings or detailed in the Specifications and not specifically set forth in Article 5 of the Agreement as a pay item shall be considered a subsidiary obligation of the Contractor, and all costs in connection therewith shall be included in the prices named in the proposal.
- D. Progress measurements (for progress payments on the pay applications) shall be determined by the amount of work performed during a given period.
 - 1. Payments for items with a lump sum unit shall be based on one of the three options below, with the payment method being agreed upon by all parties.
 - i. Field measured to determine the actual value.
 - ii. An estimated value of the work performed.
 - iii. Pro-rated over the life of the contract, based off contract time or based off the total value of work performed percentage.
 - 2. Payments for items with a unit that may be measured to the tenth may be paid to the tenth. However, rounding will only occur during the final pay application and shall not be applied to any progress measurements.
- E. Final measurement is to be applied to the final pay application. Items not requiring final measurement will pay the full amount in Article 5 of the Agreement, unless appreciable errors are found or changes are authorized by the Owner.
- F. Rounding shall be performed during the final pay application, and rounding shall be to the nearest whole number, with 0 thru 4 being rounded down, and 5 thru 9 being rounded up. The following items will not be rounded, and shall be paid to the nearest tenth:

1. Seed and temporary surfacing.

PART 2 PAY ITEMS (IN ALPHABETICAL ORDER)

2.01 MOBILIZATION

- A. Partial payment for the mobilization pay item will be based on the contract lump sum bid price for mobilization and will be made in accordance with the following Payment Schedule:
 1. Twenty-five percent, when five percent or more of the original contract amount is earned.
 2. Fifty percent, when ten percent or more of the original contract amount is earned.
 3. Seventy-five percent, when twenty-five percent or more of the original contract amount is earned.
 4. One-hundred percent, when fifty percent or more of the original contract amount is earned.

2.02 TEMPORARY TRAFFIC CONTROL

- A. Final measurement will not be made unless changes to the bid quantity are authorized.
- B. Payment for traffic control shall be based on the lump sum price as set forth in the Agreement. Said price shall include all costs necessary to complete the work including, but not limited to, temporary striping, arrow boards, construction signs, barricades and channelization devices, in addition to low-profile barricades and edge light coverings required on airside pavements, as required by the drawings and specifications. Payment for relocation and reuse of the items shall be considered subsidiary to the payment for the initial installation.

Based upon the contract lump sum price for temporary traffic control, partial payments will be allowed as follows:

- With first pay request, 25%
- When 25% or more of the original contract is earned, an additional 25%
- When 50% or more of the original contract is earned, an additional 25%
- After the work is substantially completed, all areas of the site are safely re-opened to vehicular or pedestrian traffic, the final 25%

2.03 REMOVAL OF CONCRETE CURB AND GUTTER

- A. The unit of measurement for Removal of Concrete Curb and Gutter shall be the length in linear feet of all curb and gutter actually removed to its full-depth by the Contractor, regardless of type

or actual size encountered in the field. Any curb and gutter removed outside the limits of removal because the pavement was damaged by negligence on the part of the Contractor shall not be included in the measurement for payment. No direct measurement or payment shall be made for saw cutting. Saw cutting shall be incidental to removal.

- B. Payment shall be made at the contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete this item.

Removal of existing aggregate or subgrade layers underlying the existing curb and gutter to-be-removed, where deemed necessary, shall be incidental to this item and shall be included in this pay item.

2.04 REMOVAL OF CHAIN LINK FENCE

- A. The unit of measurement for Removal of Chain Link Fence shall be the length in linear feet of existing chain link fence removed by the Contractor, regardless of type or actual size encountered in the field. Any fencing removed outside the limits of removal because the fence was damaged by negligence on the part of the Contractor shall not be included in the measurement for payment. Removal of any existing posts shall be incidental to the item and shall be included in this pay item.
- B. Payment shall be made at the contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete this item.

2.05 12" FILTER SOCK

- A. The unit of measurement for 12" Filter Sock shall be the length in linear feet of all Filter Sock actually required, installed and accepted adjacent to the project work areas as necessary to maintain compliance with the project SWPPP requirements. Prior to installation of filter sock, contractor shall notify RPR of proposed filter sock locations and request authorization of measurement for payment. Filter Sock installed in excess of the plan quantity allotted for this project will not be measured for payment without advance written approval of the RPR.

Contractor shall regularly inspect, maintain, and repair filter sock, remove silt as necessary to maintain compliance with project SWPPP requirements. Silt removal, regular maintenance and repair of filter sock, removal of filter sock, and the regrading and reseeding of the site disturbed by filter sock are all subsidiary to this item

- B. Payment shall be made at contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete

this item. No payment shall be made for any filter sock installed without authorization from the Design Professional.

2.06 INLET PROTECTION

- A. The unit of measurement for Inlet Protection shall be the number per each of all inlet protections, regardless of type, actually required, installed and accepted adjacent to the project work areas as necessary to maintain compliance with the project SWPPP requirements.

Contractor shall regularly inspect, maintain and repair inlet protection, remove silt as necessary to maintain compliance with project SWPPP requirements. Silt removal, regular maintenance and repair of inlet protection, removal of inlet protection, backfill of inlet protection trenches and the regrading and reseeding of the site disturbed by inlet protection are all subsidiary to this item.

- B. Payment shall be made at contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete this item.

2.07 EROSION CONTROL BLANKET

- A. The unit of measurement for Erosion Control Blanket shall be the area in square yardage of all erosion control blanket installed and accepted adjacent to the project work areas as necessary to maintain compliance with the project SWPPP requirements.

Contractor shall regularly inspect, maintain and repair erosion control blanket to maintain compliance with project SWPPP requirements. Regular maintenance and repair of erosion control blanket are all subsidiary to this item.

- B. Payment shall be made at the contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete this item.

2.08 TURF REINFORCEMENT MAT (BASIN EMERGENCY SPILLWAY)

- A. The unit of measurement for Turf Reinforcement Mat shall be the area in square yardage of all mat installed and accepted adjacent to the project work areas as necessary for the emergency spillway as shown in the Drawings.

Contractor shall regularly inspect, maintain and repair TRM to maintain compliance with project SWPPP requirements until completion of project. Regular maintenance and repair are all subsidiary to this item.

- B. Payment shall be made at the contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete this item.

2.09 RIP RAP

- A. Final measurement will be based on the square yard of the completed and installed item.
- B. Payment for rip rap shall be based on the unit price per square yard as set forth in the Agreement, per thickness of rip rap. Said price shall include all costs necessary to complete the work including, but not limited to, geotextile, all excavation (earth, rock, shale), backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

2.10 EXCAVATION IN PLACE – AGGREGATE OR SOIL MATERIAL RECYCLED ON-SITE

- A. Method of Measurement: The unit of measurement for Excavation –Aggregate or Soil Material Recycled On-Site payment shall be made at the contract unit price per cubic yard of the excavation of any existing aggregate or soil from the site as required by the plans that is permanently relocated, installed and compacted in another area of the site that requires soil or aggregate fill material. Specifically, this pay item shall include general excavation on site (earth, rock shale), excavation required for the stormwater basin, excavation of existing aggregate that is replaced in a new permanent location on (or below) site. If contractor elects to store material in temporary stockpiles intended for the staging of material until final placement of material on site or the eventual removal of the material from site - the relocation of material to these temporary storage stockpiles will not be measured for payment under this (or any) pay item. These temporarily relocated materials will not be measured for excavation payment until moved into their permanent location. Any excavation or backfill for proposed building footings or utility trenches shall not be included as measurement for payment for this pay item.

This pay item shall not include the cost of topsoiling, that shall be measured separately per the Topsoiling pay item

Measurement for payment specified by the cubic yard shall be computed by the comparison of digital terrain model (DTM) surfaces for computation of neat line design quantities. After completion of pavement removal and excavation operations, contractor shall conduct field survey in the presence of the Engineer to record elevations at ground-line beneath existing pavements. Upon completion of final grading operations, Engineer will conduct topographic

survey of final surface grades. The end area is that bound by the original ground line established by field cross-sections and the final theoretical pay line established by cross-sections shown on the plans, subject to verification by the Engineer. Load counts will not be accepted for method of measurement of excavation. If contractor elects not to conduct a field survey as described above, final quantity of excavation shall be the plan quantity specified in the bid form.

- B. Basis of Payment: Payment shall be made at contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete this item.

2.11 8' BLACK VINYL CHAIN LINK FENCE WITH BARBED WIRE

- A. Measurement of black vinyl fencing with barbed wire will be made to the nearest linear foot, measured along the slope of the fabric, but shall not include gates for each type of fence installed. Ground rods, new posts, and the 3-strand barbed wire extension will not be measured for payment but will be considered incidental to the fence installation.
- B. Payment shall be made at the contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete this item.

No direct payment will be made for concrete footings, post hole excavation, for excavation and embankment necessary to smooth the area under the fence, placing extra strands of barbed wire for depressions, construction of water gates and all other incidental work or material.

2.12 32' ELECTRIC BLACK VINYL BI-DIRECTIONAL ROLLING GATE SYSTEM

- A. Measurement for the 32' Electric Black Vinyl Bi-Directional Rolling Gate System will not be made, but it will be considered a lump sum item. The double drive gate system will be considered as part of the lump sum item. Ground rods, and the 3-strand barbed wire extension will not be measured for payment but will be considered incidental to the fence installation.

Included within the cost of this gate system shall be the cost of all conduit/cabling required (power and communication) from gate system to building and between gate system components, furnish and installation of card reader systems, gate operator and loop detectors.

- B. Payment shall be made at the contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all preparation, hauling,

and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete this item.

No direct payment will be made for concrete footings, post hole excavation, for excavation and embankment necessary to smooth the area under the fence, placing extra strands of barbed wire for depressions, construction of water gates and all other incidental work or material.

2.13 18' ELECTRIC BLACK VINYL BI-DIRECTIONAL ROLLING GATE SYSTEM

- A. Measurement for the 18' Electric Black Vinyl Bi-Directional Rolling Gate System will not be made, but it will be considered a lump sum item. The double drive gate system will be considered as part of the lump sum item. Ground rods, and the 3-strand barbed wire extension will not be measured for payment but will be considered incidental to the fence installation.

Included within the cost of this gate system shall be the cost of all conduit/cabling required (power and communication) from gate system to building and between gate system components, furnish and installation of card reader systems, gate operator and loop detectors.

- B. Payment shall be made at the contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete this item.

No direct payment will be made for concrete footings, post hole excavation, for excavation and embankment necessary to smooth the area under the fence, placing extra strands of barbed wire for depressions, construction of water gates and all other incidental work or material.

2.14 CEMENT (SOIL STABILIZATION)

- A. The amount of cement placed for cement-treated subgrade soil stabilization shall be based on the number of tons of cement used to complete the stabilization work at the specified application rate.

Cement shall be added at an application rate of **6 percent** of dry unit weight of soil. The amount of cement shall be paid by the number of tons of cement used in the completed and accepted work. The Contractor shall provide the RPR with weight tickets from a certified scale to verify the amount of cement delivered and used on the project. No measurement for payment shall be made for any material in excess of 105% of expected yield quantity required to treat the site at the required application rate. Expected yield quantity shall be determined by multiplying application rate to the estimated weight of soil to be treated (estimated weight of soil equals average dry unit weight on-site (102 pcf) multiplied by the volume of soil to be treated.)

Cement treatment beneath the building footprint shall be included for measurement for payment per this item.

- B. Payment for cement shall be made at the contract unit price per ton for the cement. The price shall be full compensation for all preparation, delivering, placing, and all labor, equipment, tools and incidentals necessary to complete this item.

2.15 12" 6% CEMENT-TREATED SUBGRADE

- A. The amount of cement-treated subgrade soil stabilization shall be based on the number of square yards complete in place, meeting the specified thickness, grade, and density standards and accepted by the RPR.

Cement shall be added at an application rate of **6 percent** of dry unit weight of soil. The amount of cement used shall be paid for under the Cement (Soil Stabilization) project item and shall not be included in the price of this item.

Cement treatment beneath the building footprint shall be included for measurement for payment per this item.

- B. Payment for placement shall be made at the contract unit price per square yard for the cement-treated subgrade for the thickness specified. The price shall be full compensation for all preparation, placing and mixing these materials, and all labor, equipment, tools, and incidentals necessary to complete this item.

2.16 4" COMPACTED AGGREGATE BASE COURSE

- A. Final measurement will not be made unless changes to the bid quantity are authorized.
- B. Payment for aggregate shall be based on the unit price per square yard as set forth in the Agreement, per type of material and thickness of the installed item. Said price shall include all costs necessary to complete the work including, but not limited to, placing, compacting, rolling, watering, maintaining and removing, as required by the drawings and specifications.

2.17 6" COMPACTED AGGREGATE BASE COURSE

- A. Final measurement will not be made unless changes to the bid quantity are authorized.

6" Aggregate base course beneath the building footprint shall be included for measurement for payment per this item.
- B. Payment for aggregate shall be based on the unit price per square yard as set forth in the Agreement, per type of material and thickness of the installed item. Said price shall include all

costs necessary to complete the work including, but not limited to, placing, compacting, rolling, watering, maintaining and removing, as required by the drawings and specifications.

2.18 8" PORTLAND CEMENT CONCRETE PAVEMENT

- A. Final measurement will not be made unless changes to the bid quantity are authorized.
- B. Payment for pavement shall be based on the unit price per square yard as set forth in the Agreement, per type of pavement and thickness of the installed item. Said price shall include all costs necessary to complete the work including, but not limited to, forming, reinforcing, placing, compacting, saw cutting, connections to existing pavement, milling, doweling, jointing, curing and sealing, as required by the drawings and specifications.

2.19 11" PORTLAND CEMENT CONCRETE PAVEMENT

- A. Final measurement will not be made unless changes to the bid quantity are authorized.

Proposed building slab on grade concrete shall not included for measurement for payment per this item. Building slab on grade to be included in pricing for Hangar 2 (Excluding LSR7 Components) pay item.

- B. Payment for pavement shall be based on the unit price per square yard as set forth in the Agreement, per type of pavement and thickness of the installed item. Said price shall include all costs necessary to complete the work including, but not limited to, forming, reinforcing, placing, compacting, saw cutting, connections to existing pavement, milling, doweling, jointing, curing and sealing, as required by the drawings and specifications.

2.20 4" PORTLAND CEMENT CONCRETE SIDEWALK

- A. Final measurement will be based on the square yard of the completed and installed item.
- B. Payment for sidewalks shall be based on the unit price per square yard as set forth in the Agreement, per thickness of the installed item. Said price shall include all costs necessary to complete the work including, but not limited to, placing, compacting, aggregate course, saw cutting, milling, doweling, jointing, curing and sealing, as required by the drawings and specifications.

2.21 TYPE CG-1 CURB AND GUTTER

- A. Final measurement will not be made unless changes to the bid quantity are authorized.
- B. Payment for curb and gutter shall be based on the unit price per linear foot as set forth in the Agreement, per the type of curb and gutter. Said price shall include all costs necessary to complete the work including, but not limited to, subgrade preparation, forming, reinforcing, placing, doweling, jointing, throat construction, deflector construction, weep holes, finishing, curing and backfilling, as required by the drawings and specifications.

2.22 ADA CURB RAMPS

- A. Final measurement will be based on each completed and installed item.
- B. Payment for ramps shall be based on the unit price per each as set forth in the Agreement, per type of installed item. Said price shall include all costs necessary to complete the work including, but not limited to, subgrade preparation, aggregate course, forming, placing, compacting, saw cutting, milling, doweling, jointing, detectable warning surface, six inch thick ramp transitions or turning spaces, integral sidewalk curb, mortar work, curing and sealing, as required by the drawings and specifications.

2.23 CONCRETE WHEEL STOPS

- A. The unit of measurement for Concrete Wheel Stops shall be per each actually required, installed and accepted in the locations designated for the new wheel stops in the Drawings.
- B. Payment shall be made at the contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete this item.

2.24 4" DOUBLE YELLOW CENTERLINE WATERBORNE MARKINGS

- A. Final measurement will not be made unless changes to the bid quantity are authorized.
- B. Payment for 4" double yellow centerline waterborne markings (striping) shall be based on the unit price per linear foot as set forth in the Agreement, per width and type of stripe. Skip stripe payment shall be based on the linear footage of the applied stripe; gaps will not be measured. Payment for double yellow centerline shall be based on the linear footage of each stripe. Said price shall include all costs necessary to complete the work as required by the drawings and specifications.

2.25 4" YELLOW PARKING STALL WATERBORNE MARKINGS

- A. Final measurement will not be made unless changes to the bid quantity are authorized.
- B. Payment for 4" yellow parking stall waterborne markings (striping) shall be based on the unit price per linear foot as set forth in the Agreement. Skip stripe payment shall be based on the linear footage of the applied stripe; gaps will not be measured. Payment for double yellow centerline shall be based on the linear footage of each stripe. Said price shall include all costs necessary to complete the work as required by the drawings and specifications.

2.26 YELLOW PARKING STALL HATCH WATERBORNE MARKINGS

- A. The unit of measurement for 4" waterborne yellow pavement marking with reflective media shall be the length in linear feet actually required, installed and accepted in the locations designated specifically for 4" yellow markings in the Drawings. The work shall include preparation of the surface, furnishing and applying pavement markings, damage repair and all subsidiary work.
- B. Payment shall be made at the contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete this item.

2.27 THERMOPLASTIC WHITE 24" CROSSWALK MARKINGS

- A. Final measurement will not be made unless changes to the bid quantity are authorized. The unit of measurement for new preformed white 24" crosswalk markings shall be based on the unit price per linear foot as set forth in the Agreement. The work shall include preparation of the surface, furnishing and applying pavement markings, damage repair and all subsidiary work.
- B. Payment shall be made at the contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete this item.

2.28 THERMOPLASTIC WHITE STOP BAR MARKINGS

- A. Final measurement will not be made unless changes to the bid quantity are authorized. The unit of measurement for new preformed white 24" stop bar markings shall be based on the unit price per linear foot as set forth in the Agreement. The work shall include preparation of the surface, furnishing and applying pavement markings, damage repair and all subsidiary work.

- B. Payment shall be made at the contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete this item.

2.29 THERMOPLASTIC ADA ACCESSIBLE PARKING SYMBOL MARKINGS

- A. The unit of measurement for accessible parking symbol markings shall be per each actually required, installed and accepted in the locations designated in the Drawings.
- B. Payment shall be made at the contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete this item.

2.30 WATERBORNE FIRE LANE PAVEMENT MARKINGS

- A. The unit of measurement for fire lane pavement shall be per each actually required, installed and accepted in the locations designated in the Drawings.
- B. Payment shall be made at the contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete this item.

2.31 8" PVC STORM LINE

- A. Final measurement will not be made unless changes to the bid quantity are authorized.
- B. Payment for PVC storm line shall be based on the unit price per linear foot as set forth in the Agreement, per type or size of pipe. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), bedding, placing, pipe to pipe connections, sealing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

2.32 15" PVC STORM LINE

- A. Final measurement will not be made unless changes to the bid quantity are authorized.
- B. Payment for PVC storm line shall be based on the unit price per linear foot as set forth in the Agreement, per type or size of pipe. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), bedding, placing, pipe to pipe connections, sealing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

2.33 18" INLINE DRAIN WITH STANDARD GRATE

- A. Final measurement will not be made unless changes to the bid quantity are authorized.
- B. Payment for 18" inline drain with standard grate shall be based on the unit price per each as set forth in the Agreement. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), bedding, placing or building the end section, end section to pipe connections, head and toe wall construction, sealing, curing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

2.34 15" REINFORCED CONCRETE PIPE (CLASS IV)

- A. Final measurement will not be made unless changes to the bid quantity are authorized.
- B. Payment for 15" Reinforced Concrete Pipe shall be based on the unit price per linear foot as set forth in the Agreement, per type or size of pipe. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), bedding, placing, pipe to pipe connections, sealing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

2.35 18" REINFORCED CONCRETE PIPE (CLASS IV)

- A. Final measurement will not be made unless changes to the bid quantity are authorized.
- B. Payment for 18" Reinforced Concrete Pipe shall be based on the unit price per linear foot as set forth in the Agreement, per type or size of pipe. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), bedding, placing, pipe to pipe connections, sealing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

2.36 24" REINFORCED CONCRETE PIPE (CLASS IV)

- A. Final measurement will not be made unless changes to the bid quantity are authorized.
- B. Payment for 24" Reinforced Concrete Pipe shall be based on the unit price per linear foot as set forth in the Agreement, per type or size of pipe. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), bedding, placing, pipe to pipe connections, sealing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

2.37 30" REINFORCED CONCRETE PIPE (CLASS IV)

- A. Final measurement will not be made unless changes to the bid quantity are authorized.
- B. Payment for 30" Reinforced Concrete Pipe shall be based on the unit price per linear foot as set forth in the Agreement, per type or size of pipe. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), bedding, placing, pipe to pipe connections, sealing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

2.38 42" REINFORCED CONCRETE PIPE (CLASS IV)

- A. Final measurement will not be made unless changes to the bid quantity are authorized.
- B. Payment for 42" Reinforced Concrete Pipe shall be based on the unit price per linear foot as set forth in the Agreement, per type or size of pipe. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), bedding, placing, pipe to pipe connections, sealing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

2.39 FLARED END SECTION FOR STORMWATER BASIN

- A. Final measurement will not be made unless changes to the bid quantity are authorized.
- B. Payment for flared end section shall be based on the unit price per each as set forth in the Agreement. Said price shall include all costs necessary to furnish the flared end section per the detention basin detail in the drawings, and complete the work including, but not limited to, all excavation (earth, rock, shale), bedding, placing or building the end section, end section to pipe connections, head and toe wall construction, sealing, curing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications. Cost shall also include all subassembly components identified in the detention basin detail (gasket, flow control assembly, screen, flange, orifice plate, etc.)

2.40 42" FLARED END SECTION

- A. Final measurement will not be made unless changes to the bid quantity are authorized.
- B. Payment for flared end section shall be based on the unit price per each as set forth in the Agreement. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), bedding, placing or building the end section, end section to pipe connections, head and toe wall construction, sealing, curing, backfilling,

compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

2.41 NEW JUNCTION STRUCTURE

- A. Final measurement will be based on each completed and installed item.
- B. Payment for storm sewer structures shall be based on the unit price per each as set forth in the Agreement, per type or size of structure. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), bedding, placing or building structure, invert construction, structure to pipe connections, weep holes, small subgrade drainage pipes, trash guards, final grade adjustments to the top, lift hook concealment, sealing, curing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

2.42 NEW CURB INLETS

- A. Final measurement will be based on each completed and installed item.
- B. Payment for storm sewer structures shall be based on the unit price per each as set forth in the Agreement, per type or size of structure. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), bedding, placing or building structure, invert construction, structure to pipe connections, weep holes, small subgrade drainage pipes, trash guards, final grade adjustments to the top, lift hook concealment, sealing, curing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

2.43 NEW TURF INLET

- A. Final measurement will be based on each completed and installed item.
- B. Payment for storm sewer structures shall be based on the unit price per each as set forth in the Agreement, per type or size of structure. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), bedding, placing or building structure, invert construction, structure to pipe connections, weep holes, small subgrade drainage pipes, trash guards, final grade adjustments to the top, lift hook concealment, sealing, curing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

2.44 STORMWATER BASIN OUTLET STRUCTURES

- A. Final measurement will be based on each completed and installed item.
- B. Payment for storm sewer structures shall be based on the unit price per each as set forth in the Agreement, per type or size of structure. Said price shall include all costs necessary to furnish the flared end section per the detention basin details in the drawings. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale),

bedding, placing or building structure, invert construction, structure to pipe connections, weep holes, small subgrade drainage pipes, trash guards, final grade adjustments to the top, lift hook concealment, sealing, curing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

2.45 ACCESSIBLE PARKING STALL SIGN AND POST

- A. The unit of measurement for New Accessible Parking Stall Sign and Post shall be per each actually required, installed and accepted in the locations designated specifically for Traffic Control Signs in the Drawings. Necessary hardware for mounting the sign shall be included in the unit cost. Installation and removal of temporary traffic control signs shall not be included for measurement for payment within this item, but shall be counted as incidental to the project.
- B. Payment shall be made at the contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete this item

2.46 ROADWAY SIGN WITH POST AND MOW PAD

- A. The unit of measurement for Roadway Sign with Post and Mow Pad shall be per each actually required, installed and accepted in the locations designated specifically for Traffic Control Signs in the Drawings.

Necessary hardware for mounting the sign shall be included in the unit cost. Installation and removal of temporary traffic control signs shall not be included for measurement for payment within this item, but shall be counted as incidental to the project.
- B. Payment shall be made at the contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete this item.

2.47 SEEDING

- A. Final measurement will be based on the acreage of the completed and installed item.
- B. Payment for seed shall be based on the unit price per acre as set forth in the Agreement, per type of seed. Said price shall include all costs necessary to complete the work including, but not limited to, aeration, fertilization, mulching and watering, as required by the drawings and specifications. As needed, Contractor shall water seed until final acceptance.

2.48 TOPSOILING (6")

- A. The unit of measurement for topsoiling payment shall be made at the contract unit price per square yard of topsoil material stripped from existing site, stored in a temporary stockpile, spread back across exposed soils.

Contractor is responsible for minimizing impacts to disturbed seeded surface areas. Replacement of topsoil to disturbed surfaces outside of the project limits shall be the responsibility of the contractor to restore at no additional cost to the contract. Seeding installed in excess of the plan quantity allotted for this project will not be measured for payment without advance written approval of the RPR.

- B. Payment shall be made at the contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete this item.

2.49 MULCHING

- A. Final measurement will be based on the acreage of the completed and installed item.
- B. Payment will be made at the contract unit price per acre or fraction thereof for mulching. The price shall be full compensation for furnishing all materials and for placing and anchoring the materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

2.50 2 x #6 XLP-USE, #12 GND in 1" Conduit (New Street Lighting Circuit)

- A. Final measurement will not be made unless changes to the bid quantity are authorized. Payment for New Street Lighting Circuit shall be based on the unit price per linear foot of conduit as set forth in the Agreement. Said price shall include all costs necessary to complete the work including, but not limited to, jointing, bends, fittings and tracer wire, as required by the drawings and specifications.
- B. No separate measurement and payment will be made for the method (i.e. hand digging, plowing, trenching or boring) of conduit installation, and no separate payment will be made for installation in rock. Payment for cable or wiring in conduit shall be based on the unit price per linear foot as set forth in the Agreement. Said price shall include all costs necessary to complete the work including, but not limited to, connectors, splicing, hardware, termination and tags, as required by the drawings and specifications.

Slack shall not be included in measurement for payment.

2.51 2 x #4 XLP-USE, #6 GND in 1" Conduit (New Apron Lighting Circuit)

- A. Final measurement will not be made unless changes to the bid quantity are authorized. Payment for New Apron Lighting Circuit shall be based on the unit price per linear foot of conduit as set forth in the Agreement. Said price shall include all costs necessary to complete the work including, but not limited to, jointing, bends, fittings and tracer wire, as required by the drawings and specifications.
- B. No separate measurement and payment will be made for the method (i.e. hand digging, plowing, trenching or boring) of conduit installation, and no separate payment will be made for installation in rock. Payment for cable or wiring in conduit shall be based on the unit price per linear foot as

set forth in the Agreement. Said price shall include all costs necessary to complete the work including, but not limited to, connectors, splicing, hardware, termination and tags, as required by the drawings and specifications.

Slack shall not be included in measurement for payment.

2.52 Electrical Demolition

- A. Payment for the Electrical Demolition pay item will be based on the contract lump sum bid price for Electrical Removals. Any electrical structures or services removed outside the limits of removal due to damage by negligence on the part of the Contractor shall not be included in the measurement for payment. Removal of any existing posts, braces, electrical lines, or any other items necessary to complete the work shall be included in this pay item.
- B. Payment shall be made at the contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete this item.

2.53 6" PVC Sanitary Sewer

- A. Final measurement will be based on the centerline length of the completed and installed item.
- B. Payment for PVC sanitary sewer pipe shall be based on the unit price per linear foot as set forth in the Agreement. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), by pass pumping, bedding, trench checks, placing, fittings (bends, sleeves, etc), pipe to pipe connections, pipe to existing structure connections, sealing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

2.54 8" PVC Sanitary Sewer

- A. Final measurement will be based on the centerline length of the completed and installed item.
- B. Payment for PVC sanitary sewer pipe shall be based on the unit price per linear foot as set forth in the Agreement. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), by pass pumping, bedding, trench checks, placing, fittings (bends, sleeves, etc), pipe to pipe connections, pipe to existing structure connections, sealing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

2.55 SANITARY SEWER CLEANOUTS

- A. Final measurement will be based on each completed and installed item.
- B. Payment for sanitary sewer cleanouts shall be based on the unit price per each as set forth in the Agreement, per type or size of structure. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), final grade adjustments

to the top, sealing, curing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

2.56 SANITARY SEWER MANHOLES

- A. Final measurement will be based on each completed and installed item.
- B. Payment for sanitary sewer manholes shall be based on the unit price per each as set forth in the Agreement, per type or size of structure. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), by pass pumping, bedding, placing or building structure, invert construction, structure to pipe connections, final grade adjustments to the top, sealing, curing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

2.57 PROPOSED OIL INTERCEPTOR

- A. Measurement for the new Proposed Oil Interceptor will not be made, but it will be considered a lump sum item.
- B. Payment shall be made at the contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete this item including excavations, backfill and pipe connections.

2.58 2" DOMESTIC WATER LINE INSTALLATION

- A. Final measurement will be based on the centerline length of the completed and installed item.
- B. Payment for 2" Domestic Water Line Installation shall be based on the unit price per linear foot as set forth in the Agreement, per type or size of pipe. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), dewatering, trench checks, bedding, polyethylene encasement, placing, pipe to pipe connections, restraint measures, flushing, disinfection, pressure testing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

2.59 8" WATER MAIN INSTALLATION

- A. Final measurement will be based on the centerline length of the completed and installed item.
- B. Payment for 8" Water Main Installation shall be based on the unit price per linear foot as set forth in the Agreement, per type or size of pipe. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), dewatering, trench checks, bedding, polyethylene encasement, placing, pipe to pipe connections, restraint measures, flushing, disinfection, pressure testing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

2.60 10" WATER MAIN INSTALLATION

- A. Final measurement will be based on the centerline length of the completed and installed item.
- B. Payment for 10" Water Main Installation shall be based on the unit price per linear foot as set forth in the Agreement, per type or size of pipe. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), dewatering, trench checks, bedding, polyethylene encasement, placing, pipe to pipe connections, restraint measures, flushing, disinfection, pressure testing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

2.61 12" WATER MAIN INSTALLATION

- A. Final measurement will be based on the centerline length of the completed and installed item.
- B. Payment for 12" Water Main Installation shall be based on the unit price per linear foot as set forth in the Agreement, per type or size of pipe. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), dewatering, trench checks, bedding, polyethylene encasement, placing, pipe to pipe connections, restraint measures, flushing, disinfection, pressure testing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

2.62 FIRE HYDRANT ASSEMBLY (WITH NEW HYDRANT)

- A. Final measurement will be based on each completed and installed item.
- B. Payment for fire hydrant installation shall be based on the unit price per each as set forth in the Agreement (per City of Lee's Summit Standard Detail). Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), dewatering, bedding, polyethylene encasement, placing, connection to main line, restraint measures, isolation valve, fittings, flushing, disinfection, pressure testing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications. This pay item includes tee-connection into main-line with thrust blocking, and all pipes/valves required from main line to hydrant.

2.63 WATER LINE BENDS WITH THRUST BLOCKING

- A. Final measurement will be based on each completed and installed item.
- B. Payment for water line bends shall be based on the unit price per each as set forth in the Agreement (per City of Lee's Summit Standard Detail), horizontal or vertical, regardless of size or angle. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), dewatering, bedding, polyethylene encasement, placing, pipe to fitting connections, restraint measures, flushing, disinfection, pressure testing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

2.64 WATER LINE TEES WITH THRUST BLOCKING

- A. Final measurement will be based on each completed and installed item.
- B. Payment for water line tees shall be based on the unit price per each as set forth in the Agreement (per City of Lee's Summit Standard Detail) , regardless of size. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), dewatering, bedding, polyethylene encasement, placing, pipe to fitting connections, restraint measures, flushing, disinfection, pressure testing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

Tees for hydrant assemblies shall not be included in this pay item, that shall be included in the Fire Hydrant Assembly pay item.

2.65 WATER LINE VALVES

- A. Final measurement will be based on each completed and installed item.
- B. Payment for water line valves shall be based on the unit price per each as set forth in the Agreement (per City of Lee's Summit Standard Detail) regardless of size. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation

(earth, rock, shale), dewatering, bedding, polyethylene encasement, placing, pipe to valve connections, restraint measures, flushing, disinfection, pressure testing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

Valves for hydrant assemblies shall not be included in this pay item, that shall be included in the Fire Hydrant Assembly pay item.

2.66 DOMESTIC WATER LINE CONNECTION WITH CURB STOP

- A. Final measurement will be based on each completed and installed item.
- B. Payment for water line connection with curb stop shall be based on the unit price per each as set forth in the Agreement (per City of Lee's Summit Standard Detail) regardless of sizes. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), dewatering, bedding, polyethylene encasement, placing, pipe to valve connections, restraint measures, flushing, disinfection, pressure testing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

Valves for hydrant assemblies shall not be included in this pay item, that shall be included in the Fire Hydrant Assembly pay item.

2.67 WATER METER INSTALLATION

- A. Final measurement will be based on each completed and installed item.
- B. Payment for water meter installation shall be based on the unit price per each as set forth in the Agreement. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), dewatering, bedding, polyethylene encasement, placing, pipe to pipe connections (including continuous copper pipe from meter to the main), restraint measures, flushing, disinfection, pressure testing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.
- C. Owner will supply new meter. Contractor shall supply all other parts and tap the line.

2.68 BACKFLOW PREVENTION VAULT

- A. Final measurement will be based on each completed and installed item.
- B. Payment for backflow prevention vault shall be based on the unit price per each as set forth in the Agreement. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), structure construction and installation, dewatering, bedding, polyethylene encasement, placing, pipe to pipe connections (including continuous copper pipe from meter to the main), restraint measures, flushing, disinfection, pressure testing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

2.69 LANDSCAPING IMPROVEMENTS

- A. Method of Measurement There will be no measurement of Landscaping Improvements. It will be considered a lump sum unit.
- B. Payment shall be made at contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete all landscaping improvements depicted in Landscaping Drawings L100, L101 and L102. There will be no pay schedule this item shall be paid in full 1 lump sum upon completion.

General erosion control, seeding and mulching of the jobsite outside of the areas of proposed landscaping improvements shall not be included in this pay item, but instead shall be included in the respective pay items for erosion control, seeding and mulching.

2.70 HANGAR 2 (EXCLUDING LSR7 COMPONENTS)

- A. Measurement for the new Hangar 2 (Excluding LSR7 Components) will not be made, but it will be considered a lump sum item.
- B. Payment shall be made at the contract unit price per lump sum for Hangar 2 (Excluding LSR7 Components) and shall be full compensation for all materials, parts, installations, deliveries, labors, tools, and other incidentals necessary to complete these items.

All components of the building within the building footprint (except those listed as excluded below) shall be included in this pay item.

Foundations excavations, foundations preparation and construction, hangar slab preparation and construction, as shown on the plan sheets, shall be included in this pay item.

All utilities inside the building footprint and within of 5-ft from the building, as shown on the plan sheets shall be included in this pay item.

- C. Excluded from this pay item:

Topsoiling/excavation/grading for the building footprint, chemically treated subgrade and the aggregate base course layer beneath the building slab shall be measured and paid for by their respective pay items and shall not be included for payment in this lump sum.

The limits of measurement for payment of all external utilities will be 5-feet from the building. All utility lines, appurtenances, connections, etc. outside of 5-feet of the building shall be measured and paid for by their respective pay items and shall not be included for payment in this lump sum. Specifically: the oil interceptor, parking lot light poles, water meter shall be measured and paid for by their respective pay items and excluded from this pay item.

Owner has retained ADS as a security contractor to install security components of this project. ADS will be contracted directly with Owner for work associated with this project. Contractor shall not have to contract work directly with ADS, but shall coordinate work with ADS throughout the course of the project. The Scope ADS is responsible for is summarized as follows:

Cameras:

- ADS will provide and install all cameras and mounts. This will include camera licensing and possibly a server on site for each owner (or they may use an existing server they have offsite). ADS will supply power for cameras over 30W.
- ADS will use their patch panels and network switches to run the cameras. Please include these counts in your patch panel and switch counts. These switches will provide power to cameras 30W or less.
- Cat 6 cabling to each camera to be provided by Contractor (not ADS), including punching down into the patch panel.

- Rough-in/Cabling pathway for all cameras to be provided by Contractor (not ADS).

Doors:

- ADS will provide the head end panel, including power supply for all door devices/hardware (excluding ADA motors). ADS will need wall space for each panel in the network closets, and a local quad power outlet. ADS will not need an individual power supply above each door.
- ADS will provide and install the card readers.
- All other door hardware (lock, contact, request to exit, ADA, etc) should be provided and installed by Contractor (not ADS).
- Cabling to each door can be provided and installed by Contractor (not ADS). ADS can provide a list of what cable is needed at each door so that it functions with the spec'd hardware.
- Rough in/Cable pathways to each device on each door can be provided and installed by Contractor (not ADS). ADS can provide a list of what is needed for each device and door so ADS can get the cabling in place.

Common Scope Gaps:

- Often, there is a gap where nobody is assigned to connect the cable to the hardware devices. ADS typically pick up these connections.
- Sometimes, there is a gap where the cabling doesn't get put into the door frames during installation or the pathways aren't complete to the device so we can fish them later. ADS can be onsite and fish the cabling into the door frames during installation. Typically, the cabling hasn't been pulled at this point in the project, so ADS will splice them together above the door.

Gates:

- ADS will provide and install the intercom/camera/readers on the gates.
- All other equipment, cabling, conduit, pathways, pedestal, gate operator, fencing, etc should be supplied and installed by Contractor (not ADS). ADS can provide a list of cabling needed, and assist with coordinating devices for proper fit.

The portion of the Hangar 2 project to be funded by the City consists of all construction costs that would be incurred by the City if the LSR7 School District Hangar Space were not included in the project. Any item of construction necessitated by adding the LSR7 Hangar Space to the project will be the responsibility of LSR7 and shall be excluded from this pay item, but instead included in the "LSR7 Components of Hangar 2" Pay Item. See the Space Plan Exhibit attached to end of this section for depiction of the LSR7 space.

- D. Progress Payments: Contractor shall prepare a schedule of values with dollar breakdown indicated on each applicable Project Manual Section. As work progresses, contractor shall indicate progression of work item by item in accordance with the prepared schedule of values with a summary total to transmit to Owner. Upon review and approval by Owner, this amount will be entered into the pay application as the portion of lump sum to be paid in that progress payment. Owner shall have the right to request substantiating information of any item to support contractor's application for payment.

2.71 LSR7 COMPONENTS OF HANGAR 2

- A. Measurement for the LSR7 Components of Hangar 2 will not be made, but it will be considered a lump sum item.
- B. Payment shall be made at the contract unit price per lump sum for LSR7 Components of Hangar 2 and shall be full compensation for all materials, parts, installations, deliveries, labors, tools, and other incidentals necessary to complete these items.

The portion of the Hangar #2 project to be funded by the City consists of all construction costs that would be incurred by the City if the LSR7 School District Hangar Space were not included in the project. Any item of construction necessitated by adding the LSR7 Hangar Space to the project will be the responsibility of LSR7 and shall be included in this pay item, and therefore excluded from the "Hangar 2 (excluding LSR7 components)" Pay Item above.

See the Space Plan Exhibit attached to end of this section for depiction of the LSR7 space.

These specific components are detailed as follows:

1. Demising wall: wall and items within demising wall between LSR7 space and hangar, overhead doors, man doors, and glazing associated with LSR7 space.
 2. Structural: structural framing and slab associated with level 2 of the LSR7 space.
 3. Tenant Finish: tenant finish costs attributed to LSR7 space including MEP, FP, communications and LV systems, lighting, walls, doors, interior glazing, finishes and interior signage.
 4. Exterior Walls: net increase to the south exterior wall over typical metal panel hanger exterior walls. Defined as: Exterior increase to include all materials attributable to exterior wall infill required over the typical hangar exterior wall, with the addition of the exterior windows and the awnings (wrapping the south side from the east elevation).
 5. Southeast corner stairwell located at the southeast corner of the building.
 6. Not included: do not include the costs of roof, PEMB (primary roof) structure, slab on grade, building foundations. Do not include the costs associated to the south-center stairwell (on south face of building). Do not include net increase to exterior walls over typical hangar exterior walls with the additional components related to the design of the east wall enclosing the LSR7 space.
- C. Progress Payments: Contractor shall prepare a schedule of values with dollar breakdown indicated on each applicable Project Manual Section. As work progresses, contractor shall indicate progression of work item by item in accordance with the prepared schedule of values with a summary total to transmit to Owner. Upon review and approval by Owner, this amount

will be entered into the pay application as the portion of lump sum to be paid in that progress payment. Owner shall have the right to request substantiating information of any item to support contractor's application for payment.

2.72 New Luminaire With Mast Arm on Light Pole

- A. Final measurement will not be made unless changes to the bid quantity are authorized. The quantity of light fixtures to be measured for payment shall be the number of light poles with luminaires, with all options and accessories, installed in place, tested and ready for use. Note that ground rods, ground wiring and wiring inside light fixtures from in-line fuses to luminaires shall not be measured separately but shall be considered incidental to this pay item. The cast in place light pole bases shall be considered incidental to this pay item.
- B. Payment for new luminaires shall be made at the contract unit price per each light pole and shall be full compensation for all materials, parts, installations, deliveries, labors, tools and other incidentals necessary to complete this item.

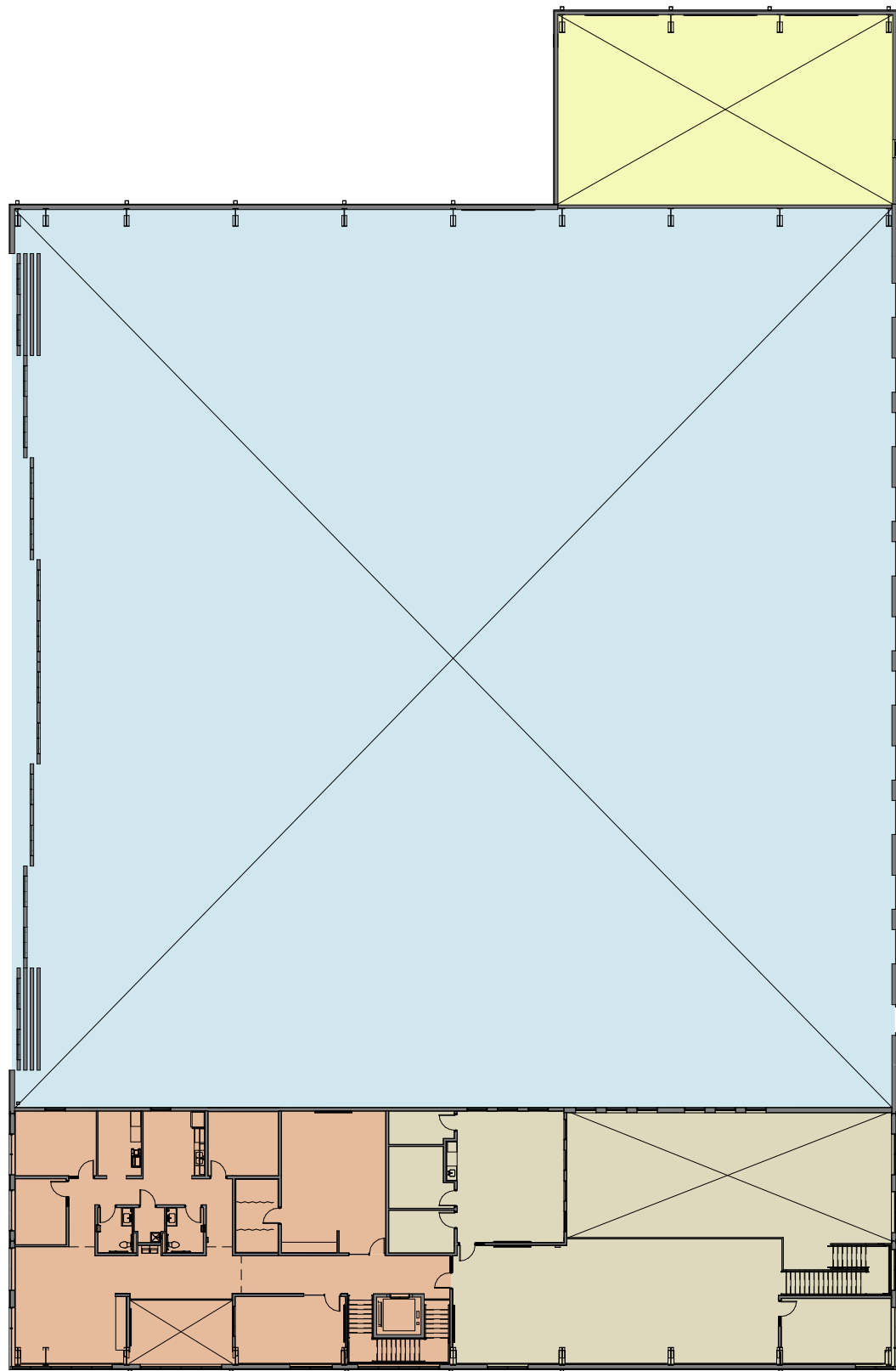
2.73 48" REINFORCED CONCRETE PIPE (CLASS IV)

- A. Final measurement will not be made unless changes to the bid quantity are authorized.
- B. Payment for 48" Reinforced Concrete Pipe shall be based on the unit price per linear foot as set forth in the Agreement, per type or size of pipe. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), bedding, placing, pipe to pipe connections, sealing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

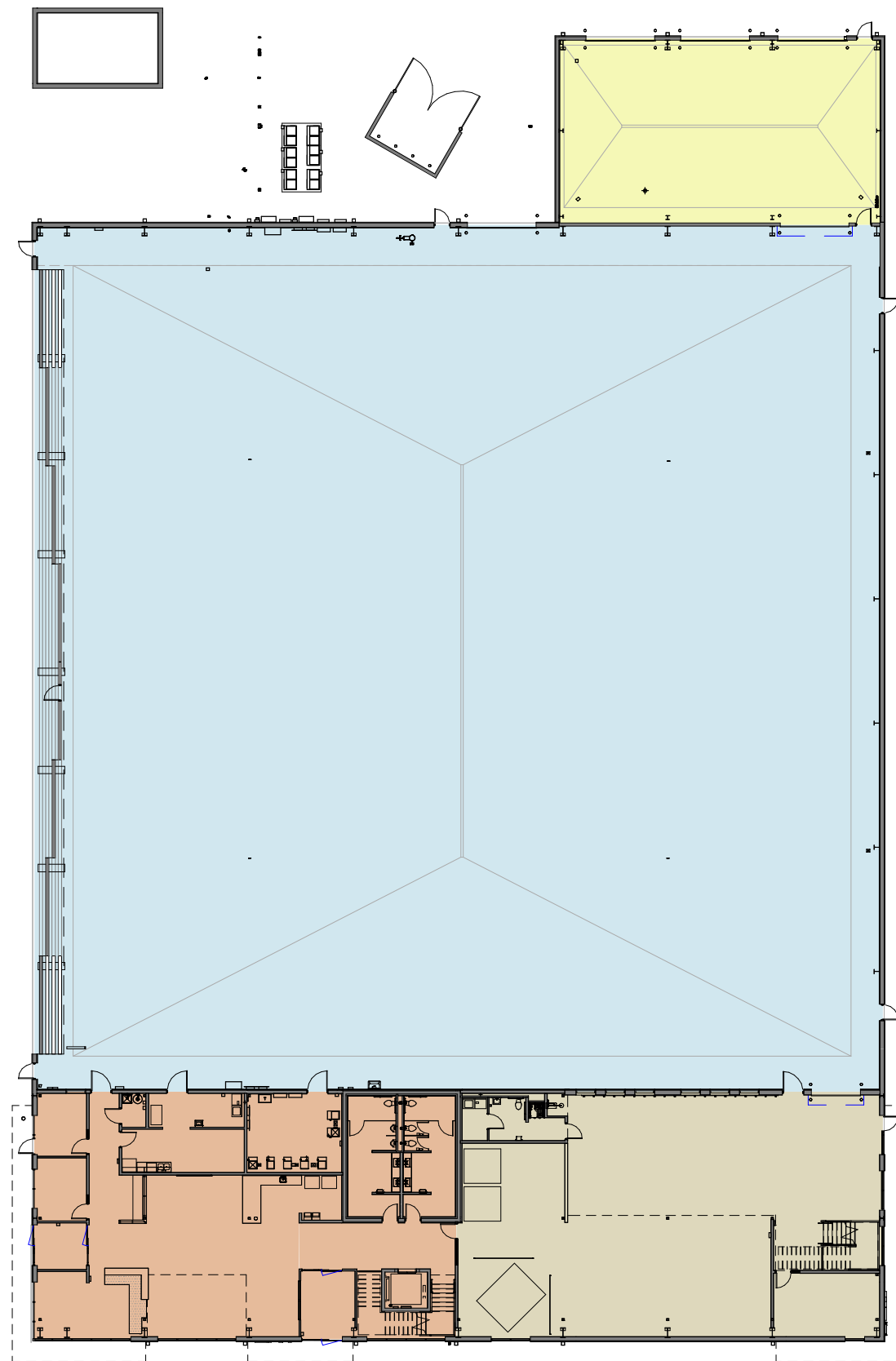
2.74 48" FLARED END SECTION

- A. Final measurement will not be made unless changes to the bid quantity are authorized.
- B. Payment for flared end section shall be based on the unit price per each as set forth in the Agreement. Said price shall include all costs necessary to complete the work including, but not limited to, all excavation (earth, rock, shale), bedding, placing or building the end section, end section to pipe connections, head and toe wall construction, sealing, curing, backfilling, compacting, grading and removal of excess or unsuitable material, as required by the drawings and specifications.

END OF SECTION



FLOOR PLAN - LEVEL 2



FLOOR PLAN - LEVEL 1

SPACE LEGEND	
	LXT - AIRPORT
	STA - SCHOOL DISTRICT LSR7
	LXT - HANGAR
	LXT - GSE STORAGE

SECTION 01120a - ALLOWANCES

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.
- B. Form 01120a.1 Allowance Authorization

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements governing allowances.
 - 1. Certain items are specified in the Contract Documents by allowances. In some cases, these allowances include installation. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Change Order.
- B. Funds will be drawn from the allowance by issuance of document 01120a.1 Allowance Authorization.

1.3 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Owner of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At Owner's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Owner from the designated supplier.

1.4 SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.
- B. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.5 COORDINATION

- A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.6 CONTINGENCY ALLOWANCES

- A. Use the contingency allowance only as directed by Owner purposes and only by Change Orders that indicate amounts to be charged to the allowance.
- B. Contractor's **overhead, profit, and** related costs for products and equipment ordered by OWNER under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs. All costs intended to be charged by the contractor shall include back-up material to support the actual costs incurred. Overhead, profit and miscellaneous costs shall be applied in accordance with the General and Supplementary Conditions.
- C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit margins.
- D. At Project closeout, credit unused amounts remaining in the contingency allowance to OWNER by Change Order.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

- A. Allowance 1: LXT Exterior Signage Allowance
 - 1. Description: this allowance is only intended for Exterior Signage not presently depicted in the drawings that the Owner may choose to implement into the contract at a later date.

If Owner shall choose to execute, Owner shall submit additional proposed signage design/details to contractor to solicit pricing to charge against this Allowance. Pricing must be reviewed by Owner and accepted via Allowance Authorization prior to implementation.

B. Allowance 2: LSR7 Exterior Signage Allowance

1. Description: this allowance is only intended for Exterior Signage not presently depicted in the drawings that LSR7 School District, through the Owner, may choose to implement into the contract at a later date. If LSR7 shall choose to execute, LSR7 shall submit additional proposed signage design/details through the Owner to contractor to solicit pricing to charge against this Allowance. Pricing must be reviewed by LSR7 and Owner and accepted via Allowance Authorization prior to implementation.

C. Allowance 3: Evergy Allowance

1. Description: Evergy did not have their electric design completed by the time this project was bid. The purpose of this Allowance is intended to be utilized to cover the costs required by contractor to complete electric design as intended by Evergy. Design is expected to supply power to Hangar 2 and relocate power to Existing Airfield Electric Vault. Once design is complete, Owner will issue revised drawings/specifications as necessary to solicit cost proposal from contractor to complete the intended work. Any costs charged directly by Evergy to complete the work shall also be included in this Allowance. Pricing must be reviewed and accepted by Owner via Allowance Authorization prior to implementation.

D. Allowance 4: Spire Allowance

1. Description: Spire did not have their gas design completed by the time this project was bid. The purpose of this Allowance is intended to be utilized to cover the costs required by contractor to complete gas design as intended by Spire. Design is expected to supply gas to Hangar 2. Once design is complete, Owner will issue revised drawings/specifications as necessary to solicit cost proposal from contractor to complete the intended work. Any costs charged directly by Spire to complete the work shall also be included in this Allowance. Pricing must be reviewed and accepted by Owner via Allowance Authorization prior to implementation.

END OF SECTION

01120a.1 ALLOWANCE AUTHORIZATION

Project Number: 47732472

Project Title: Hangar 2 and Eastside Development

To: _____

Allowance No.: _____

Re: _____

Authorization Number: _____

From: _____

Date: _____

Contract For: _____

You are authorized to perform the following item(s) of work and to adjust the Allowance Sum accordingly:

This is NOT a CHANGE ORDER and does NOT INCREASE OR DECREASE the CONTRACT AMOUNT.

Original Allowance	\$ _____
Allowance Expenditures prior to this Authorization	\$ _____
Allowance Balance prior to this Authorization	\$ _____
Allowance will be [<input type="checkbox"/> increased] [<input type="checkbox"/> decreased] by this Authorization	\$ _____
New Allowance Balance	\$ _____

APPROVAL RECOMMENDED

CITY APPROVAL

Design Professional Date

City's Representative Date

CONTRACTOR ACCEPTANCE

Construction Manager Date

Contractor Date

☐ Attachments:

Distribution: ☐ City
☐ Contractor
☐ Construction Manager
☐ Design Professional
☐ Consultant
☐ Other

SECTION 01120b - 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. This 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 CITY 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. 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: Modify 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. Notification: Owner will notify successful bidder of the status of the alternate(s) in the Intent to Contract notification.
- C. Accepted Alternates will be included in C410 Bid Form/Contract subject to the same conditions as other work of the Contract.
- D. 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

ALTERNATE NO. 1 DEDUCT GSE Storage/Lean-too from Project

1. Description

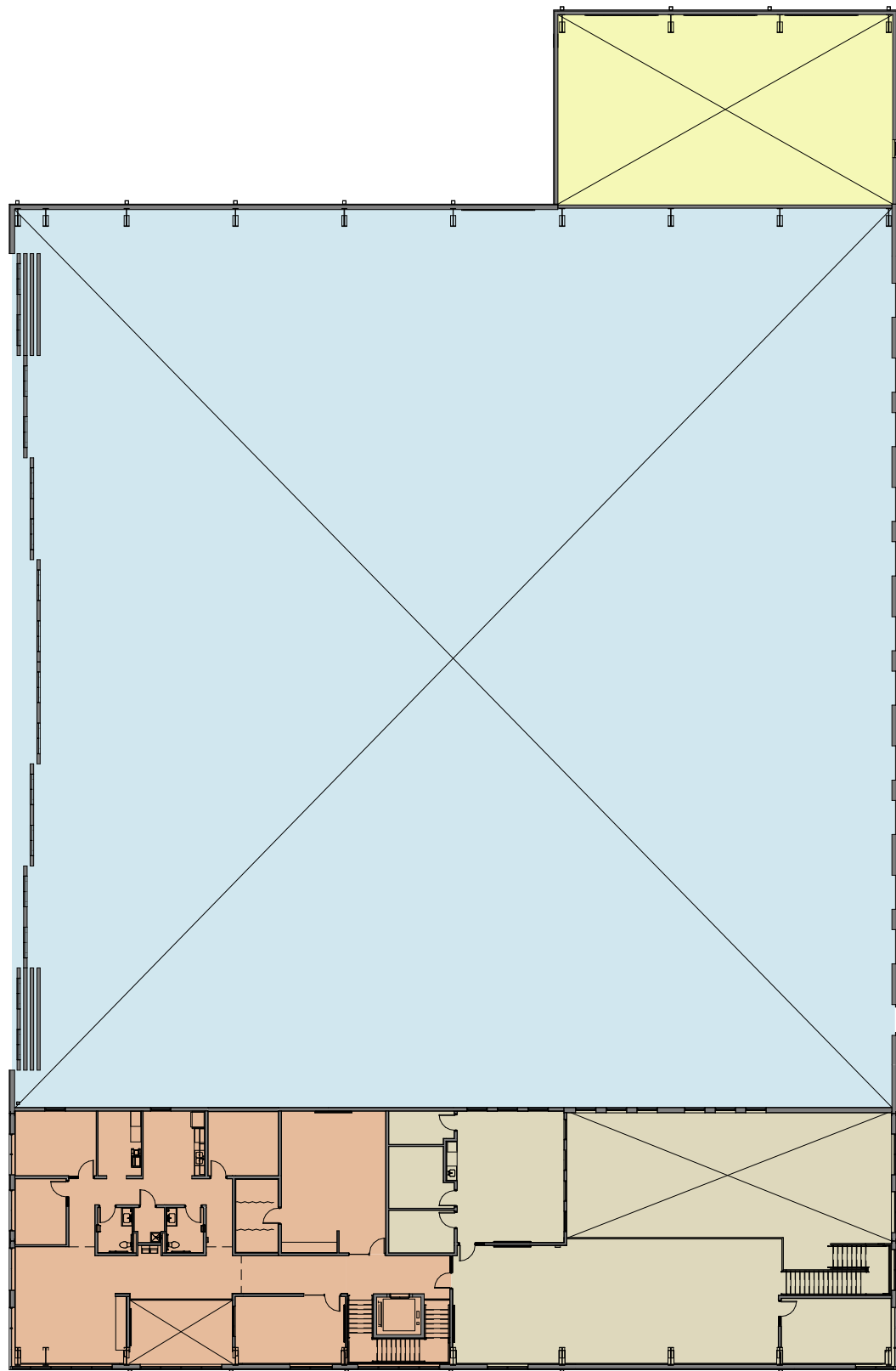
This item consists of the potential DEDUCT of the GSE Storage/Lean-Too from this contract. See the Space Plan exhibit following this section for Depiction of this exact area. Price this Alternate per the following description:

- A. Exterior envelope: removal of associated exterior wall finishes, roofing, overhead sectional doors, man door.
- B. Structural: removal of columns, beams, framing, associated structure, floor slab and footings.
- C. MEP: removal of associated mechanical, plumbing, and electrical within the space for items not also intended for the remainder of the building.
- D. Demising wall: CMU 2 hour rated assembly, rated coiling door, and rated man door are removed. Overhead door and man door within the demising wall / exterior wall to be replaced with an overhead sectional door similar to door west of trash enclosure, and insulated hollow metal exterior door similar to other man doors at hangar. Associated exterior electrical / plumbing items such as wall light fixtures, and hose bibs to shift south from GSE north wall to hangar north wall.
- E. Add Cost: Paving: without the GSE space the slab footprint will become concrete paving per civil similar to adjacent paving north and west of GSE storage. Add cost of 11" PCC pavement matching exterior pavement structure to backfill the complete GSE footprint.
- F. Add cost of PEMB wall framing, insulation, metal panel (MP-2), downspouts extended to storm sewer, and associated cost of exterior wall assembly needed along the face of GSE storage.

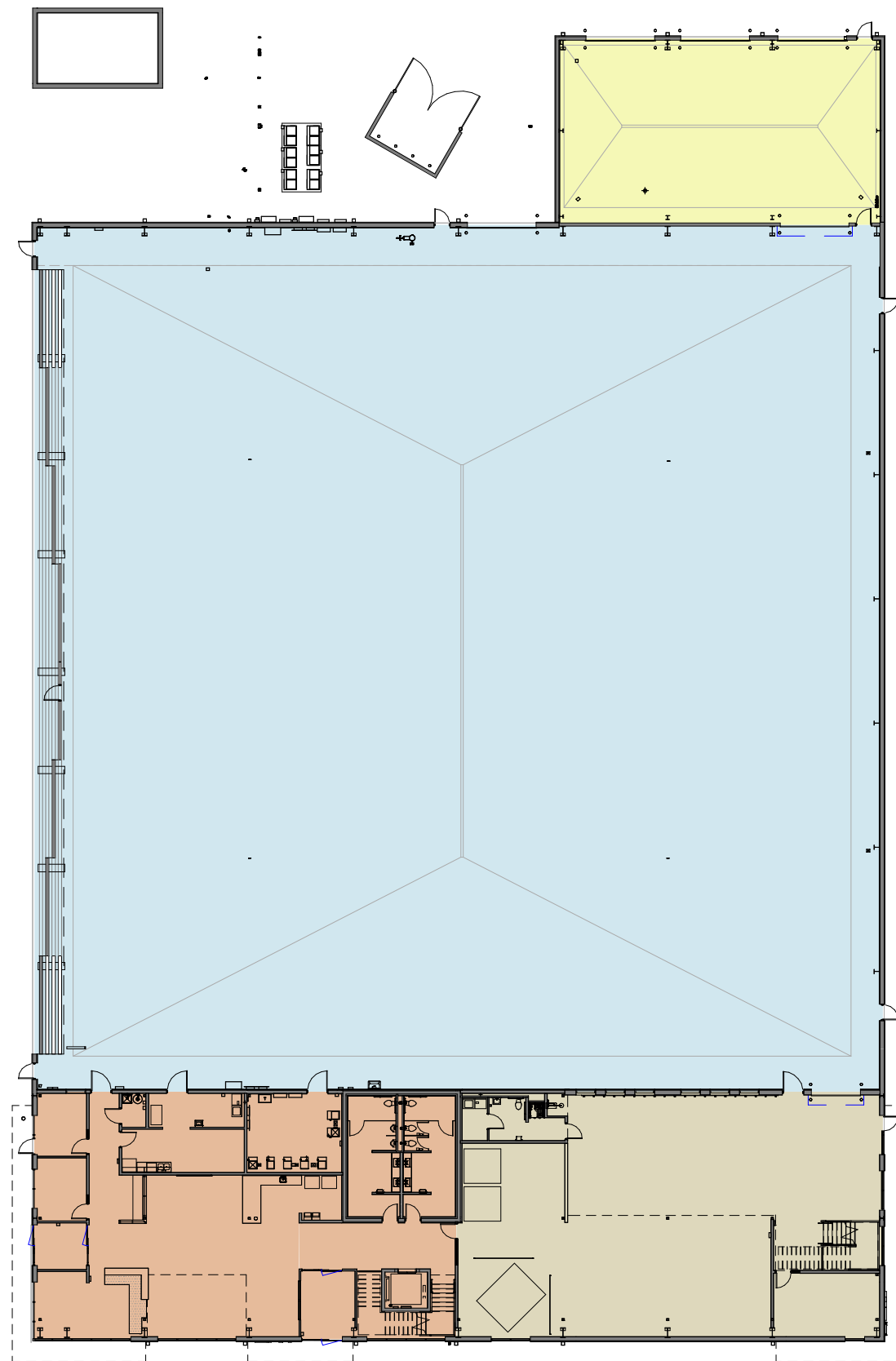
2. Process

If this Alternate is accepted, the As-Bid Lump Sum Unit Price for "HANGAR 2 (EXCLUDING LSR7 COMPONENTS)" will be adjusted to deduct the as-bid price of this Alternate. Owner will provide revised Drawings reflecting the deduction as part of the Issued-For-Construction set.

END OF SECTION



FLOOR PLAN - LEVEL 2



FLOOR PLAN - LEVEL 1

SPACE LEGEND	
	LXT - AIRPORT
	STA - SCHOOL DISTRICT LSR7
	LXT - HANGAR
	LXT - GSE STORAGE

SECTION 01121

PAY APPLICATIONS AND PAYROLLS

PART 1 GENERAL

1.01 APPLICATIONS FOR PAYMENT OR PROGRESS PAYMENTS

- A. Applications for Payment (pay applications) shall be generated by the Owner and reside within Owner's construction management software. Quantities included in the Pay Application will be based solely on the quantities entered into the project inspector's electronic Daily Diary.
- B. Though written authorization (Work Change Directives) can be given to increase a line item above the bid amount, the actual payment of a line item shall not exceed the bid amount until a Change Order has been approved.
- C. Contractor will review then approve or reject the Pay Application. If Contractor agrees with the Pay Application, the Contractor shall electronically sign the Pay Application. If Contractor does not agree with the Pay Application, the Contractor shall reject the Pay Application and shall include reasons why the Application was rejected.
- D. Prior to the Owner approving payment:
 - 1. The requirements of Article 15 in GC-700 must be met.
 - 2. Weekly and post rain event inspection reports, in accordance with PSP3.
 - 3. Submittal of certified payrolls and any corrections to certified payrolls.
 - 4. Submittal of an updated Progress Schedule.

1.02 PAYROLLS (CERTIFIED PAYROLLS)

- A. Contractor shall be responsible for submitting copies of all payrolls, including payrolls for all Subcontractors. Certified payrolls shall be uploaded into the appropriate folder. The standard naming nomenclature for the payrolls shall be Contractor's name, date, payroll #.
- B. Weekly payrolls shall be submitted at least monthly to the Owner.
- C. Payrolls shall be accompanied by a statement signed by Contractor indicating that the payrolls are correct and complete, that wage rates contained therein are not less than those determined by the State Labor Commissions or the U.S. Department of Labor, and that classifications set forth for each laborer or mechanic, including apprentices and trainees, conform with the Work performed.
- D. The first payroll submitted with Apprentices or Trainees shall include a letter from the Union with the percent of wages approved by the training program.

END SECTION

SECTION 01125

PROJECT MEETINGS

PART 1 GENERAL

1.01 PRE-CONSTRUCTION MEETINGS

- A. The Contractor shall attend a pre-construction meeting with representatives of the Owner and the Engineer, in accordance with GC-700. Aspects of the meeting include:
 - 1. Owner will provide agenda, chair meeting and provide meeting minutes to all participants.
 - 2. Contractor's attendees shall include the Contractor's resident superintendent and key individuals from subcontractors and Contractor shall bring schedules per Paragraph 2.03 of GC-700.
 - 3. The Public Utility Companies shall be invited and are expected to provide current information regarding the status of any relocation efforts.
- B. A "Meet the Contractor" public information meeting is not required for this Work.

1.02 PROGRESS MEETINGS

- A. Owner may request meetings with Contractor and its subcontractors at any time during progress of the Work. The Contractor is responsible for providing any requested information. As needed, the Engineer and other pertinent parties will be invited to attend.
- B. Aspects of the meeting include:
 - 1. Meetings will normally occur bi-weekly or as required to ensure proper communication.
 - 2. Owner will chair meetings, set agenda and provide meeting minutes to all participants.
- C. Contractor may request meetings at any time, however any meetings involving the Engineer must be requested through the Owner.

1.03 POST CONSTRUCTION MEETING

- A. Contractor shall attend and subcontractors may attend.

END OF SECTION

SECTION 01130

CONSTRUCTION RECORDING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. It is the intent of this coverage to accurately, clearly document and define pre-existing, post-construction and/or construction conditions to minimize potential construction claims.
- B. Contractor shall provide to Owner one copy of a high quality color audio and video recording of the existing surface conditions within the project's zone of influence. The zone of influence shall be defined as an area within a temporary construction easement or public right-of-way, as indicated by the Drawings, or within 35 feet of the proposed Work.
- C. The following recording(s) shall be completed:
 - 1. Prior to any construction activity.
- D. The Owner reserves the right to reject and request another recording because of poor quality, unintelligible audio or uncontrolled pan or zoom. Under no circumstances shall construction begin until the Owner has received, reviewed and accepted the recording.
- E. A qualified, established recording company, knowledgeable in construction practices and experienced in recording of construction projects, shall perform the recording. If requested, the company shall provide examples of prior work and/or references.
- F. Contractor shall obtain permission from property owners prior to entering said property.
- G. Owner must be given adequate notice of the recording appointment so Owner has the opportunity to accompany the videographer.

PART 2 PRODUCTS

- 2.01 A digital recording shall be supplied on a DVD, USB or other method approved by Owner.

PART 3 EXECUTION

3.01 COLOR AUDIO/VIDEO SURVEY

- A. Coverage shall include, but not be limited to, all existing roadways, sidewalks, fences, curbs, driveways, buildings and structures, ditches, above ground utilities, landscaping, trees, culverts, headwalls, retaining walls, signage and other physical features located within the Project's zone of influence. Detailed, close range photography and sufficient location information shall be given to any defects, such as cracks, disturbed areas or other damaged items. The coverage may be expanded if Owner so directs.
- B. All recording will be done during daylight hours and during dry, clear weather conditions.

- C. Adequate lighting, to produce the proper detail and perspective, will be required to fill in areas covered by shadows.
- D. If insufficient landmarks exist, the construction limits and/or excavation areas shall be identified by station and offset information on survey stakes and/or high visibility paint. There is no additional payment for this marking.
- E. The marking of underground utilities should be considered prior to the recording.

3.02 AUDIO AND VIDEO REQUIREMENTS

- A. Properly identify all recordings by recording number, Owner's name, project name and number, contractor's name, date and time of recording and location of recording.
- B. A record of the contents of each recording shall be supplied, and it shall be sufficiently detailed so that Owner may easily retrieve the footage of a specific location.
- C. Bookmarks or chapters must be included at a minimum of every 500 feet or at a suitable landmark (intersection, etc.) if less than 500 feet.
- D. Each recording shall begin with a verbal description per 3.02.A. Clear narration during the course of the recording shall include sufficient location information, direction of travel, viewing side and highly detailed descriptions of the existing conditions. The date and time must appear on the recording.
- E. Identify houses and buildings visually by house number and in such a manner that structures in the proposed Work, (i.e. manholes, etc.) can be located by reference. Use of station numbers is acceptable if the stationing coincides with the Drawings.
- F. Information appearing on the recording must be continuous and run simultaneously with computer generated translucent digital information. No editing or overlaying of information at a later date will be acceptable.
- G. The rate of speed in the general direction of travel during the recording shall be sufficient to accurately document the area of Work. Panning rates and zoom-in and zoom-out rates shall be controlled sufficiently such that during playback, the picture shall be in focus and maintain clarity at all times.

END OF SECTION

SECTION 01135

REPORTING OF DAMAGED UTILITIES

PART 1 GENERAL

1.01 SCOPE

- A. If in the performance of the Work there is damage or interruptions to the electrical, fuel (natural gas, propane, etc.), telephone, water, sanitary or storm supply and/or distribution system, then the Contractor will immediately notify the appropriate utility and make arrangements to repair said damage. In support of Section 7.15 of GC-700, the Contractor shall take the following additional steps:
1. Damaged fuel (natural gas, propane, etc.) lines require the Contractor to immediately notify the Lee's Summit Emergency Services (Dial 911).
 2. Downed power lines or other hazard that may put the public at risk requires the Contractor to immediately notify the Lee's Summit Emergency Services (Dial 911).
 3. Contractor shall notify Owner of all damage or interruptions after the Utility Company and/or Emergency Services have been contacted.

END OF SECTION

SECTION 01140

ACCESS AND CLOSURES

PART 1 GENERAL

1.01 ACCESS AND CLOSURES

- A. Consult Section 1105 (Sequencing and Coordination) for notification procedures and timeframes, and consult the Drawings for any specific access details.
- B. Public Property: Unless directed by Owner or detailed in the Drawings, all streets, intersections, and/or public driveways shall be maintained at all times.
- C. Private Property:
 - 1. Unless written permission is received from a private property owner, access to and from the respective property shall be maintained at all times.
 - 2. Driveway reconstruction shall be accomplished with minimum inconvenience to the primary user(s), and suitable access will be maintained at all times.
- D. Emergency Vehicles: Suitable access for emergency vehicles will be maintained at all times.
- E. Special Provisions:
 - 1. See Sheet G003 Construction Activity Plan for closure information.
 - 2. Temporary partial-closures may be necessary at Hagan Road. Prior to the implementation of any traffic closures a temporary traffic control plan shall be developed by Contractor following guidelines in the Lee's Summit Standard Traffic Control Details and MUTCD. Contractor shall submit temporary traffic control plan for approval prior to implementation.
 - 3. Airfield pavement closures require a special-type low-profile barricade. Refer to Drawings to ensure that appropriate barricades are supplied.
 - 4. Some airfield lights will need to be covered for the duration of this work. Refer to Drawings for details.

1.02 DETOURS AND TIME RESTRICTIONS

- A. No detours shall be required for this project

1.03 TEMPORARY SURFACING

- A. No temporary surfacing is required for this project. Should the contractor elect to use temporary surfacing to support their operations it shall be done so at no additional cost to the contract.

END SECTION

SECTION 01145

PROPERTY MAINTENANCE AND CLEANING

PART 1 GENERAL

1.01 PROPERTY MAINTENANCE

- A. Contractor will be responsible for the maintenance of the Site until a Certificate of Substantial Completion is issued. Included, but not limited to, are the following items:
 - 1. The height of grass or weeds shall not exceed the maximum allowed by Code. Note: Contractor shall continue to maintain areas that have not had a final application of seed or sod, even though the Contractor has received their Substantial Completion notice.
 - 2. As indicated in the Drawings or Specifications, safe and passable surfaces, whether permanent or temporary, shall be maintained for the traveling public (whether vehicular or pedestrian) throughout the Project. Contractor shall maintain the roadbed substantially free of ruts, holes and detrimental surface deformations. This work may include pothole repairs, sidewalk repairs and shoulder repair. No direct payment will be made for this work, unless listed in the bid tab.
- B. Owner will be responsible for the following items:
 - 1. Snow removal and deicing measures per Owner's plan. In order to facilitate these operations the Contractor shall:
 - i. Clearly identify the location of any street plates and any structures (manholes, valve boxes) projecting above the roadbed or base.
 - ii. Remove any obstructions, materials and equipment that may impede the Owner's operations or the operations of those having interest along the Project.
 - iii. Have suitable measures installed to protect the Work, the public, the Owner's equipment and the Contractor's material and equipment from damage.

1.02 CLEANING

- A. Contractor shall execute cleaning during progress of the Work and at completion of the Work.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Choose materials which will not create hazards or cause damage to health or property.
- B. Use only those materials and methods accepted by both the manufacturer of surface material that is to be cleaned and recommended by the cleaning material manufacturer.

PART 3 EXECUTION

3.01 DURING CONSTRUCTION

- A. Execute periodic cleaning, to the Owner's satisfaction, to keep the Site and adjacent properties free from accumulations of waste materials, rubbish and windblown debris.
- B. Provide sufficient onsite containers for the collection of waste materials, rubbish and debris. Containers shall be clearly marked with the Contractor's name and shall be conveniently located for use by workers. Containers shall be covered to prevent wind from removing debris, and Contractor shall relocate containers as required during the course of the Work.
- C. Contractor shall be responsible for keeping its trucks and equipment clean for the duration of the Contract. If mud is deposited on any paved area, as a result of the Contractor's actions, the Contractor will immediately remove the mud upon oral or written notice by the Owner.

3.02 DUST CONTROL

- A. Schedule construction operations so that dust and other contaminants will not fall on newly-coated surfaces.
- B. The removal of dust will be determined by the Owner, in order to maintain the safety and convenience of the public and for the reduction of dust nuisance to adjacent properties.
- C. Contractor shall apply suitable materials and use appropriate equipment to control the dust. Enclosed dust collection systems may be required, especially within residential areas.
- D. Dust control shall be repeated at such intervals as to satisfactorily control dust, and the Contractor must have sufficient equipment on site at all times.

3.03 FINAL CLEANING

- A. The Contractor shall obliterate all signs of temporary construction facilities such as haul roads, work areas, structures, foundations or temporary structures, stockpiles of excess or waste materials, or any other vestiges of construction, as directed by Owner. Disturbed areas shall be graded, filled and properly covered (seed, pavement, etc.).
- B. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition that is also free of stains, films and other foreign substances. Remove any non-permanent labels.
- C. Restore reflective surfaces to their original reflective condition.
- D. Broom clean paved surfaces and rake clean other surfaces of the grounds, so as to leave the Site ready to be opened for use and/or occupancy by Owner or public. Restore those portions of the Site not designated for alteration by Contract Documents to their original condition.
- E. Restoration of damaged landscape: Any landscape feature scarred or damaged by Contractor's equipment or operations shall be restored as nearly as possible to its original condition at Contractor's expense. Contractor shall be responsible for replacing any trees, grass, landscaping, or piping systems damaged by construction.

END OF SECTION

SECTION 01150

SALVAGE OF MATERIALS

PART 1 GENERAL

1.01 SALVAGE OF MATERIALS

- A. Unless specified herein or identified in the drawings, specifications or agreements, all material and debris shall be the property of the Contractor.

1.02 SALVAGE MATERIALS TO OWNER

- A. Owner shall be given the opportunity to salvage the following items.
 - 1. Existing street signs. Contractor to deliver to:
 - i. 1971 SE Hamblen Road
 - 2. Abandoned or replaced water meters and meter assemblies will be reviewed on a case by case basis.
 - 3. Removed fire hydrants will be reviewed on a case by case basis.

END OF SECTION

SECTION 01155

INCIDENTAL ITEMS

PART 1 GENERAL

1.01 MAIL BOXES

- A. Mail boxes within the construction limits shall be removed by the Contractor and temporarily set where they will be accessible to both the postal carrier and the patron. Owner will approve of the location and material used for the temporary access.
- B. Prior to final acceptance, Contractor shall properly reset and relocate all mail boxes.
- C. Mail boxes damaged by the Contractor shall be replaced by the Contractor.
- D. Mail boxes shall be installed per United States Postal Service requirements and per applicable AASHTO guidelines.
- E. Contractor shall coordinate with the United States Postal Service as required.

1.02 ADJUSTMENT OF MANHOLES AND UTILITY COVERS

- A. Manholes and utility covers shall be raised or lowered to the proposed grade or slope.
- B. In paved areas, the work shall be accomplished in such a manner as to not create a traffic hazard, while providing for proper construction and compaction requirements.

END OF SECTION

SECTION 01160

PERFORMANCE TESTS, DATA AND INSTRUCTION

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

- A. Performance tests, operational data or instruction requirements are generally listed in the applicable technical specifications; any additional requirements are listed in this Section.

1.02 PERFORMANCE TESTS

- A. Performance tests shall be completed prior to acceptance and placement of the equipment, system or facility into service or final service.
- B. As required, Contractor shall submit a written plan detailing steps involved in performance testing or startup of equipment, system or facility 14 calendar days prior to startup or testing.
- C. If equipment, system or facility fails to function properly, or guaranteed performance is not indicated, Contractor shall make necessary corrections, including replacement, at no cost to Owner, and after such corrections are completed, demonstrate to Owner that equipment, system or facility functions properly and guaranteed performance is obtainable. Such failures do not provide grounds to justify claims for delays on Contractor's part.

1.03 OPERATIONAL DATA

- A. Contractor shall supply additional operational data as follows:
 - 1. Operational data shall be supplied as indicated in the technical specifications

1.04 INSTRUCTION REQUIREMENTS

- A. Contractor shall perform additional instructional requirements as follows:
 - 1. Instructional requirements shall be as indicated in the technical specifications

END OF SECTION

SECTION 01205

STAGING AREA AND MATERIAL STORAGE

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS INCLUDED

- A. Refer to the Agreement, Article 5 GC-700 for additional information applicable to the Site and the use of the Site; and
- B. Contractor will maintain adequate drainage and not hinder or block existing facilities.
- C. Contractor will maintain erosion control measures as necessary or directed.
- D. Contractor's field offices, sheds, equipment, materials storage, and/or other authorized use of the staging area will not hinder traffic nor create a hazard to the public.
- E. Waste materials shall not be permitted to accumulate.
- F. Except as noted, Contractor shall furnish, install, and maintain all temporary services.
- G. Following completion of the Work, Contractor shall remove all temporary facilities, field offices, sheds, equipment and material and then restore the areas according to the Contract Documents.

1.02 EQUIPMENT TRANSPORTATION AND DELIVERY

- A. Transport and handle equipment in accordance with manufacturer's instructions. Deliver products to the site in manufacturer's original sealed containers or other packing systems, complete with instructions for handling, storing, unpacking, protecting and installing.
- B. Schedule delivery to reduce long term on-site storage prior to installation and/or operation.
- C. Unload all items delivered to the site and place in a manner which will not endanger the Public, interfere with the flow of traffic or hamper work by others.
- D. Promptly inspect shipment to assure that products comply with requirements, quantities are correct and items are undamaged. Notify Owner immediately of any problems.

1.03 MATERIALS, EQUIPMENT and FURNISHINGS STORAGE

- A. All materials, equipment and furnishings being provided are to be serviceable, adequate for the required purpose, and must not violate applicable codes or regulations.
- B. Store and protect products in accordance with the manufacturer's instructions, with seals and labels intact and legible. Arrange storage to permit access for inspection.
- C. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

- D. Store cement and lime under a roof and off the ground and keep completely dry at all times. Store all structural, miscellaneous and reinforcing steel off the ground or otherwise to prevent accumulations of dirt or grease and in a position to prevent accumulations of standing water and to minimize rusting. Handle and store precast concrete in a manner to prevent accumulations of dirt, standing water, staining, chipping or cracking.
- E. Store all mechanical and electrical equipment and instruments subject to corrosive damage by the atmosphere in a weathertight building to prevent damage. The building may be a temporary structure on the site or elsewhere, but it must be satisfactory to the Owner. Provide building with adequate ventilation to prevent condensation. Maintain temperature and humidity within range required by manufacturer.
- F. Rotate moving parts a minimum of once weekly to ensure proper lubrication and to avoid metal-to-metal "welding." Upon installation of the equipment, the Contractor shall start the equipment, at least half load, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.

1.04 SPECIFIC REQUIREMENTS FOR STORAGE, DELIVERY AND STAGING AREAS

- A. This project is located inside the airport operations area of an airport. A staging area has been provided as specified in the Construction Activity Plan. All contractor vehicles, equipment, personnel and stored materials shall stay within the boundaries identified in the Construction Activity Plan. Contractor personnel and operations shall not be permitted on any active airfield pavements. No vehicles, equipment, personnel or materials may be within the Object Free Area for an active Taxilane, Taxiway or Runway at any time.

END OF SECTION

SECTION 01210

FIELD OFFICES AND SHEDS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS INCLUDED

- A. As required for the Work, Contractor shall furnish, install and maintain field offices, storage and work sheds. All offices, trailers or sheds shall be subject to the Owner's approval.
- B. If a Contractor's field office is established, it shall be the headquarters of their representative who is authorized to receive drawings, instructions, or other communication or articles. Any communication given to the said representative or delivered at Contractor's field office, in their absence, shall be deemed to have been delivered to Contractor.

1.02 REQUIREMENTS FOR FIELD OFFICES

- A. Field Office for Owner (or their Representative) is **not** required for the Owner or their Representative

~~B. Field Offices (whether for Contractor or Owner) shall be:~~

- ~~1. In good condition, structurally sound and weathertight with floors raised above ground.~~
- ~~2. All utilities shall be in service when the office has been placed on site.~~
- ~~3. Automatic heating and mechanical cooling equipment shall be able to maintain appropriate conditions for occupants and/or storage requirements.~~
- ~~4. All offices shall remain on site, with all utilities in service, until the work is complete, or the Contractor is notified by the Owner.~~

1.03 REQUIREMENTS FOR STORAGE SHEDS

- 1. Appropriate to the trade, with dimensions adequate for storage and handling of products.
- 2. Ventilation, heating and cooling shall comply with specified codes, temperatures and requirements for the products stored.

END OF SECTION

SECTION 01215

TEMPORARY ELECTRICITY, HEAT OR TELEPHONE

PART 1 GENERAL

1.01 SCOPE

- A. Except as specifically noted herein, the Contractor shall provide all temporary utilities required for construction and shall remove all such facilities at end of Work.
- B. Contractor shall clean and repair damage caused by installation or use of temporary facilities. Restore existing facilities used during construction to original (or specified) condition.

1.02 PAYMENT

- A. Except as specifically noted herein, all costs of temporary utilities and controls are considered incidental to the Contract and shall be included in the Contract Price.

1.03 ELECTRICITY AND LIGHTING

- A. Contractor shall make all arrangements, pay all costs and provide electricity as required for construction.
- B. Contractor shall provide temporary lighting for construction operations.
- C. Owner will furnish electrical power for startup and testing of equipment to be permanently incorporated into this Project. Electric meters will be in the name of the Owner, and the Owner will pay the utility bill necessary for startup and testing of equipment.

1.04 HEAT AND VENTILATION

- A. Contractor shall make all arrangements, pay all costs and provide heat and ventilation as required to maintain specified conditions for construction operations, and to protect materials and finishes from damage due to temperature or humidity.
- B. Contractor shall provide ventilation of enclosed areas to cure materials to disperse humidity and to prevent accumulations of dust, fumes, vapors or gases.

END OF SECTION

SECTION 01220

TEMPORARY SANITARY FACILITIES

PART 1 GENERAL

1.01 SCOPE

- A. Except as specifically noted herein, the Contractor shall provide all temporary utilities required for construction and shall remove all such facilities at end of Work.
- B. Contractor shall clean and repair damage caused by installation or use of temporary facilities. Restore existing facilities used during construction to original (or specified) condition.

1.02 PAYMENT

- A. Except as specifically noted herein, all costs of temporary utilities and controls are considered incidental to the Contract and shall be included in the Contract Price.

1.03 SANITARY FACILITIES

- A. Contractor shall provide and maintain sanitary facilities (restrooms) as required for the Contractor's work force (including sub contractors).
- B. Discharge into Owner's sanitary system:
 - 1. With proper notification (and scheduling) to the Owner, the discharge of super-chlorinated water (from the flushing out of new water lines installed for this Project) will be allowed.
 - 2. Note: Discharge into the Owner's sanitary system will not be allowed during wet-weather flow conditions.
 - 3. Contractor will supply all fittings, pipes and hoses.
 - 4. Contractor will be billed, at the current rates, by the Owner.

END OF SECTION

SECTION 1225

TEMPORARY WATER FACILITIES

PART 1 GENERAL

1.01 SCOPE

- A. Except as specifically noted herein, the Contractor shall provide all temporary utilities required for construction and shall remove all such facilities at end of Work.
- B. Contractor shall clean and repair damage caused by installation or use of temporary facilities. Restore existing facilities used during construction to original (or specified) condition.

1.02 PAYMENT

- A. Except as specifically noted herein, all costs of temporary utilities and controls are considered incidental to the Contract and shall be included in the Contract Price.

1.03 WATER

- A. Contractor shall purchase and deliver to job site potable water for drinking. No drinking water will be provided to Contractor by the Owner.
- B. Connection to Owner's water system:
 - 1. With proper notification to the Owner, the Contractor will be allowed to connect to publicly owned fire hydrants on the City's water system.
 - 2. Hydrant meters shall be obtained from the City of Lee's Summit Water Utilities Department.
 - 3. Contractor shall provide all fittings, pipes and hoses as needed.
 - 4. Contractor will be billed, at the current rates, by the Owner.
- C. Existing Water Valves
 - 1. Unless specific permission is obtained, the Contractor shall not operate any valves (including hydrant branch valves) on the Owner's existing water system.
 - 2. The operation of all valves shall be performed by the Owner, and the Contractor shall make the request for valve operation at least 48 hours in advance.

END OF SECTION

SECTION 01305

TESTING LABORATORY SERVICES

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. An independent testing laboratory may be retained to perform sampling and testing in order to determine the compliance of the Work with the Contract Documents. Testing requirements may include, but are not limited to, design mixes, job mix formulae, materials, manufactured items, earthwork, paving, grouting and concrete. Also see Article 14 of GC-700.
- B. Any testing laboratory employed by the Contractor must be independent and comply with the Contract Documents.
- C. Quality Control and Quality Assurance testing requirements are found in Section 01306.

1.02 PAYMENT

- A. Quality Control (QC) tests and tests required to determine initial compliance and initial material acceptance, shall be paid for by:
 - 1. The Contractor
- B. Quality Assurance (QA) tests shall be paid for by:
 - 1. The Owner
- C. Costs for retest(s) performed because the first test (whether initial, QC or QA) resulted in a failure shall be paid for by:
 - 1. The Contractor
 - 2. If Contractor does not agree with the test results or any costs associated with retesting, then the procedure in Paragraph 1.04 of Section 1306 shall be followed.
 - 3. Additionally, any costs incurred by the Owner or Engineer for retesting shall be paid for by Contractor or deducted from the Progress Payments.
- D. If Contractor gives inadequate notice, and proper testing cannot be performed, the Contractor shall bear all additional expenses incurred by laboratory personnel and their travel, and no changes to contract time will be considered if Work cannot proceed without the testing.

1.03 QUALIFICATIONS OF LABORATORY

- A. Independent testing laboratories shall meet at least one of the following qualifications:
 - 1. Participate in AASHTO Accreditation Program (AAP) and maintain current and applicable AASHTO Laboratory Accreditation for materials testing as appropriate for the Project, including but not limited to soil, aggregate, Portland Cement Concrete and hot-mix asphalt.

The Laboratory's accreditation shall be listed in AASHTO R-18 accredited laboratory list as accessed on the internet.

2. Provide adequate proof of compliance with the most current edition of ASTM E 329, *Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction* for the construction materials specified for sampling and testing during the Project.

1.04 AUTHORITY LIMITATIONS OF TESTING LABORATORY

A. Laboratory is not authorized to:

1. Release, revoke, alter or enlarge on requirements of Contract Documents.
2. Approve or accept any part of Work.
3. Perform any duties of Contractor.

1.05 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with laboratory personnel, and provide access to Work.

B. As required, secure and deliver to the laboratory adequate quantities of representational samples of materials proposed for use and which require testing.

C. Provide to the laboratory the preliminary design mix proposed to be used for concrete and other materials mixes which require control by the testing laboratory.

D. As required, furnish copies of products' test reports.

E. As required, furnish incidental labor and facilities to:

1. Provide access to work that requires testing.
2. Facilitate tests including obtaining and handling samples at Project if so requested.

END OF SECTION

SECTION 01306

QUALITY CONTROL AND QUALITY ASSURANCE

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

- A. Quality Control (QC) and Quality Assurance (QA) measures are listed in this Section. All sampling and testing is to be performed in accordance with Article 14 of GC-700 and per the requirements in Section 01305.

1.02 QUALITY CONTROL

- A. QC shall be the responsibility of the Contractor.
- B. The Contractor shall include the Owner's Resident Project Representative on the standard distribution list for all QC test reports, preliminary field test results, and Daily Field Reports.
- C. The minimum testing frequency for QC is shown in the following table. Where multiple tests are required, samples shall be distributed such that the entire day's production is represented.
- D. Preliminary field test results shall be delivered to Owner's Resident Project Representative on the same day the tests are conducted. Preliminary QC test failures shall be annotated on the Daily Field Report.
- E. QC test results and documentation shall be uploaded into the folder labeled *4.1, QC (Contractor) Test Reports* within the Owner's construction management software.
- QC test results shall be uploaded within 7 calendar days after tests are completed
 - QC test result failures shall be reported to the Owner's Resident Project Representative within 4 hours of test completion via telephone and email.

Activity	Required Test	Minimum QC Testing Frequency
Grading – Embankment	Density/Moisture Curve In-Place Density/Moisture	1 per Material Type LSMO 2102.6.H 1 per 500 CY of material placed, minimum 1 per lift.
Pavement Subgrade	Roll tested per APWA 2201.4.E and as modified by LSMO DCM/PSP Density/Moisture Curve Gradation Plasticity Index In-Place Density/Moisture	Prior to placing aggregate base for chemically stabilized subgrade After placing aggregate base for mechanically stabilized subgrade 1 per Material Type 1 per Material Type One per Material Type. LSMO 2102.7.F 1 per 750 Square Yards of material placed, minimum 2 per day

Activity	Required Test	Minimum QC Testing Frequency
Aggregate Base	Density/Moisture Curve Gradation In-Place Density/Moisture Plasticity Index Roll tested per APWA 2201.4.E and as modified by LSMO DCM/PSP	1 per Material Type 1 per Material Type 1 per 750 square yards of Subgrade, Min. 4 per day One per Material Type. Prior to placing aggregate base for chemically stabilized subgrade After placing aggregate base for mechanically stabilized subgrade
Trenching and Backfilling)	Density/Moisture Curve	1 per Material Type LSMO 2102.4.J
Trench Backfill	In-Place Density/Moisture	1 test per 200 to 400 linear feet per lift, Minimum of 1 per lift (or 1 test per 100 to 200 cubic yards of backfill placed, Minimum of 1 per lift) LSMO 2102.4.O
Backfill around structures	In-Place Density/Moisture	1 test per 100 to 200 cubic yards of backfill placed, Minimum of 1 per lift
Asphaltic Concrete	Gradation (in-place Behind Paver) Oil Content Oil Type Density (1000 tons or greater) Density (less than 1000 tons)	1 per day per spread. 1 per day. 1 per mix. 10 per day per spread 6 per day per spread
Concrete (Curb, Sidewalk, Driveways, etc.) Required for each mix design.	Air Content Slump Compressive strength	1 at beginning of each daily pour and 1 per 25 CY thereafter. 1 at beginning of each daily pour and 1 per 25 CY thereafter. 1 set of 4 cylinders at beginning of each daily pour and 1 per 100 CY thereafter
Concrete for Structures (Pavement, Boxes, etc). Required for each mix design.	Air Content Slump Compressive strength	1 at beginning of each daily pour and 1 per 100 CY thereafter. 1 at beginning of each daily pour and 1 per 100 CY thereafter. 1 set of 4 cylinders at beginning of each daily pour and 1 per 200 CY thereafter

1.03 QUALITY ASSURANCE

- A. QA shall be the responsibility of the Owner.
- B. The minimum testing frequency for QA is shown in the following table. Where multiple tests are required, samples shall be distributed such that the entire day's production is represented.
- C. Any reductions in the testing frequency in to the QA program below shall be issued by a Field Order by the Engineer at the sole discretion of the Owner.
- D. The Owner's Resident Project Representative may authorize additional QA testing based on the actual conditions of the project, changes in materials, or observations of test results reported

as part of the Contractor's QC testing program, or other conditions that may warrant additional testing.

- E. QA test results and documentation shall be uploaded into the folder labeled 4.2, *QA (City) Test Reports* within the Owner's construction management software.

Activity	Required Test	Minimum QA Testing Frequency
Grading – Embankment	Density/Moisture Curve	1 per Material Type
	In-Place Density/Moisture	3 per week with mass grading work on the project.
Aggregate Base	Density/Moisture Curve	1 per Material Type
	Gradation	1 per source
	In-Place Density/Moisture	1 per Material Type placed on project
	Plasticity Index	1 per source.
Trenches (Earth Backfill)	Density/Moisture Curve	1 per Material Type
	In-Place Density/Moisture	3 per week
Excavation Pits (Such as bore pits, anode pits, or small, non-linear excavations)	Density/Moisture Curve	1 per Material Type
	In-Place Density/Moisture	3 per week
	Plasticity Index	1 per Material Type
Asphaltic Concrete	Gradation (in-place Behind Paver)	1 per Mix Design
	Oil Content	1 per Mix Design.
	Oil Type	1 per Mix Design.
	In-Place Density	3 per Mix Design
Concrete (Curb, Sidewalk, Driveways, etc.) Required for each mix design	Air Content	1 per month for each mix design.
	Slump	1 per month for each mix design
	Compressive strength	1 per month for each mix design
Concrete for Structures (Pavement, Boxes, etc.) Required for each mix design	Air Content	1 per month for each mix design.
	Slump	1 per month for each mix design
	Compressive strength	1 per month for each mix design

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1.04 QC AND QA RESULTS COMPARISON

A. If differences are found between QC and QA results, then Owner and Contractor shall:

1. Identify any procedural differences between QC and QA and correct any improper procedures.
2. If no procedural differences are found and Owner and Contractor cannot agree on the results and subsequent impact to the Work, then an independent third party lab will be utilized. If the final results of the third party testing indicate the Owner's test results were correct, then the Contractor shall be responsible for the cost associated with the third party testing. Likewise, if the final results of the third party testing indicate the Contractor's test results were correct, then the Owner shall be responsible for the cost associated with the third party testing. Unless Owner or Contractor cannot agree, the results of the third party lab will be final and binding.

END OF SECTION

SECTION 01310

PROJECT CLOSEOUT

PART 1 GENERAL

1.01 SCOPE

- A. Per Paragraph 15.05 of GC-700, Contractor will initiate the project closeout process by sending written notice to the Owner that the entire work (or agreed portion thereof) is complete. The appropriate parties will promptly make a final inspection to determine if any portion of the Work is incomplete or defective.
- B. In accordance with Paragraphs 15.05 and 15.06 of GC-700, and additional items as required by the Owner, the following items shall be accomplished prior to final payment.

1.02 CONTRACTOR TO FILE WITH OWNER

- A. Any remaining submittals.
- B. Any record documents which indicate changes to the original plans.
- C. An Excel Comma-Separated Values (.csv) file in Point, Northing, Easting, Elevation and Description (PNEZD) format containing accurate horizontal control, coordinates, and elevations based on the Missouri State Plane Coordinate System, West Zone, NAD83 and NAVD88 (expressed in US survey feet) must be produced for the following infrastructure:

Water Main

- Beginning and End points
- Beginning and End points of deflection
- Bends
- Tees
- Fittings
- Valves
- Hydrants
- Elevation top of main at every fitting and Station at maximum spacing of 50'

Sanitary Sewer Main

- Manholes
- Inverts
- Service wye
- Elevation top of main at a maximum Station spacing of 50'

Storm Sewer Main

- Elevation top of structure
- Inverts

- D. Any requirements outlined in the permits that were issued for the Work.
- E. Any instructions, manuals or schedules which are due to Owner.

- F. Any guaranties, warranties, parts or tools that are due to Owner.
- G. Notification of any pending or unresolved property or injury insurance claims.
- H. Any remaining or corrected payrolls for the Contractor or any of their Subcontractors.
- I. A notarized original of the Consent of Surety to Final Payment.
- J. A notarized original of the Certificate and Release or Waiver and Release of Lien from the Contractor and all Subcontractors.
- K. A notarized original of the Affidavit of Compliance with Prevailing Wage Law from the Contractor and all Subcontractors.

1.03 OWNER TO COMPLETE

- A. Convene post construction meeting with Contractor and Engineer.
- B. Complete and distribute Certification of Project Acceptance Letter.
- C. Complete Final Permit Reports, as required and as issued for the Project.

END OF SECTION

Project Special Provisions
Project No. 47732472
LXT Hangar 2

The attached editions of Sections 2150, 2200, 2300, 2400, 2600, and 2700 of the Kansas City Metropolitan Chapter of APWA Construction and Material Specifications, and Sections 2100, 2800, 2900, 3000, 3500 and 3900 of the Lee's Summit, Missouri Standard Specifications, all as modified herein, are the standard technical specifications for this Project.

PSP1 – Modification of all sections of the Standard Specifications

Delete all references to Measurement and Payment in both the APWA and Lee's Summit, Missouri Standard Specifications. Measurement and Payment will conform to the requirements of Division 1, Section 01120.

PSP2 - Modification of Section 2100 of the APWA Standard Specifications

Remove APWA Standard Specifications in its entirety and replace with Lee's Summit, Missouri Standard Specifications for Grading and Site Preparation

PSP3 - Modification of Section 2150 of the APWA Standard Specifications

2151.15 Records

ADD the following:

Weekly and post rain event inspection reports shall be uploaded into Owners document management system. All reports must be received prior to the Owner processing progress payments.

2154.5.A (Silt Fence) Materials, Construction Requirements, and Maintenance

ADD the following:

1. Silt fence typically should not be used in swales, drainage-ways, channels and other conduits of concentrated stormwater flow and will only be considered on a case by case basis.
2. Silt fence typically should not be used to direct or divert water and will only be considered on a case by case basis.

PSP4 - Modification of Section 2200 of the APWA Standard Specifications

2201.3.B Definitions – Subgrade Preparation: REMOVE and REPLACE with following:

Subgrade Preparation: Subgrade preparation is the repeated operation of fine-grading, ***scarification***, ***moisture conditioning***, and compacting the subgrade until the specified lines, grades, and cross-section, as indicated on the Plans are obtained and the materials are compacted to the specified depth and density.

2201.4.E Roll Testing of compacted Subgrade

ADD the following:

Roll testing shall be conducted on the finished layer of improved subgrade. Chemical stabilized subgrade shall be roll tested in accordance with Section 2202.7.1 or 7.2, whichever is applicable. Subgrade mechanically stabilized with geogrid or woven geotextile overlaid by aggregate base shall be roll tested on the finished aggregate base layer instead of the unimproved subgrade soils. Areas failing roll testing will be reworked and retested.

The City will have the final authority in approving or failing roll testing. The Contractor/Developer shall retain a qualified testing lab as described in Section 1000, Appendix B at no cost to the City.

2201.4 (Subgrade Preparation) Construction

ADD the following:

F. Quality Control Testing:

TEST	FREQUENCY
Density/Moisture Curve	1 per Material Type
Gradation	1 per Material Type
Plasticity Index	1 per Material Type
In-Place Moisture Density	1 per 500 square yards of subgrade Minimum 4 per day
Roll Testing	Per Section 2201.4.E above

Testing shall be performed by a qualified testing lab hired by the Contractor and approved by the Owner.

Any work by Contractor prior to test submittals and subsequent Owner review and approval shall be work done at the Contractor's risk.

Field Density Test reports shall be submitted to the City daily. The reports shall clearly indicate the location of all tests by street name, station and/or lot number, type of subgrade material, and subgrade elevation of test. The reports shall include the results of all tests (pass or fail) and all re-tests.

2202.1 Scope: ADD the following:

Subgrade stabilization material shall be one of the following, as indicated on the plans.

- A. Chemical Stabilization with either Portland Cement, hydrated lime, quicklime or Lime Kiln Dust (LKD).
- B. Mechanical Stabilization will use Biaxial Geogrid, Triangular Geogrid, or Woven Polypropylene Geotextiles for roadway construction that are listed in the current Lee's Summit Public Works Approved Products List.

2202.3.A Materials: DELETE fly ash as an approved material for chemical stabilization:

2202.3 Materials:

ADD the following:

- E. Lime Kiln Dust is an approved material for chemical soil stabilization.
- F. Portland Cement is an approved material for chemical soil stabilization.
- G. Biaxial Geogrid, Triangular Geogrid, or Woven Geotextiles for Roadway Reconstruction listed in the current Lee's Summit Public Works Approved products list are approved materials for mechanical stabilization of subgrade. Geogrid shall be installed in accordance with the manufacturer's instructions.

2202.5 Thickness (for chemical stabilization):

MODIFY as follows:

Minimum thickness for compacted soil mixture shall be 9 inches.

2202.7 Construction:

ADD the following:

- J. Lime Kiln Dust and Portland Cement shall be installed in accordance with *SECTION 2200 – PAVING APPENDIX for CHEMICAL STABILIZATION OF SOIL Using CEMENT or LIME KILN DUST.*
- K. Biaxial Geogrid, Triangular Geogrid, or Woven Geotextiles for Roadway Reconstruction shall be overlain by at least 6 inches of aggregate base. Thicker aggregate base sections shall be installed as required by the approved pavement design.
- L. Quality Control Testing Summary:

TEST	FREQUENCY
Density/Moisture Curve	1 per Material Type
Gradation	1 per Material Type
Plasticity Index	1 per Material Type
In-Place Moisture Density	1 per 750 square yards of subgrade Minimum 2 per day
Roll Testing	Per Section 2201.4.E above

2203.3.A. Materials

ADD the following:

MoDOT Type 5, MoDOT Type 1 or KDOT AB-3 aggregates for aggregate base construction may be used for untreated aggregate layer in lieu of the material specified in this paragraph.

2203.4.A (Construction) Untreated Compacted Aggregate

ADD the following:

7. Quality Control Testing:

TEST	FREQUENCY
Density/Moisture Curve	1 per Material Type
Gradation	1 per Material Type
Plasticity Index	1 per Material Type
In-Place Moisture Density	1 per 750 square yards of subgrade Minimum 2 per day
Roll Testing	Per Section 2201.4.E above

Testing shall be performed by a qualified testing lab hired by the Contractor and approved by the Owner.

Any work by Contractor prior to test submittals and subsequent Owner review and approval shall be work done at the Contractor's risk.

Test reports shall be submitted to the City daily. The reports shall clearly indicate the location of all tests by street name, station and/or lot number, type of subgrade material, and subgrade elevation of test. The reports shall include the results of all tests (pass or fail) and all re-tests.

2203.4.C.6 (Construction) Plant Mix Bituminous Drainable Base

DELETE and REPLACE with the following:

6. Handle, place and compact materials in accordance with the following:
 - a. Contamination of the finished base material that affects the drainage capability of the product shall not be permitted. Any areas determined to be contaminated shall be completely removed without disturbing the adjacent or underlying material and replaced at contractor's expense.
 - b. Rutting or other displacement of the permeable base or the underlying base will not be permitted. If displacement occurs, the material shall be completely removed without disturbing the adjacent or underlying material and shall be replaced at the contractor's expense.
 - c. A minimum of three passes of a 5 to 10 ton steel wheel roller shall be made, compacting the material until no further displacement is noted. Compaction shall begin as soon after spreading the mixture as the mixture is able to bear the weight of the roller without undue

displacement and shall be completed before the temperature of the mixture drops below 100° F. Material shall be placed in one lift.

2205.3 Referenced Standards:

ADD the following
KCMMB Asphalt Material Specification

2205.3 Materials:

DELETE and REPLACE with the following.
All asphalt materials shall conform to the KCMMB ASPHALT MATERIAL SPECIFICATION, current edition.

2205.4 Mixing and Proportioning:

DELETE and REPLACE with the following.
All asphalt materials shall conform to the KCMMB ASPHALT MATERIAL SPECIFICATION, current edition.

2208.3.A Materials-Concrete:

DELETE Paragraphs 1-4, and REPLACE with the following.
All concrete materials for paving curb and gutter, sidewalks, paths, commercial driveways and other pavements in the right of way shall conform to the KCMMB specifications. Note that KCMMB, although recommended, is not required for residential driveways.

2205.9.E Density and Surface Requirements

DELETE the last sentence: "Tests shall be performed at intervals as directed by the Engineer" and REPLACE with "Tests shall be performed as required by Section 1306 of this Project Manual."

2206.3.A (Asphalt) Crack Sealing/Filling

DELETE and REPLACE with the following:

- A. **Crack Sealant and Filler Material:** Material shall comply with ASTM D6690 Type II as shown below.

TEST	METHOD	SPECIFICATION
Cone Penetration at 25°C (77°F)	ASTM D5329	90 max
Softening Point	ASTM D36	80°C (176°F) minimum
Bond at -29°C (-20°F), 50% extension	ASTM D5329	Pass 3 cycles
Resilience	ASTM D5329	60% minimum
Asphalt Compatibility	ASTM D5329	Pass

Additionally, material shall meet the following standards:

TEST	METHOD	SPECIFICATION
Application Temperature Range	ASTMD5167	193 – 204°C (380 – 400°F)
Maximum Heating Temperature	ASTM D6690	204°C (400°F)

2208.3.A (Portland Cement Concrete Pavement) Materials

DELETE Paragraphs 1-4 and REPLACE with the following:

All concrete materials for paving curb and gutter, sidewalks, paths, commercial driveways and other pavements in the right of way shall conform to the KCMMB specifications. Note that KCMMB, although recommended, is not required for residential driveways.

2208.3.B.1 (Materials) Reinforcement

DELETE and REPLACE with the following:

1. Bars: All bars shall be Epoxy coated and shall conform to ASTM A775.

2208.8.D.3 (Joints)

ADD the following:

1. Longitudinal joints: Generally, longitudinal joint spacing should have the same spacing as the transverse joint spacing. The ratio between transverse and longitudinal joint spacing should not exceed 1.25. If monolithic curb is used, the width of the curb and gutter is included in the panel width along longitudinal joints. Maximum longitudinal spacing is shown in Table below:

Thickness of PCC	Max. Longitudinal joint spacing
6 inch	12 feet
7 inch	14 feet
8 inch	14 feet
9 inch	15 feet

2208.6 Repairing Defects

DELETE and REPLACE with the following:

Any damaged concrete panel, or panels, with random cracking shall be removed and replaced at the Contractor's expense. The minimum replacement area shall be one full panel. Any alternate repair methods shall be approved by the Owner.

2209.4.D (Curbing) Construction

REVISE to read as follows:

- D. Curb Machine: A slip-form curb machine shall be used to place any section of curb greater than 100 feet in length. The machine must be equipped with mechanical internal vibrators and capable of placing curb to the correct cross section, line and grade within the allowable tolerances.

2209.4.E.2. Contraction Joints

Delete the first sentence and REPLACE with the following:

Curbing for asphalt pavements shall have contraction joints at intervals of not more than 10 feet. They shall extend through the entire curb section from the top of the curb to a depth 2 inches below pavement surface.

Curbing for concrete pavements shall have contraction joints aligned with transverse pavement joints, but no greater than 15-foot intervals.

2211.4 (Smoothness) Construction

DELETE and REPLACE with the following:

A. Arterials and Collectors:

1. Pavement smoothness on major arterial, minor arterial, and collector streets will be measured at the Contractor's expense by a 25-foot California profilograph using a 0.2 inch blanking band. Run one trace three feet from the longitudinal joint between the lanes, and another three feet from the shoulder or curb edge of the lane (five feet from the back of curb). The profilograph and testing shall be performed by a trained and certified operator. A copy of the operator's profilograph certification shall be submitted to the City prior to testing. The Contractor shall provide the Engineer with the profilogram and its evaluation within two days after paving has been completed.
2. All pavements will be corrected at the Contractor's expense to less than 15 inches per mile. Pavement sections with a horizontal curve radius of less than 300 feet and/or vertical curves or transition areas with K values less than 30 will be excluded from the profilograph specification. Bumps greater than 0.25 inches in 25 feet shall be corrected to a bump height of less than 0.25 inches.
3. For asphalt pavements, the profilograph shall be run on the top of the base course. Grinding and corrections shall be made on the base course before placing the final surface course.

B. Local and Access Roads:

1. Finished pavements on local roads, access roads and other areas exempted from profilographing shall be checked with a 10 foot straightedge placed parallel to the center line at any location within a driving lane. Areas showing high spots of more than 1/4 of an inch in 10 feet shall be marked and ground down with approved grinding equipment to an elevation where the area or

spot will not show surface deviations in excess of 1/8 inch when tested with a 10 foot straight edge.

2. For asphalt pavements, the straight-edge smoothness shall be measured on the top of the base course. Grinding and corrections shall be made on the base course before placing the final surface course.

C. Corrections:

Smoothness corrections shall be made by diamond grinding. Grinding will be performed on the full width of the lane failing to meet the smoothness criteria. The cost of correcting the smoothness and associated traffic control shall be at Contractor's expense.

D. Final Report:

The Contractor shall submit a final report to the Engineer with final profilograph results or straightedge measurements verifying compliance with the specified pavement smoothness requirements.

E. Measurement and Payment:

There is no measurement or payment for smoothness. These items shall be subsidiary to other pay items. There are no pay adjustments (incentive or disincentive) shall be made to the smoothness or pavement items based on the results of the profilograph testing.

PSP5 - Modification of Section 2300 of the APWA Standard Specifications

2301.3.A Materials

Delete and REPLACE with the following:

- A. Concrete Mix: Concrete shall be a currently approved KCM MB 4K mix.

2301.3 Materials

ADD the following:

- F. ADA Detectable Warning Surfaces: The material used to provide contrast shall be an integral part of the walking surface. The material for detectable surface shall consist of:
 1. Grouted-in-Place Clay Pavers
 - a. Paving brick shall be 2 1/4" x 3 5/8" x 7 5/8" and shall meet the requirements of ASTM C902 for Class SX, Type 1 brick and ASTM C1272.
 - b. The bricks shall be placed in a Soldier Course pattern on Type A and Type M ramps, or in the Herringbone or Soldier Course pattern on Type B ramps.
 - c. The bricks shall be saw cut only and any brick shall not be less than 25% of a full brick.
 - d. Type M mortar shall be used for the setting bed and grouted joints in accordance with ASTM C270, Table 1 (Masonry Cement Type only).

2. Cast-in-Place Tiles: Acceptable products include ceramic composites, composites, reinforced concrete, or materials of strength and durability similar to that of the concrete walking surface. Proposed materials shall be approved by the Owner prior to installation.
3. Color for all surfaces options shall be 'brick red'. (Federal Standard Color No. 22144). Any color variation to meet contrast requirements must be approved by the City.
4. Surface applied retrofit tiles shall not be allowed.

D. Stamped and Colored Concrete:

1. Color shall be Federal Standard Color No. 37030 (Dark Brown).
2. Refer to LS Section 2400 Appendix A for stamped concrete additional material requirements, material approval process, mock ups, and installation.

2302.1 (Asphalt Sidewalks, Driveways, and Bicycle/Pedestrian Paths) Scope

ADD the following:

Asphalt shall not be allowed for sidewalks, driveways and bicycle/pedestrian paths within the public right-of-way.

2304.3.A (Concrete Paver Stones (for Median Treatment)) Materials

ADD the following:

1. Stamped and colored concrete shall be used for medians and edge treatments along arterial streets. Interlocking paver stones will not be allowed for such use along arterial streets.

2305 Maintenance of Traffic

DELETE APWA section in its entirety and replace with Section 3000 of the City of Lee's Summit Standard Specifications – Traffic Control, Marking and Signing.

2306 Pavement Markings

DELETE APWA section in its entirety and replace with Section 3000 of the City of Lee's Summit Standard Specifications – Traffic Control, Marking and Signing.

PSP6 - Modification of Section 2500 of the APWA Standard Specifications

2500 Sanitary Sewers

DELETE APWA Section 2500 in its entirety and replace with Section 3500 of the City of Lee's Summit Standard Specifications.

PSP7 Modification of Section 2600 of the APWA Standard Specifications

2602.2.B Corrugated Metal Pipe

DELETE and REPLACE with the following:

- B. Corrugated metal pipe shall not be used in the construction of public infrastructure. Storm drainage systems to remain privately owned and maintained may use corrugated aluminized steel pipe.

2602.2.E Ductile Iron Pipe

DELETE and REPLACE with the following:

- E. Ductile Iron pipe shall not be used in the construction of public infrastructure. Storm drainage systems to remain privately owned and maintained may use corrugated aluminized steel pipe.

2602.2.F Dual and Triple Walled Polypropylene Pipe

DELETE Paragraphs 1 and 2 and REPLACE with the following:

1. Double wall polypropylene pipe shall have a smooth interior and annular exterior corrugations and conform to ASTM F2881 and AASHTO M330. Triple wall polypropylene pipe shall have smooth interior and exterior surfaces with inner corrugations and conform to ASTM F2764. The pipe shall not be perforated unless otherwise specified.
2. Pipe shall be joined with a gasketed integral bell and spigot joint meeting the requirements of ASTM F2881 for double wall pipe or ASTM F2764 for triple wall pipe.

2602.3 B.5.d Structure Connections

DELETE and REPLACE with the following:

Pipes connected to structures shall be cut parallel with the inside face of the structure for structures having plane walls and parallel with the spring line of the pipe for structures having curved walls. Projection of the pipe beyond the inside face shall not exceed 3 inches (measured at the springline for structures having curved walls). When installed, all gaps and openings intended to be closed, shall be sealed with grout, concrete or other approved material.

2602.3 Construction

ADD the following:

D. Acceptance Testing and Inspections

Alignment, grade and visible defects shall be checked by closed circuit television. Storm sewer lines installed as part of the Work are subject to inspection by closed circuit television prior to issuing a Certificate of Substantial Completion. Television inspection will be done by the Contractor at the Contractor's expense. Reports and video shall be submitted to the City within 2 days. Any deficiencies noted shall be repaired at the expense of the Contractor.

2604.2.A Concrete Mixes (Materials)

DELETE and REPLACE with the following:

- A. Concrete for structures and structural components shall be KCMMB 4k or 5k mix; or MCIB 4,500 psi or 5,000 psi mix. Nominal aggregate shall be 1-inch or larger. Concrete used for soil stabilization, pipe cradles, filling, leveling courses and other similar purposes may be use smaller nominal aggregate sizes of 1/2-inch, 3/4-inch."

2604.2.F Manhole Castings (Materials)

ADD the following:

- 3. Metal Castings shall be selected from the current City of Lee's Summit Public Works Approved Products List.

2604.3.A.2 (Construction) Finishing

ADD the following:

- c. If an adjustment is required for the top slab which is less than or equal to 6 inches, the adjustment shall be made with non-shrink grout with a coating of cement on both faces, if the adjustment is greater than 6 inches, the adjustment shall be made with dowelled concrete. Dowels shall be bars embedded 6 inches into the walls. All reinforcement shall be the same size and spacing as the wall steel.

2604.3 Construction

ADD the following:

- D. Cast-in-Place Box Culvert Support Slab: Cast in place box culverts shall have a 3 inch thick grade slab cast under the bottom slab. The grade slab shall be at least as wide as the structure and shall stop short of the toe walls. Commercial grade concrete may be use with minimum 2500 psi compressive strength. The slab should be set with good grade control to match the elevations required for the culvert.

PSP8 - Modification of Section 2800 of the Lee's Summit Standard Specifications

2801.8 Electrical Service

DELETE and REPLACE with the following:

The City is responsible for contacting the electrical utility company in advance to schedule delivery of service to each power supply. The City shall pay the electrical utility company's fees to deliver electrical service and shall be billed for all electrical utility service charges.

PSP9 - Modification of Section 2900 of the Lee's Summit Standard Specifications

2901.4.2 General

DELETE and REPLACE with the following:

The City is responsible for contacting the electrical utility company in advance to schedule delivery of service to each power supply. The City shall pay the electrical utility company's fees to deliver electrical service and shall be billed for all electrical utility service charges.

SECTION 2100 - GRADING AND SITE PREPARATION

CITY OF LEE'S SUMMIT, MISSOURI STANDARD SPECIFICATIONS

The City of Lee's Summit hereby adopts Section 2100 of the Kansas City Metropolitan Chapter of APWA Construction and Material Specifications, current edition. The following additions, deletions and/or revisions are adopted as a part of Section 2100 for use within Lee's Summit. Text in bold italics indicates revisions or additions to the APWA standard.

2102.3.J Blasting: DELETE "permitted by the Engineer" and REPLACE with "permitted by the City"

2102.3.K No Blasting Areas: DELETE "permitted by the Engineer" and REPLACE with "permitted by the City"

2102.4.I.6 Trench Backfill: DELETE paragraph and REPLACE with the following

The backfill material shall be place in layers not exceeding 8-inches in loose thickness and be compacted to at least 95% of maximum density. A minimum of one compaction test shall be taken every 100 to 150 linear feet for each lift of backfill.

Testing shall be performed by a qualified testing lab hired by the Contractor and approved by the Owner.

Laboratory compaction test and index property test results for each material used on site shall be submitted to the Engineer prior to construction. Any work by Contractor prior to test submittals and subsequent Owner review and approval shall be work done at the Contractor's risk.

Field Density Test reports shall be submitted to the City daily. The reports shall clearly indicate the location of all tests by street name, station and/or lot number, type of backfill material, utility type, and depth of test. The reports shall include the results of all tests (pass or fail) and all re-tests.

2102.4.J.2 Trench Backfilling in Street or Alley Right of Way and under Pavement

ADD "***untreated compacted aggregate meeting APWA 2203.3.A***" to list material allowed for dense, well-graded aggregate base materials suitable for trenches between 24 to 48 inches wide.

2102.6.E Consolidated Rock Embankment

ADD the following:

***The upper layer of rock shall be filled with a 6-inch thick layer of 3/4-inch choker stone prior to placing soil material.
(standard APWA detail changed to require 95%)***

DIVISION II
CONSTRUCTION AND MATERIAL SPECIFICATIONS
SECTION 2100 GRADING AND SITE PREPARATION

APPROVED AND ADOPTED THIS 15th DAY OF FEBRUARY, 2017
Revised October 18, 2019 (See underlined text)

KANSAS CITY METROPOLITAN CHAPTER
OF THE AMERICAN PUBLIC WORKS ASSOCIATION

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October 18, 2019 – Section 2102.2.E.6: Revised min. unit wt. of flowable fill per latest KDOT standard.
May 17, 2019 - Section 2102.2.E.6: Revisions made to strengths and unit weights of flowable fill.

SECTION 2101 CLEARING, GRUBBING, AND SITE PREPARATION

2101.1 Scope

This section governs the furnishing of all labor, materials, and equipment for the performance of all clearing, grubbing, and demolition within the limits of work as shown on the Plans and in accordance with the Standard Drawings, the Specifications, and the Special Provisions.

2101.2 Referenced Standards

The following standards are referenced directly in this section. The latest version of these standards shall be used. If conflicting standards are referenced, the more stringent standard shall apply.

APWA

2150	Erosion and Sediment Control
2201	Subgrade Preparation
2203	Aggregate Base
2307	Fencing
2700	Structures

ASTM

ASTM C 150	Standard Specification for Portland Cement
ASTM C 260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 33	Standard Specification for Concrete Aggregates
ASTM C 494	Standard Specification for Chemical Admixtures for Concrete
ASTM C 618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM D 698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
ASTM C 1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D 4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 4832	Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders

Kansas Department of Transportation

Standard Specifications for State Road and Bridge Construction, 2015 Edition
KDOT AB-3 Aggregate Base

Missouri Highways and Transportation Commission

Missouri Standard Specifications for Highway Construction, 2011 Edition
MoDOT Types 1 or 5 Aggregate Base

2101.3 Definitions

The following terms have the meanings indicated:

- A. Clearing: Clearing shall consist of removing all vegetative matter such as trees, brush, down timber and other objectionable materials found on or above the surface of the site. It shall include removing buildings, fences, lumber, waste dumps and trash and the salvaging of such materials as may be specified and disposing of the

debris.

The Contractor shall not occupy any portion of the Project Site prior to the date established in the Notice to Proceed without prior approval of the Owner.

- B.** Grubbing: Grubbing shall consist of removing and disposing of all vegetative matter such as stumps, roots, buried trees and brush encountered below the surface of the ground or subgrade, whichever is lower, which have not been included in Section 2101.2.A entitled "Clearing".

Trees to be removed shall be completely removed, including stump and large roots, unless such removal may result in damage to existing utilities. In that event, trees shall be sawn off not more than four (4) inches above the ground and the stump shall be removed to twelve (12) inches below finish grade.

In all cases of grubbing, the vegetative matter shall be removed to a minimum depth of 12 inches below ground line or subgrade, whichever is lower, except as provided in Section 2101.3.C.

When deleterious materials are encountered below ground line which may be detrimental to the proposed improvement, these materials shall be removed to a depth necessary to provide adequate support for the proposed improvement.

- C.** Site Preparation: Site Preparation shall consist of all initial preparation work for the project site and includes, but is not limited to: steps to minimize site disturbance of existing vegetative, structures and private property; phasing and sequence construction activities into logical work zones; installation of erosion control measures; topsoil stripping, stockpiling and spreading; identifying haul roads, construction entrances and/or exits, construction parking areas; mailbox and fencing adjustments; etc. All site preparation shall be considered incidental unless such site preparation is listed separately in the Contract Documents.

- D.** Demolition and Removal: This work shall consist of demolishing, removing, and disposing of all structures and improvements within the construction limits unless included in other items of work as shown on the Plans or in the Special Provisions. This work shall apply to all structures and improvements, whether on, above or below the surface of the ground or subgrade.

Demolition and removal shall include but not be limited to items such as buildings, drainage structures, pipes, pavements, fences, retaining walls, guard rails, and signs.

Items such as fences, drainage structures, streetlighting, signing and guard rails shall be salvaged and relinquished to the appropriate owner or relocated, where indicated on the Plans.

Relocation of signs, fences, guardrails, etc. shall be considered incidental to removal work except where such relocation is listed separately in the Contract Documents.

All pipes which are to be abandoned shall be removed unless otherwise shown on the Plans or approved by the Engineer.

- E.** Trees: Vegetative growth 6 inches in diameter and larger, measured 3 feet above ground shall be classified as a tree.
- F.** Brush: Vegetative growth less than 6 inches in diameter, measured 3 feet above ground shall be classified as brush.

2101.4 Construction

- A.** Erosion and Sediment Control: Comply with Section 2150 Erosion and Sediment Control.
- B.** Limits of Work: The limits for clearing, grubbing, and demolition shall extend to the construction limits unless otherwise shown on the Plans. Contractor shall do all clearing necessary for performance of their work and shall confine their operations to that area provided through easements, licenses, agreements and rights-of-way. The Contractor's entrance upon any lands outside of that area provided by easements, licenses, agreements or public rights-of-way, shall be at the Contractor's sole liability.

In the event construction limits have not been indicated on the Plans, the limits for clearing, grubbing, and demolition shall not extend beyond the limits of the Owner's property, right-of-way, or easements.

- C.** Protection of Greenery, Existing Structures and Private Facilities: The Plans will designate trees, shrubs or other plants that are to be saved and the Contractor will take necessary steps to protect this greenery. All reasonable effort shall be made to save as many trees as possible. If trees can be saved by trimming, this shall be done in accordance with acceptable pruning practices. Trees may be pruned, upon prior approval of the Engineer, but only in accordance with the best practices of arboriculture in respect to the individual species with due regard to their natural form and growth characteristics.

Small Plants and Flowers: At least two weeks prior to the start of construction, property owners shall be notified by the Contractor of the proposed starting date. The purpose of this notification is so that the property owners can remove any small plants or flowers that they, the property owners, desire to save.

Existing structures within or adjacent to the construction limits that are not to be removed or demolished, shall be protected by the Contractor during their construction. Any private facilities such as house sewer laterals which are disturbed or damaged by the Contractor's work, shall be repaired by the Contractor prior to the close of the work day. This repair shall be made in a manner sufficient to restore utility service to that property. Restoration of utilities damaged by the Contractor shall be restored as directed by the utility company at no additional cost to the Owner. Unless otherwise provided in Basis of Payment no separate or additional payment will be made for any work in connection with removal, relocation or restoration of obstructions and existing facilities.

- D.** Surface Obstructions: Natural obstructions, existing facilities and improvements encountered during site preparation shall be removed, relocated, reconstructed or worked around as herein specified. Care shall be used while performing site preparation work adjacent to any facilities intended to remain in place. Except as otherwise specified, the Contractor shall be responsible for any damage to existing facilities and improvements and any repairs required shall be promptly made at the Contractor's expense. Waste materials shall be disposed of in a satisfactory manner off the work site.
- E.** Surface Obstructions for Pipeline Trenches: Sidewalks, curb and gutter, drainage structures and similar obstructions shall be tunneled under if tunneling is best suited, otherwise the obstruction shall be cut in straight lines or removed to the nearest construction joint if located within five feet of the center-line of the trench. In no case shall the joint or line of cut be less than one foot outside the edge of the trench. Surface obstructions removed to permit construction shall be reconstructed as specified and to the dimensions, lines and grades of original construction.
- F.** Embankment Areas: When undisturbed stumps and roots are encountered where the fill depth will exceed 3 feet, the stumps and roots may be left in place provided they do not extend more than 3 inches above the original ground line.

- G.** Borrow Areas: All stumps, roots and other objectionable matter shall be removed from the borrow material used for embankment or fill. The borrow area shall be left in a well-drained and smooth condition.
- H.** Backfilling the Site: All trenches, holes, pits, and basement areas resulting from the operations of clearing, grubbing, demolition and removal on the site, shall be backfilled with suitable material placed and compacted in conformance with applicable sections of these specifications.
- I.** Disposal of Materials: All materials with the exception of those which are designated for salvage or which are used in the embankment in conformance with this specification, shall become the Contractor's property and shall be disposed of by Contractor, outside the project limits at a site as approved by the Owner, unless otherwise indicated on the Plans. The disposal of waste and excess excavated materials, including hauling, handling, grading, and surfacing shall be a subsidiary obligation of the Contractor.
- J.** Hazardous Materials
1. In the event hazardous waste as defined by the Resource Conservation and Recovery Act of 1976 (PL94-580) are encountered, work shall be halted and the Owner shall be notified. Work shall be resumed only after the Owner notifies the Contractor. Regulation of removal, handling and disposal of hazardous wastes is the responsibility of Federal and State agencies.
 2. All other items classified as "hazardous" shall be disposed of in accordance with the applicable codes. The Contractor shall refer to Section 2150 entitled "Erosion and Sediment Control".
- K.** Items to be Left in Place: In removing items such as concrete pavements, curbs, curb and gutter, sidewalks and similar objects where portions of these objects are to be left in place they shall be removed to an existing joint or a new joint, sawed to a minimum depth of 2 inches or $\frac{1}{4}$ the slab thickness, whichever is greater. This joint shall be to true line and vertical face. Sufficient portions of such items shall be removed to provide the proper grade and connection to the new work.
- L.** Mailboxes: Mailboxes shall be maintained in the manner that the Postal Service requires to prevent interruption of mail delivery.
- M.** Fences: Refer to Section 2307 for fencing.
- N.** Property Pins: The Contractor shall preserve all property corners, pins or markers. In the event any property corners, pins, or markers are removed by the Contractor, such property points shall be replaced at the Contractor's expense and shall be reset by competent surveyors properly licensed to do such work. In the event such points are section corners or Federal land corners, they shall be referenced and filed with the appropriate authority.
- O.** Subsurface Obstruction of Pipeline Trenches: Where existing utilities and service lines are to be encountered, the Owner thereof shall be notified by the Contractor at least 48 hours (not including weekends and/or holidays) in advance of performing any work in the vicinity. All excavation, pipeline installation and backfilling work in the vicinity of such utilities shall be accomplished in the manner required by the respective Owner and, if requested, under their direct supervision. The Contractor shall be responsible for any and all damages to a public or private utility that may occur as the result of the construction.

The Contractor shall make a reasonable effort to ascertain the existence of obstructions and shall locate obstructions by digging in advance of machine excavation where definite information is not available as to their

exact location. Where such facilities are unexpectedly encountered and damaged, responsible officials and other affected utilities shall be notified and arrangements made for the prompt repair and restoration of service.

SECTION 2102 GRADING

2102.1 Scope

This section governs the furnishing of all labor, materials, and equipment required to excavate, place, remove, dispose or compact materials encountered within the limits of the project as shown on the Plans and in accordance with the Standard Drawings, the specifications, and the Special Provisions.

2102.2 Definitions

The following terms have the meanings indicated:

- A.** Grading: Grading as used herein shall mean the performance of all excavation, embankment, and backfill in connection with the construction of all improvements.
- B.** Excavation: Excavation is defined as the removal of materials from the construction area to the lines and grades shown on the Plans and includes trenching for pipelines, utilities, and structures.
 - 1. Unclassified Excavation: Unclassified excavation is defined as the removal of all material encountered regardless of its nature. All material excavated will be considered as Unclassified Excavation unless otherwise specified in the Contract Documents.
 - 2. Rock Excavation: Rock excavation is defined as the removal of all rock ledges 6 inches or more in thickness, and detached rock or boulders having a volume of more than 1 ½ cubic yards and shale occurring in its natural state, hard and un-weathered.
 - a. A rock ledge is defined as a continuous body of rock which may include thin interbedded seams of shale or other soft materials less than 12 inches thick. The vertical limit of each ledge shall be defined by interbedded seams of soft materials 12 inches or more in thickness. The beds of soft interbedded material 12 inches or more in thickness shall not be included in the measurement for "Rock Excavation" but shall be included in the measurement for "Earth Excavation".
 - b. The following items shall not be considered as rock excavation: soft or disintegrated rock or flowable backfill (CLSM) which can be removed with a pick or digging machine; loose, shaken or previously blasted rock; broken stones and rock which may fall into the trench from outside the limits of excavation.
 - c. When solid rock (including non-diggable flowable backfill (CLSM)) is unexpectedly discovered, the Contractor shall notify the Owner.
 - 3. Earth Excavation: Earth excavation is defined as the removal of all material not defined as rock.
 - 4. Trench Excavation: Trench excavation is defined as excavation to the width and depth as necessary to lay the pipe to the grade line as indicated on the Plans and in the specifications.
 - 5. Tunneling, Boring and Jacking: Includes all underground horizontal excavations necessary to install the pipeline to the grade line as indicated on the Plans and in the specifications.

- C.** Trench Foundation: The area at the bottom of the excavation shall be composed of a stable material capable of supporting the placement of bedding material, pipe, or structures.
- D.** Unstable Foundation: Materials encountered in the bottom of the trench deemed as unsuitable by the Engineer to afford a sufficiently stable pipe foundation.
- E.** Flowable Backfill / Controlled Low Strength Material (CLSM): A mixture of portland cement, fly ash (optional), fine aggregate, water, and admixtures (as approved by the Engineer) proportioned to a consistency to fill voids without vibration. Flowable Backfill (CLSM) shall consist of:

1. Cement: The portland cement shall conform to ASTM C 150, Type 1 or Type II.
2. Fly ash: Fly ash, when used, shall conform to the requirements of ASTM C 618 Class C or F.
3. Fine Aggregate: Fine aggregate shall conform to ASTM C 33.
4. Mixing Water: Mixing water shall conform to ASTM C 1602.
5. Admixtures: Air entrainment, when used, shall conform to ASTM C 260. Water reducing admixtures, when used, shall conform to ASTM C 494. All other admixtures shall only be used when approved by the Engineer.
6. Other materials: Proposed replacement or supplementary materials shall be approved by the Engineer and in conformance with current NRMCA or ACI guidelines for CLSM.

Flowable Backfill (CLSM) compressive strength testing results are required for approval of mix design prior to placement of flowable backfill. Compressive tests are to be conducted at 7 and 28 days in accordance with ASTM D 4832. CLSM shall have a minimum and maximum 28-day design compressive strength of 50 psi and 125 psi, respectively. The unit weight of the CLSM shall be a minimum of 125 lbs. per cubic foot (pcf). All tests necessary for determining conformance with the requirements specified herein will be at the Contractor's expense.

- F.** Bedding: The placing and compacting of the aggregate material above the stable foundation and below the pipes or structures.
- G.** Embedment: The placing and compacting of approved material surrounding the pipe up to a maximum of 12-inches above the top of pipe.
- H.** Embankment or Backfill: The placing and compacting of approved material in the construction areas to the lines and grades shown on the Plans.
1. Unsuitable Material: Muck, frozen material, organic material, top soil, or rubbish. Rock with a maximum dimension greater than 24 inches is also defined as unsuitable. Top soil is unsuitable for embankment and backfill, but may be used as the surfacing for graded areas to be seeded or sodded (see Section 2400).
 2. Suitable Material: Suitable material is defined as entirely imperishable with that portion passing the No. 40 Sieve having a liquid limit not exceeding 40 and a plastic index not exceeding 25, when tested in accordance with ASTM D 4318.

- a. Rock Embankment: Material for rock embankment shall be free of unsuitable material and shall contain, by volume, greater than 10 percent rock or gravel having a maximum dimension greater than 3 inches but not greater than 24 inches.
 - b. Earth Embankment: Material for earth embankment shall be free of unsuitable material and shall, contain by volume, less than 10 percent rock or gravel having a maximum dimension greater than 3 inches.
- 3. Pipe Backfill: Pipe backfill materials shall be furnished and installed to complete the work shown on the Plans or as called for in the Contract Documents.
 - a. Select Earth Backfill Material: Select earth backfill shall be finely divided job excavated material free from debris, organic matter, rocks larger than one (1) inch and/or frozen materials.
 - b. Other Earth Backfill: Other backfill may be job excavated material free from debris and organic matter. No rock greater than three-inches in diameter shall be placed in any trench excavation as backfill unless approved by the Engineer.
 - c. Aggregate Backfill Material: Approved material meeting ASTM C33 requirements and the specified gradations.
 - d. Flowable Backfill (CLSM): See Section 2102.2.E.
- I. Borrow: Approved material excavated from an area outside of the project limits and required for the construction of the embankment.
- J. Waste: Waste is defined as excavation material not used in the embankment and disposed of outside of the embankment areas.
- K. Structures: Used herein refers to culverts, storm sewer and/or sanitary appurtenances, and similar construction. See Section 2700 for other structures.

2102.3 Construction

- A. The Contractor shall adhere to any and all statutes regarding the notification of utilities prior to beginning any work within public right-of-way. The relocation and/or protection of any utility that is shown on the Plans, that lies within a utility easement and is endangered by this construction shall be the responsibility of the Contractor.
- B. The Contractor shall make every reasonable effort to protect private facilities. These facilities may not be shown on the Plans. When these facilities are disturbed or damaged by the work, the Contractor shall make necessary arrangements for repairs to the facilities for continuous service prior to the close of that work day.
- C. It shall be the responsibility of the Contractor to protect all property lot corners and control monumentation. Should it be necessary to disturb any such monument, whether stake, pin, bar, disk, box, or other, it remains the responsibility of the Contractor to reference such markers prior to removal, reset them, and file such relocations or monumentation documents as the law may require. Any such references, removal, replacement and certification of monuments shall be performed by a registered licensed surveyor. A copy of all such certification documents shall be provided to the Owner prior to final payment. Any monument destroyed or improperly reset by the Contractor may be replaced by the Owner to the standards required by law at the expense of the Contractor.
- D. Grading, excavation, and backfilling for all improvements, shall be made to the lines, grades, and cross sections

indicated by the Plans.

- E.** In addition, to any erosion control measures shown on the Plans, the Contractor shall schedule and conduct their operation in such a manner and shall provide any necessary control facilities to protect downstream and adjacent properties from pollution, sedimentation, or erosion caused by the grading operations. Any pollution or damage occurring shall be the responsibility of the Contractor. See Section 2150 Erosion and Sediment Control.
- F.** During construction, the graded area shall be maintained by the Contractor in such condition that it will be well drained at all times. Roadway ditches, channel changes, inlet and outlet ditches and other ditches in connection with the roadway shall be cut and maintained to the required cross section. All drainage work shall be performed in proper sequence with other operations. All ditches and channels shall be kept free of debris or obstructions not identified in the erosion control plan.
- G.** All suitable material removed by excavation shall be used as far as practicable in the formation of embankment as required to complete the work. The Contractor shall sort all excavated material and stockpile when necessary, so as to provide suitable materials for embankments.
- H.** After removal of the roadway excavation material to the required section, all material between lines 1 foot outside of the curbs and within the top 6 inches of the subgrade shall be compacted to 95 percent of maximum density for the material as defined in Section 2102.6.F.
- I.** Rock encountered within the full width of the roadway, toe of slope to toe of slope, shall be undergraded to an elevation of 6 inches below the finished subgrade elevation. Care shall be taken to avoid overshooting when blasting. Rock shall be removed in such a manner as to leave no excessive water pockets in the surface.
- J.** **Blasting:** When blasting is permitted by the Engineer, the Contractor shall use the utmost care to protect life and property. The Contractor shall obtain any required permits from the agency having site jurisdiction and shall comply with all laws, ordinances, and the applicable safety code requirements and regulations relative to the handling, storage and use of explosives and protection of life and property, and he shall be responsible for all damage caused by his or his subcontractor's operations.

 - 1. The Contractor shall provide insurance as required by the Contract Documents before performing any blasting. The governing agency shall be notified at least 24 hours before blasting operations begin.
- K.** **No Blasting Areas:** No blasting of any kind for rock excavations or any other purpose will be allowed unless noted otherwise on the Plans or permitted by the Engineer.
- L.** Areas of undergrading or overbreakage in rock between lines 1 foot outside of the curbs shall be backfilled with spalls, rock fragments or a granular type material. Backfill materials shall have a plasticity index not to exceed 10 and a gradation such that at least 50 percent of the material will be retained on the No. 4 Sieve.
- M.** **Cribbing and Sheeting:** The Contractor shall furnish, install, and maintain such sheeting, bracing, and other components, as may be required to support any excavation and to prevent any movement which could in any way injure or delay the work or endanger adjacent pavement, building, or other structures. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed they shall be immediately filled and consolidated.

For the purpose of preventing injury or property damage, Contractor may leave in place all sheeting or bracing,

and other items to be embedded in the backfill of the trench. No sheeting or bracing, however, shall be left in place within 5 feet of the surface without the written permission of the Engineer.

2102.4 Excavation, Trenching, And Backfilling For Pipe And Structures

A. Dewatering of Excavation

1. The Contractor shall maintain a dry and stable excavation, obtain necessary permits, and provide for the proper method of discharging water from the work site at all times until installation is completed.
2. The Contractor shall not allow hydrostatic pressure flotation or other adverse effects to cause damage to the structure or pipeline.
3. Proper dewatering techniques are the Contractor's responsibility. All work performed by the Contractor that is adversely affected by his/her failure to adequately dewater trenches will be subject to rejection by the Engineer. The Contractor shall repair and/or replace affected structures or pipelines.
4. The Contractor shall remove any water that may accumulate or be found in the trenches and other excavations made as part of the work.
5. Grading shall be done to prevent surface water from flowing into trenches or other excavations, and to maintain the flow of water in natural watercourses on or adjacent to the site. Any water accumulating in trenches or other excavations shall be removed by pumping or by other approved methods.

B. Trench Excavation: Trenches shall be excavated to the width and depth as necessary to lay the pipe to the grade line as indicated on the Plans with proper pipe embedment. The Contractor shall perform excavation of materials encountered in accordance with Section 2102.3, regardless of material type, to the depths indicated on the drawings or as otherwise specified herein. Excavated materials are to be deposited beside trenches and excavations to avoid overloading, and to prevent slides or cave-ins, transported to the spoil banks, or used for backfilling. All excavated materials not required or not suitable for backfill shall be removed and disposed of off the site by the Contractor as part of the Work. The trench excavation opened at one time shall be limited by the nature of the soil and other safety considerations.

1. All pipeline excavation work shall be accomplished under the supervision of a person employed by the Contractor or his subcontractor and experienced with the materials and procedures which will provide protection to existing improvements, including utilities and the proposed pipeline.
2. The alignment, depth, and pipe subgrades of all trenches shall be determined by a laser beam parallel to the pipe invert.
3. Deviation from the indicated alignment will not be permitted except under special circumstances, subject to approval of the Engineer.
4. Trenches that are parallel to structures, pavements or walls shall be no closer than 18 inches from the closest edge of footings or pavement. Also, no parallel trench shall extend in depth below a plane having a downward slope of 1 horizontal to 2 vertical starting from a line 9 inches above the bottom edge of footings or pavement. The bottom of pavement shall be the lowest improved section of pavement to include chemically stabilized subgrade or aggregate base layers.

5. When pipe is to be installed in embankment or fill, the embankment shall be constructed in accordance with APWA section 2102.6 and shall be built up to a plane at least 18 inches above the top of the pipe prior to the excavation of the pipe trench.
 6. The Contractor shall not open more trench in advance of pipe laying than is necessary. Four hundred (400) feet will be the maximum length of open trench allowed on any line under construction. All open trenches shall be adequately protected.
 7. Undercutting of trench walls is not permitted.
 8. Option to Trenching: Contractor may perform excavation by tunneling methods as set forth herein at no additional cost to the Owner provided prior written approval for each such location is obtained from the Engineer. The Contractor shall submit to the Engineer, prior to actual work, a written description of his proposed operation. It shall include the types and locations of shafts, methods to provide safe support strength for the pipeline when the shafts or bore pits exceed maximum allowable trench widths and other features that would affect the pipeline. Tunneling shall be done with a minimum inconvenience and disturbance to the general public and abutting property owners.
- C.** Trench Widths: Trenches shall be excavated to a width that will provide adequate working space and pipe clearances for proper pipe installation, jointing, and embedment. Over-excavation shall be replaced with granular bedding material or flowable backfill (CLSM). See applicable Plans, Standard Drawings, and manufacturers' recommendations for trench widths for pipe installations.
- D.** Preparation of Pipe Subgrade: Pipe subgrade shall be prepared to provide uniform and continuous support of pipe. The trench bottom shall be evenly graded. Areas that are too high shall be shaved as required. Any portions of the trench that are found to be too low shall be filled with suitable materials, thoroughly compacted, and brought to true grade, allowing for placement of bedding material as shown in the Standard Drawings.
- E.** Trench Bottom in Rock Excavation: Where rock is encountered in excavation, the rock shall be removed to provide a minimum clearance of 6 inches below and 6 inches along each side of the pipe.
- F.** Replacement of Unsuitable Pipe Foundation Material
1. If unstable subgrade conditions are encountered and it is determined by the Engineer that the excavation bottom will not provide suitable support, the Contractor shall remove all unstable or unsuitable material over the entire width of the trench to the depth required by the Engineer to provide a stable foundation. Removal shall not be less than 6 inches.
 2. Materials so removed shall be replaced with bedding aggregate material as specified herein. Bedding material shall be mechanically compacted over the entire width of the trench and shall be brought to proper grade, shape, and elevation for the installation of the pipe as shown on the Plans or Standard Drawings.
- G.** Granular Bedding Materials: Granular bedding material shall meet ASTM C33 with one of the following gradation requirements:

Sanitary Sewer Bedding Material Gradation Limits (% Passing)	
Sieve Size	3/4"
1"	100
3/4"	90 – 100
3/8"	20 – 55
No. 4	0 – 5
No. 8	0 – 2

Storm Sewer Bedding Material Gradation Limits (% Passing)			
Sieve Size	3/4"	1/2"	3/8"
1"	100		
3/4"	90 – 100	100	
1/2"		80 – 100	
3/8"	20 – 55	40 – 77	100
No. 4	0 – 10	0 – 15	30 – 40
No. 8	0 – 5	0 – 5	0 – 4

Waterline Bedding Material Gradation (% Passing)				
Sieve Size	Type 1 (1/2")	Type 2 (Buckshot)	Type 3 (Man. Sand)	Type 4 (River Sand)
3/4"	95 – 100			
3/8"	40 – 60	100	100	
1/4"			90 – 100	
No. 4		60 – 80	85 – 90	100
No. 8	0 – 5	0 – 15	35 – 75	
No. 50			10 – 25	
No. 200		0	0 – 10	0 – 10

- H. Pipe Embedment: All water, sanitary sewer, and storm sewer pipe shall be bedded in bedding aggregate as specified herein.
1. Bedding shall cover the entire width of trench.
 2. The first layer of bedding placed on the bottom of excavation shall be in accordance with Figures 1 through 3.
 3. Bedding at bottom of trench, in the middle 1/3 of trench under the pipe shall be loose.
 4. After pipe is placed, bedding material shall be placed in layers in accordance with manufacturer's recommendations.
 5. Second layer of bedding material shall be placed under the lower haunches of the pipe up to the springline (center of pipe). Material shall be spaded to be placed under haunches and compacted at the springline elevation prior to placing additional bedding material.
 6. The third layer of bedding material shall be placed to 12 inches over the top of pipe.
 7. Contractor shall take measures to prevent pipe from floating during placement of bedding material so that pipe maintains proper line and grade as shown on the Plans.

I. Trench Backfill

1. Backfill shall not be placed when material contains frost, is frozen, or a blanket of snow prevents proper compaction.
2. The Contractor shall remove from the project site waste material, trees, organic material, rubbish, or other deleterious materials.
3. All trash and debris shall be removed from the pipeline excavation prior to backfilling.
4. Backfill material shall be carefully placed to avoid damage to or displacement of the pipe, other utilities or structures.
5. Unless otherwise specified, all trenches and excavations around structures shall be backfilled to the original ground surface.
6. Outside of paved areas, the backfill material shall be placed in layers not exceeding 8-inches in loose thickness and be compacted to at least 90% of maximum density. Compaction testing shall be at the discretion of the Engineer.
7. The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe.
8. The combination of the thickness of the layer, the method of compaction and the type of compaction equipment used shall be at the discretion of the Contractor subject to obtaining the required densities.

J. Trench Backfilling in Street or Alley Right of Way and under Pavement

1. Narrow Trench: Suitable backfill material for trenches 24 inches or less in width and shall be flowable backfill (CLSM).
2. Standard Trench: Suitable backfill material for trenches between 24 to 48 inches wide shall be either flowable backfill (CLSM) or dense, well-graded aggregate base material. Aggregate base material shall meet the requirements for KDOT AB-3 or MoDOT Types 1 or 5.
3. Wide Trench: Suitable Backfill Material for trenches greater than 48 inches wide shall be either materials specified for standard trench or suitable material as specified for "Earth Embankment" in APWA Standard Specifications, Section 2102.2.H.
4. Suitable Backfill Material outside of paved areas within Right of Way, and all areas outside Right of Way, may be suitable material as specified for "Earth Embankment" in APWA Standard Specifications, Section 2102.2.H. Suitable Backfill Material may also be other trench backfill material (flowable backfill or aggregate base) depending on site conditions, trench widths or at the direction of the Engineer.
5. Aggregate backfill material placed between lines one foot behind curbs, or edge of uncurbed pavement, shall be meet density and testing requirements as outlined in APWA 2203 Aggregate Base Course.

6. The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe.
7. The combination of the thickness of the layer, the method of compaction and the type of compaction equipment used shall be at the discretion of the Contractor subject to obtaining the required densities.
8. A minimum of one compaction test shall be taken for each lift of earth embankment backfill or dense, well-graded aggregate base material for each road crossing or each 50 feet of trench length under pavement.
9. Testing shall be performed by a qualified testing lab hired by the Contractor and approved by the Owner.
10. Laboratory compaction test and index property test results for each material used on site shall be submitted to the Engineer prior to construction. Any work by Contractor prior to test submittals and subsequent Owner review and approval shall be work done at the Contractor's risk.
11. Test reports shall be submitted to the Engineer daily. The reports shall clearly indicate the location of all tests by street name, station and/or lot number, type of backfill material, utility type, and depth of test. The reports shall include the results of all tests (pass or fail) and all re-tests.
12. All test reports shall be submitted prior to receiving approval of subgrade for curb and pavement installation. Pavement, curb or other surface features placed prior to receiving subgrade approval shall be placed at the Contractor's risk.

K. Flowable Backfill (CLSM) Installation

1. Flowable Backfill (CLSM) shall be constructed to the configuration and the lines and grades shown on the Plans, or as directed by the Engineer. No additional payment will be allowed for placement beyond these limits.
2. The producer may cut back on the quantity of water incorporated during batching with the approval of the Engineer. Additional water may be added on-site to achieve the intended consistency. The final mix unit weight and compressive strength shall fall within the specified ranges as described in Section 2102.2.E.
3. No Flowable Backfill (CLSM) shall be placed on frozen ground or in standing water.
4. When the ambient temperature is either falling or forecasted to fall below 35° F within 24 hours of its proposed placement time, the Contractor may submit the use of cold weather methods for approval by the Engineer.
5. Care shall be taken to prevent the movement of any conduit, pipe or structure from the designated location or intrusion of flowable backfill into undesirable locations. If such movement or intrusion occurs, the Engineer may require the affected structure to be excavated and replaced to the proper grade at the Contractor's expense.
6. If flowable backfill is placed in more than one layer, loose and foreign material shall be removed prior to placing the next layer.

7. No flowable backfill shall be covered or accepted until a minimum compressive strength has been attained, as demonstrated by failure to deform or crush underfoot. If the flowable backfill does not harden to required strength, the flowable backfill shall be removed and replaced with an acceptable material at the Contractor's expense. Acceptance of the flowable backfill shall be based on visual inspection.
8. Random compressive strength testing may be conducted at the Owner's expense to verify compliance with strength requirements. Compressive tests shall be in accordance with ASTM D 4832.

L. Trench Checks

1. Install where shown on the Plans.
2. The backfill above the trench check shall meet the specifications for backfill material.

M. Excavation by Tunneling or Boring: Where depth of trench and soil conditions will allow it, tunneling may be required under pavement, railroad tracks, or other surface structures. Tunnel sections shall provide adequate clearance for pipe and workers for proper lining, grading, and jointing the pipe installed therein.

All tunnel excavation shall provide an excavation conforming to the outside diameter of the casing and/or carrier conduit. The excavation shall be to an alignment and grade which will allow the carrier conduit to be installed to proper line and grade as shown on the Plans and as established in Section 2505.2.H. Conduct excavation in a manner to prevent disturbing overlying and adjacent material. Perform dewatering and chemical soil stabilization or grouting if necessary, due to existing field conditions.

N. Settlement: The Owner may perform periodic inspections to insure that no settlement has occurred. The Contractor shall be responsible for all settlement of backfill, fills and embankments which may occur within two (2) years of time after final acceptance of the contract under which the work was performed.

The Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within thirty (30) days after notice from the Owner. Should the Contractor fail to make such repairs the Owner may cause repairs to be made and the cost of these repairs shall be the responsibility of the Contractor.

O. Excavation and Backfilling for Piping and Structures

1. All structure foundations shall be founded on stable, undisturbed subgrade. Excavation shall be sufficient to provide at least 12 inches clear between the outer surfaces of the structure (including formwork) and the embankment or timber that may be used to hold and protect the excavation.
2. Unsuitable or unstable foundation soil that will not properly support the structure, as determined by the Engineer, shall be removed to the depth required and the excavation backfilled to the proper grade with compacted bedding material or other material approved by the Engineer.
3. All excavations for structure shall be kept dry; no reinforcing steel shall be installed in water; and no water shall be permitted to inundate the reinforcing steel before concrete has been placed.
4. Street Right-of-Way Areas: All structures located under or within paved or graveled areas shall be backfilled with flowable backfill (CLSM) to a level flush with the top of pavement subgrade. Structures located under or within vegetated areas shall be backfilled with flowable backfill (CLSM) to a level

twelve inches below finish grade and consolidated topsoil. The external opening surfaces of weep holes shall be covered with hardware cloth and surrounded with a minimum of three cubic feet of consolidated granular bedding material.

5. Areas other than Street Right of Way: All structures located under or within paved or graveled areas shall be backfilled with flowable backfill (CLSM) to a level flush with the top of pavement subgrade. Structures located under or within vegetated areas shall be backfilled with CLSM, untreated compacted aggregate, consolidated granular bedding material, or compacted soil to a level twelve inches below finish grade. The external opening surfaces of weep holes shall be covered with hardware cloth and surrounded with a minimum of three cubic feet of consolidated granular bedding material. The top twelve inches shall be backfilled with topsoil.
6. Backfilling
 - a. No backfill shall be placed over or around any structure until the concrete or mortar therein has attained a minimum strength of 2000 psi and can sufficiently support the loads imposed by the backfill without damage.
 - b. The Contractor shall use utmost care to avoid any wedging action between the side of the excavation and the structure that would cause any movement or floating of the structure. Any damage caused by premature backfill or by the use of equipment on or near a structure will be the responsibility of the Contractor.
 - c. Backfill shall be placed and compacted on all sides of the structure simultaneously, and operations shall be so conducted that the backfill is always at approximately the same elevation on all sides of the structure.
 - d. No excavated rock larger than 3 inches maximum dimension shall be placed within 1 foot of the exterior surface of any structure except as allowed with flowable backfill (CLSM) placement.
 - e. No backfill material containing rock, or detritus from rock excavation, shall be placed in the upper 24 inches of the excavation.
 - f. Large rock may be placed in the remainder of the backfill upon approval of the Engineer. Approved rock material shall be placed so that it is well separated, allowing proper compaction of soil backfill around the rock material.
 - g. All excavation shall be backfilled to the lines and grades shown on the Plans.
 - h. After the required curing time, backfill shall be placed and compacted in layers. Contractor shall monitor impact of placement, vibration and related work so not to damage or disturb structures.
 - i. Backfill shall be placed in compacted in layers not exceeding 8-inches in loose thickness and be compacted to at least 95% of maximum density at optimum moisture \pm 3% as determined by ASTM D 698. Each lift shall be compacted and tested to the required density prior to the next lift being placed. Testing shall be performed by a qualified testing lab hired by the Contractor and approved by the Owner.
 - j. In no instance shall backfill be dumped, bulldozed, or otherwise deposited in bulk upon the newly constructed structure.

P. Backfill of Drainage Course Crossings

1. Excavation in rock to a distance of 10 feet beyond each bank (measured perpendicularly to the stream flow) shall be backfilled with concrete to the existing rock elevation. The excavation above the rock elevation shall be backfilled with soil above that concrete encasement or as indicated on the Plans.

The soil placed above the encasement shall be compacted to at least 95% of maximum density at optimum moisture \pm 3% as determined by ASTM D 698.

2. Pipe placed in an excavation in soil shall be encased in concrete to a minimum of 1 foot above and below the pipe and backfilled with soil above that concrete encasement or as indicated on the Plans. The soil placed above the encasement shall be compacted to at least 95% of maximum density at optimum moisture \pm 3% as determined by ASTM D 698.

2102.5 Undergrading

- A.** Where materials are encountered which are deemed as unsuitable by the Engineer for use in the work, they shall be removed to the depth and limit as ordered by the Engineer. Areas undergraded shall be backfilled with one of the following materials:
1. Replacement with suitable materials from excavation on the work site or from an off-site borrow area, compacted to the required moisture and density requirements where practicable.
 2. Mixing of stone base or rock materials, hydrated lime, portland cement or fly ash into the sub-grade.
 3. Placement of compacted aggregate.
 4. Rock fragments or spalls. A granular type material having a plasticity index not to exceed 10 and a gradation such that at least 50 percent of the material will be retained on the No. 4 Sieve and not more than 40 percent will pass the No. 10 Sieve.
 5. A material meeting the requirements of Section 2102.2.H.2.

2102.6 Embankment

- A.** This section governs embankment for all improvements. The embankments shall be constructed using suitable materials, as herein defined, procured from excavations made on the project site or from borrow areas as required to complete the grading work.
- B.** Starting the Embankment: Where embankments, regardless of height, are placed against hillsides or existing embankments, either of which have a slope steeper than 1 vertical to 4 horizontal, the existing slope shall be benched or stepped in approximately 24 inch rises as the new fill is brought up in 8 inch maximum layers or lifts. The material bladed out, the bottom of the area cut into, and the embankment material being placed, shall be compacted to the required density. Material cut out, bladed into place and compacted shall not be measured and paid for directly but will be considered as incidental work.

The existing surface upon which embankment material is to be placed shall have all unstable and unsuitable material removed before starting the embankment work. Where embankments 2 feet or less in depth are to be placed on areas covered by existing pavement, the existing pavement shall be removed and the cleared ground surface shall be compacted to the specified density. Where embankments greater than 2 feet in depth are to be placed on areas covered by existing pavement, the existing pavement shall be broken into pieces no larger than 18 inches maximum dimension, left in place and the embankment started thereon.

- C.** Placing Earth Embankment: Earth shall be placed in successive horizontal layers distributed uniformly over the full width of the embankment area. Each layer of material shall not exceed 8 inches maximum in thickness

(loose state) and shall be compacted to not less than the required density before the next layer is placed thereon. As the compaction of each layer progresses, continuous blading, or dozing will be required to level the surface and to ensure uniform compaction. Embankment construction shall not be performed when material contains frost, is frozen or is snow covered.

- D.** Placing Earth and Rock Embankment: When earth and stone or rock fragments are mixed in the embankment, all stones or rock fragments exceeding the thickness of the compacted lift shall be disposed of by being incorporated into the embankment outside the limit of the proposed paved areas. The thickness of the layer in these areas may be increased if necessary to accommodate the rocks, but shall not exceed 12 inches in thickness (loose state). The stones or rock fragments are to be placed so there will be no nesting.
- E.** Consolidated Rock Embankment: When the excavated material consists predominantly of stone or rock fragments of such size that the material cannot be placed in layers of the thickness prescribed, such material shall be placed in the embankment in layers having a thickness of the approximate average size of the larger rocks but not to exceed 24 inches. Rocks or boulders too large to permit placing in a 24 inch layer shall be reduced in size as necessary to permit placement. Rock shall not be dumped in place but shall be distributed by blading or dozing in a manner to insure proper placement in final position in the embankment. Voids shall be filled with smaller stones, earth, sand, or gravel. Each layer shall be thoroughly consolidated before the next layer is placed.

Rock embankment shall be capped with 3 feet of soil material on all sides. The soil cap material shall not contain material having a maximum dimension greater than 3 inches.

- F.** Compacting the Embankment: Before placing any embankment, the surface of the existing ground shall be prepared as specified herein, moistened as required, and the top 6 inches compacted to a density of 90 percent as prescribed by the following paragraph:

All embankment shall be compacted to a density of at least 90 percent of the maximum density for the material used as determined by ASTM D 698 with a moisture range sufficient to allow for proper compaction. In addition to the above required compaction, the subgrade between lines 1 foot outside of the curbs and within the top 6 inches of the subgrade in cut sections and the top 18 inches in fill sections shall be compacted to a density of at least 95 percent of the maximum density for material used as determined by ASTM D 698 and with a tolerance of $\pm 3\%$ of the optimum moisture at maximum density.

All work involved in either adding moisture to or removing moisture from embankment materials to within these moisture limits shall be considered incidental to the completion of the grading operation.

- G.** Moisture – Density Determination: In-place density and moisture content of the embankment will be determined by an acceptable method as approved by the Engineer.

H. Testing

1. Laboratory compaction test and index property test results for each material used on site shall be submitted to the Engineer prior to placement. Any work by Contractor prior to test submittals and subsequent Engineer review and approval shall be work done at the Contractor's risk.
2. In-Place Density/Moisture tests shall be taken at the frequency of 4 per day per spread, with a minimum of one test per lift.
3. Test reports shall be submitted to the Engineer daily. The reports shall clearly indicate the location of

all tests by street name, station and/or lot number, type of material, and elevation of test. The reports shall include the results of all tests (pass or fail) and all re-tests.

4. All test reports shall be submitted prior to receiving approval of subgrade for subsequent work. Pavement, curb, other surface features or utilities placed prior to receiving embankment approval shall be placed at the Contractor's risk.
- I. Backfilling Curb and Gutter: Backfilling behind curb or curb and gutter shall be done within seven (7) days after being laid unless otherwise approved by the Engineer. The material used to fill the void behind curb or curb and gutter shall be free of rock and debris and shall be of a type that will leave no voids to pocket water. Unless otherwise shown on the contract drawings, the finish grading from the back of the curb to the right-of-way line and/or utility easement line or construction easement line shall be performed to provide a smooth transition between existing yard grades at the right-of-way line and/or easement line to the curb so that positive drainage will exist.

The top portion of the backfill within right-of-way areas shall be finished with at least 6 inches of topsoil corresponding to, or better than, that underlying adjoining sodded areas. Topsoil shall be approved by the Engineer prior to placement, and unless otherwise directed, shall be material previously excavated and stockpiled for the purpose during excavating and grading operations. Immediately prior to dumping and spreading topsoil, the surface shall be loosened by discing or scarifying to a minimum depth of two (2) inches to permit bonding of the topsoil to the underlying surface.

2102.7 Finishing

- A. In areas where sodding or seeding is proposed, the upper 12 inches of the surface area shall be earth material free of rocks greater than 1 inch in diameter. The top 6 inches shall be topsoil suitable for sustaining grass or sod.
- B. Except where other permit or utility work is in progress, the graded surface shall be made free of rock, concrete, and brick, or fragments thereof, or rubbish and shall be finished to the lines, grades, and cross-section indicated on the Plans, including shoulder, berm and sidewalk spaces.
- C. The Contractor shall repair any damaged surface, and shall not use any finishing equipment that will leave a marred surface. When the subgrade preparation is included as a part of the finishing, the work shall be accomplished according to the requirements of Section 2201 entitled "Subgrade Preparation", and shall be considered incidental to finishing the grading work.

2102.8 Cleanup

Cleanup shall follow the work progressively and final clean-up shall follow immediately behind the finishing. The Contractor shall remove from the site of the work all equipment, tools and discarded materials, and other construction items. The entire right-of-way or easement shall be left in a finished and neat condition. Cleanup shall be considered as incidental to the completion of grading work.

SECTION 2103 MEASUREMENT AND PAYMENT

2103.1 General

There will be no measurement or separate payment for any items of work not specifically identified and listed in the Contract Documents and all costs will be included in the contract unit prices for other items listed in the Contract Documents.

2103.2 Method of Measurement

The quantities of accepted work will be measured and determined as follows:

A. Clearing, Grubbing, and Demolition

1. Clearing may be listed in the Contract Documents and measured per acre or hundredth part thereof.
2. Grubbing may be listed in the Contract Documents and measured per acre or hundredth part thereof.
3. Demolition may be included as Clearing or may be listed in the Contract Documents as a separate item and measured per each and as such shall include all work as defined in Section 2101.2.D.
4. Tree removal may be included in Clearing or may be listed as a separate item in the Contract Documents and measured per each.
5. Brush removal shall not be measured and will be subsidiary to other items in the Contract Documents.

B. Grading

1. Unclassified Excavation may be listed in the Contract Documents and measured to determine the quantity in cubic yards or tenth part thereof.
2. Rock Excavation may be included as Unclassified Excavation or may be listed in the Contract Documents as a separate item and measured to determine the quantity in cubic yards or tenth part thereof. No measurement will be made for rock overbreak in excess of 12 inches below the subgrade elevation.
3. Earth Excavation may be included as Unclassified Excavation or may be listed in the Contract Documents as a separate item and measured to determine the quantity in cubic yards or tenth part thereof. No measurement will be made for embankment performed in rock overbreak areas, where the overbreak is in excess of 12 inches below the subgrade elevation.
4. Embankment may be listed in the Contract Documents and measured to determine the quantity in cubic yards or tenth part thereof.
5. Undergrading may be listed in the Contract Documents and measured to determine the quantity in cubic yards or tenth part thereof.

C. Excavation for pipelines, utilities and all other underground facilities is subsidiary to the pay item for the pipeline, utility or specific underground facility.

D. Testing required by the Contractor shall be subsidiary to other items of the Contract Documents. No separate payment will be made.

2103.3 Basis of Payment

Payment for the quantities of accepted work will be made as follows:

A. Clearing, Grubbing, and Demolition

1. Clearing, grubbing, or clearing and grubbing may be included in the Contract Documents as separate items or as one item and will be paid for by one of the following:
 - a. Payment will be made at the contract unit bid price.
 - b. Payment will be made at the contract lump sum bid price.
2. Demolition, if listed as a separate item in the Contract Documents and not included as a part of Clearing, or Clearing and Grubbing will be paid for by one of the following:
 - a. Payment will be made at the contract unit bid price.
 - b. Payment will be made at the contract lump sum bid price.
3. Site Preparation, if listed in the Contract Documents as a separate item and not included as a part of Clearing, or Clearing and Grubbing will be paid for by one of the following:
 - a. Payment will be made at the contract unit bid price.
 - b. Payment will be made at the contract lump sum bid price.

B. Grading

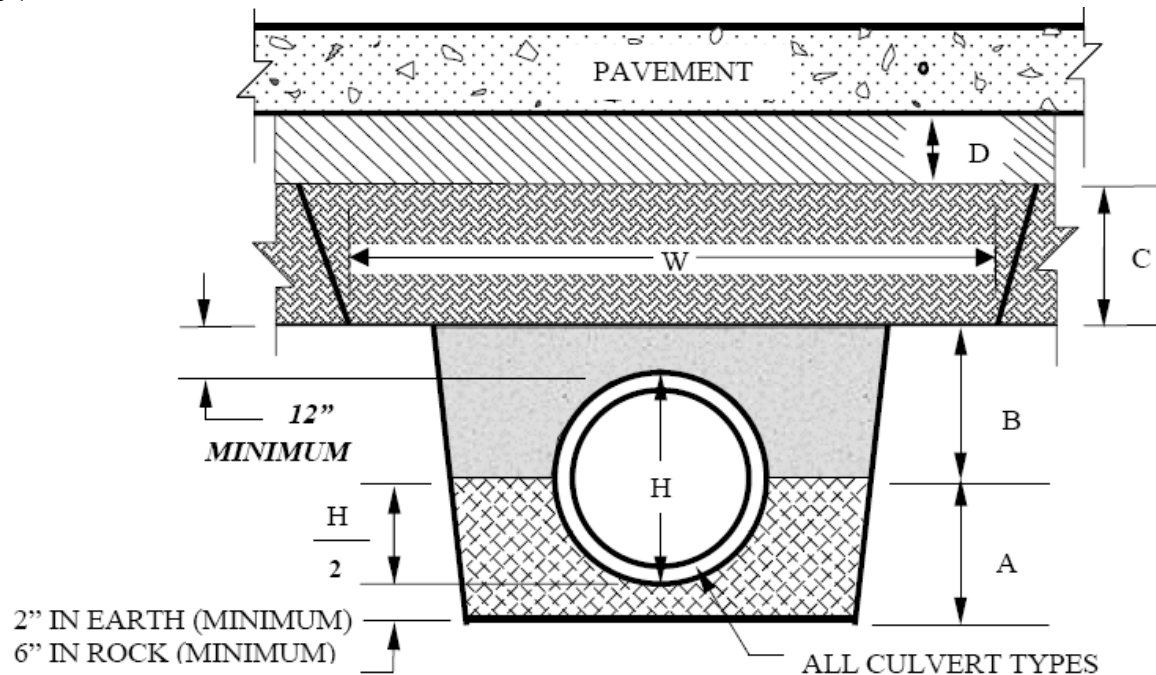
1. Unclassified Excavation, Rock Excavation, or Earth Excavation may be included in the Contract Documents as separate items or as one item and will be paid for by of the following:
 - a. Payment will be made at the contract unit bid price.
 - b. Payment will be made at the contract lump sum bid price.
2. Embankment may be included in the Contract Documents and will be paid for by one of the following:
 - a. Payment will be made at the contract unit bid price.
 - b. Payment will be made at the contract lump sum bid price.
3. Undergrading may be listed in the Contract Documents and will be paid for at the Contract unit bid price.

C. Excavation for pipelines, pipeline structures, utilities and all other underground facilities is subsidiary to the pay item for the pipeline, utility or specific underground facility.

D. Testing required by the Contractor shall be subsidiary to other items of the Contract Documents. No separate payment will be made.

SECTION 2104 BACKFILL DETAILS

Figure 1



A- Consolidated granular bedding material.

B- Granular bedding material or Flowable Backfill (CLSM).

C – Compacted Embankment - 2102.6. Lift thickness shall not exceed the capability of the equipment being utilized to achieve the proper density and consolidation, and in no case shall a lift exceed twelve inches for soil. The minimum width, W, shall be two feet wider than the width of the required compaction device, or five feet, whichever is greater.

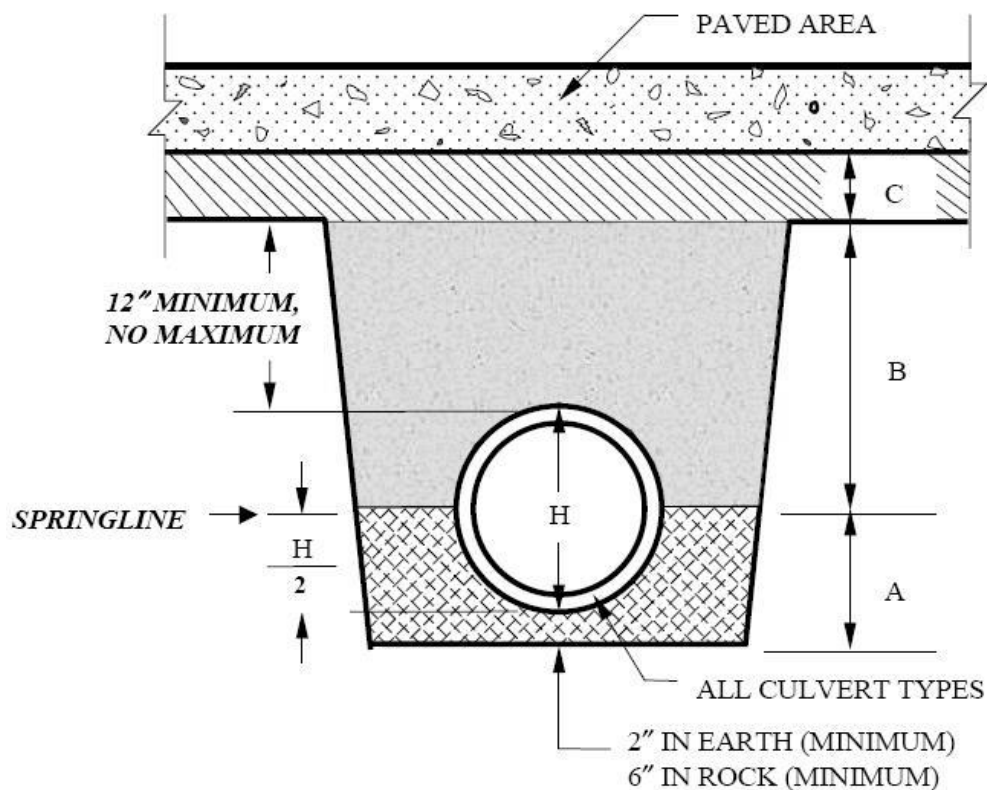
D – Compacted Subgrade - Subgrade thickness shall be as specified in Table 1 of Section 5206 and as directed by the Engineer. Subgrade preparation shall be done in accordance with Section 2201 and shall consist of aggregate for base course, stabilized subgrade, or compacted soil – in accordance with the associated Sections 2201, 2202, and 2203.

Figure 1
(Deep Sewer Lines Using Earth Compaction Equipment,
or in Depths Exceeding 30" of Cover)

Figure 2

The following cross-sectional view of typical storm sewer trench construction under street, alley pavements, and entrances Figure 2, shall apply to all storm sewer backfill areas where deep trenches are not widened to allow heavy roadway compaction equipment. Figure 2 shall also apply to shallow (30" to 18" from top of pipe to bottom of pavement) roadway trenches:

Backfilling shall be placed as shown in Figure 2.



A- Consolidated granular bedding material.

B- Granular bedding material, hand compacted soil - 95% of max. density using ASTM D 698, or Flowable Backfill (CLSM). Maximum lift thickness 6". Granular bedding material shall be used in Zone B for all pipe except reinforced concrete pipe.

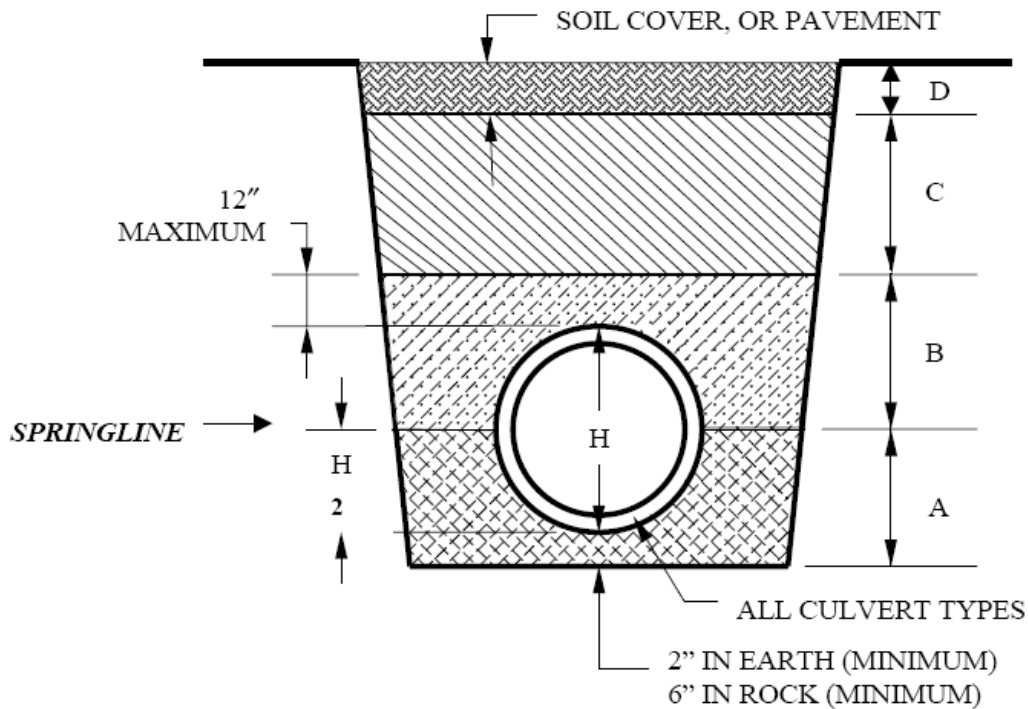
C – Compacted Subgrade - Subgrade thickness shall be as specified in Table 1 of Section 5206 and as directed by the Engineer. Subgrade preparation shall be done in accordance with Section 2201 and shall consist of aggregate for base course, stabilized subgrade, or compacted soil – in accordance with the associated Sections 2201, 2202, and 2203.

Figure 2
(For Deep Trenches Without Roadway Compaction Equipment,
or Shallow Trenches Having Less than 30" of Cover)

Figure 3

Trench backfilling in areas other than street and alley pavements where the near edge of trench is behind the back of curb:

Backfilling shall be placed as shown in Figure 3.



A – Consolidated granular bedding material.

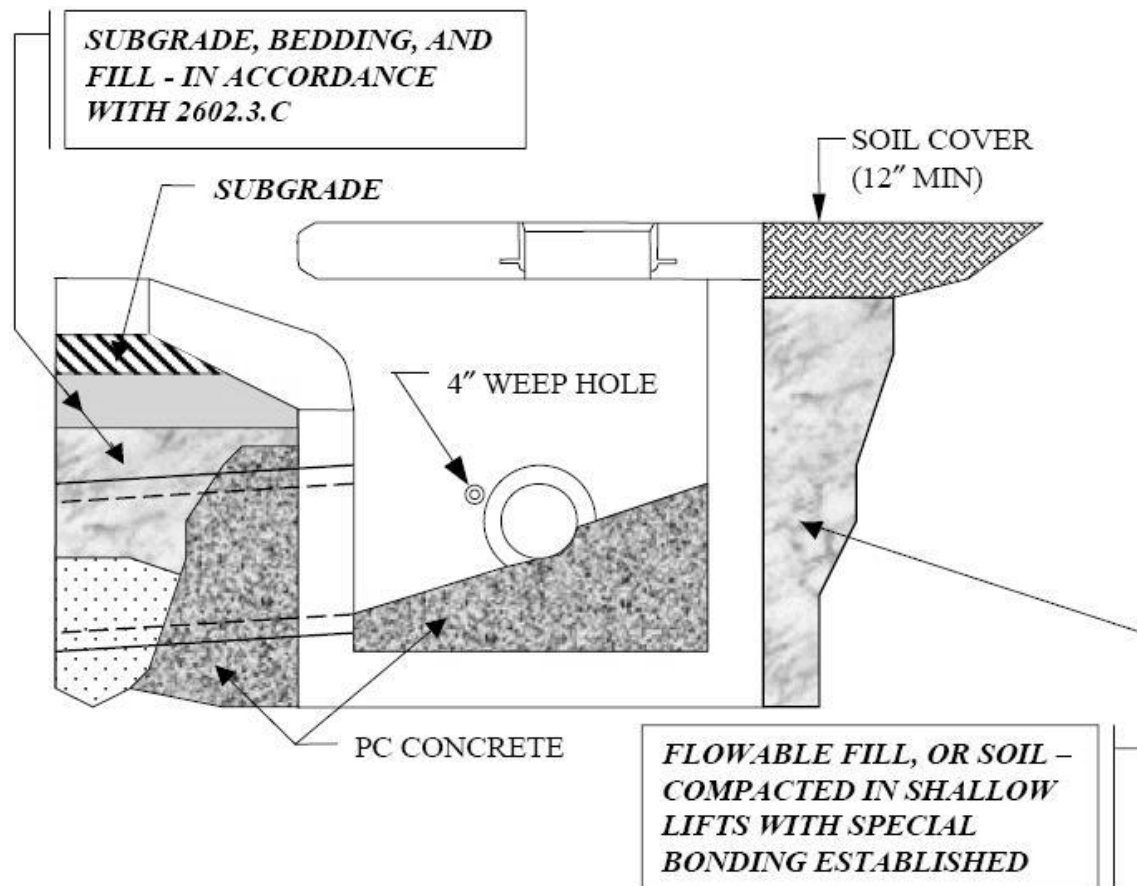
B – Consolidated granular bedding material, flowable backfill (CLSM), or compacted soil – compacted to 90% of maximum density using ASTM D 698. Maximum lift thickness for the granular or soil materials shall be six inches.

C – Consolidated granular bedding material, flowable backfill (CLSM), or compacted soil – compact to approximate density of adjacent soil but not less than 90% of maximum density using ASTM D 698. Lift thickness shall not exceed the capability of the equipment being utilized to achieve the proper density and consolidation; however, in no case shall it exceed six inches for soil.

D – Soil Cover – Soil cover shall be as specified in Section 2102.7. The top twelve inches shall be consolidated soil; the top six inches shall be topsoil suitable for sustaining grass.

Figure 3
(Trenches Outside of Street Pavements)

Figure 4



Note: Weep hole shall be backed by filter fabric or hardware cloth, and 3 cubic feet of granular material.

FIGURE 4
(Structures Adjacent to Street Pavements)

SECTION 2150 – EROSION AND SEDIMENT CONTROL

CITY OF LEE'S SUMMIT, MISSOURI STANDARD SPECIFICATIONS

The City of Lee's Summit hereby adopts Section 2150 of the Kansas City Metropolitan Chapter of APWA Construction and Material Specifications, current edition. The following additions, deletions and/or revisions are adopted as a part of Section 2150 for use within Lee's Summit. Text in bold italics indicates revisions or additions to the APWA standard.

2154.5.A (Silt Fence) Materials, Construction Requirements, and Maintenance:

ADD the following:

1. *Silt fence typically should not be used in swales, drainage-ways, channels and other conduits of concentrated stormwater flow and will only be considered on a case by case basis.*
2. *Silt fence typically should not be used to direct or divert water and will only be considered on a case by case basis.*

DIVISION II
CONSTRUCTION AND MATERIAL SPECIFICATIONS

SECTION 2150 EROSION AND SEDIMENT CONTROL

Approved and Adopted this 15th day of February, 2017

Kansas City Metropolitan Chapter
American Public Works Association

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SECTION 2151 GENERAL REQUIREMENTS

2151.1 Summary: This section describes general requirements to prevent or minimize the pollution of rivers, streams, lakes, and wetlands caused by runoff from the construction zone. Such pollution includes sediment that may migrate offsite through the action of wind, water, or traffic, as well as chemical spills or other refuse from the site.

2151.2 Contractor's Responsibility: The Contractor shall take measures to prevent or minimize the transport of sediment or pollutants from the project limits or into bodies of water that are intended for protection, in accordance with the plans, the requirements of applicable permits and regulations, and best available management practices.

2151.3 Compliance with NPDES Permits: The Owner will obtain a National Pollutant Discharge Elimination System (NPDES) permit and other similar local water pollution control permits as required. Where such permits are required, the Owner will provide the Contractor with a Stormwater Pollution Prevention Plan (SWPPP) which has been prepared by the Engineer or other qualified professional. The Contractor shall comply with all requirements of such permits and the SWPPP, and shall enforce compliance with such requirements by all Subcontractors. The Contractor shall complete the required certification forms for coverage under the relevant permit and shall notify all Subcontractors in writing of the requirements of the SWPPP, obligate them under contract to comply, and enforce compliance during the work.

2151.4 Projects Not Requiring a Permit: If neither NPDES permit nor other local water pollution control permits are required for a project, the Engineer may waive certain documentation and record-keeping provisions of this specification. The Contractor is required to comply with all other provisions in this specification and is required to install such measures for erosion and pollution control as may be called for in the plan or ordered by the Engineer.

2151.5 Stormwater Pollution Prevention Plan (SWPPP): The Stormwater Pollution Prevention Plan (SWPPP) outlines methods and controls to be used to prevent stormwater pollution from the construction activities.

The SWPPP will generally consist of the following elements: (a) a site description; (b) a site map or plan sheets showing areas of soil disturbance, an outline of areas which will not be disturbed, and a drainage area map; (c) plan sheets, tables, or other schedules detailing the location of major structural and non-structural controls and areas where stabilization practices are expected to occur; (d) a description of erosion and sediment controls to be used; (e) a description of any permanent stormwater management features which are incorporated into the project; (f) a description of other controls related to waste disposal practices; (g) a description of the timing, during the construction, of when the measures will be implemented and removed; and (h) a description of maintenance procedures for control measures identified in the plan.

Where multiple agencies have jurisdiction over erosion and sediment control, the SWPPP will be prepared to satisfy the requirements of each. The use of the term "Stormwater Pollution Prevention Plan" or "SWPPP" is not intended to limit its content to the provisions of any single permit program or jurisdiction, and this specification shall have the same meaning regardless of whether the applicable plans are referred to as a "SWPPP," "erosion control plan," "erosion and sediment control plan," "temporary water pollution control plan," or other equivalent term.

All elements of the project bid documents relating to erosion and pollution control are considered part of the SWPPP, either by direct inclusion or by reference, including plan sheets,

specifications, special provisions, quantity tabulations, bid sheets, and contract documents. A copy of all NPDES and other water pollution related permits and permit applications are also part of the SWPPP. This APWA specification is an integral part of the SWPPP.

2151.6 Contractor Amendments to the SWPPP: Prior to beginning work, the Contractor shall review the SWPPP in detail and provide the Engineer with written recommendations for amendments to improve the effectiveness of the SWPPP or to bring it into better alignment with the Contractor's intended method of operations. The Contractor shall also advise the Engineer of any omissions or deficiencies they find in the SWPPP. During the progress of the job, the Contractor shall continue to monitor the effectiveness and performance of the control measures used and propose additional amendments as needed. No amendment shall be incorporated unless approved by the Engineer, and a log of such amendments shall be made by the Contractor. When required by the permit or state law, such amendments shall be developed and prepared under the supervision of a qualified professional as defined in said permit or law. A copy of the SWPPP and all amendments shall be retained by the Contractor onsite and ready for inspection without notice.

2151.7 Contractor Schedule: In addition, the Contractor shall also provide the Engineer with a detailed schedule of their work prior to beginning, which shall include information on the expected timing, duration, and sequencing of erosion and sediment control measures and overall job completion and phasing. Once approved, such schedule shall become a part of the SWPPP, and changes to the schedule shall require amendment to the SWPPP.

2151.8 Alternate Methods or Materials: The Contractor may propose alternative methods or materials for any of the specific erosion and sediment controls given in the SWPPP, provided that such methods provide equal or improved measures of control, as determined by the Engineer. The Contractor shall submit any documentation required by the Engineer to evaluate the alternative. If agreed to by the Engineer (and subject to state or other permitting agency approval if applicable), payment for such alternate method shall be handled in accordance with the applicable provisions of the Contract for changes in work.

2151.9 Superintendent Training Required: The Contractor's resident superintendent shall have no less than 8 hours of formal training on erosion and sediment control within the last 24 months. Such training shall include the principles of erosion and sediment control, technical information on typical and/or innovative controls, and the contents of these specifications and related Standard Drawings and Design Criteria. The training shall be taught primarily by a registered professional engineer or other professional who is considered by the applicable regulatory agencies to be qualified to prepare a SWPPP. Documentation of training shall be submitted to the Engineer upon request, prior to beginning work.

2151.10 Duration of Contractor's Responsibility: The Contractor is responsible for water pollution control and permit compliance from the issuance of Notice to Proceed until final completion of the work and during any subsequent maintenance bond period. The notice of termination will not be submitted by the Owner until all permit requirements are met, which includes the requirement that final stabilization be achieved on 100% of the site. Vegetation shall achieve a density of at least 70% of full turf to be considered acceptable as final stabilization.

2151.11 Installation of Controls: The Contractor shall obey all requirements for chemical and waste controls specified in Section 2152. Contractor shall provide all specific erosion and sediment controls required by the SWPPP in accordance with the requirements of Section 2153

and 2154. If the SWPPP calls out items or controls not included in this specification, refer to the project special provisions and plans for requirements. Controls shall be installed prior to disturbance in an area, unless otherwise indicated in the plans.

2151.12 Maintenance: The Contractor shall maintain the integrity of the temporary erosion and sediment control devices as long as they are in place and necessary. Devices not functioning properly shall be corrected or replaced. Accumulated sediments shall be removed promptly as detailed in Section 2154.

2151.13 Removal: Control measures shall be completely removed from the site when they are no longer needed, unless they are approved by the Engineer to remain in place for permanent stabilization or biodegradation (i.e. erosion control blankets).

2151.14 Inspections: The Contractor shall inspect the construction site within twenty-four hours of the end of a storm which results in precipitation of 0.5 inches or greater, during both active and inactive phases. In addition, regular inspections shall be made weekly during active phases of construction. During inactive phases (such as winter when construction activity has temporarily ceased), an inspection of the site condition shall be made no less than once every 14 days. All installed practices shall be checked for proper installation, operation, and maintenance. Locations where stormwater runoff leaves the site shall be inspected for evidence of erosion or sediment deposition. Deficiencies shall be noted in a report of the inspection and corrected within seven calendar days of the inspection.

A report of each inspection is to be made within 24 hours of the inspection and shall contain the following minimum information: inspector's name, date of inspection, observations relative to the effectiveness of the practices, actions taken or necessary to correct deficiencies, a listing of areas where construction operations have permanently or temporarily stopped, observations at stormwater discharge locations, and any other item required of an inspection by the applicable permits. The inspection report shall be signed by the person performing the inspection. Site inspection reports shall be maintained onsite with the SWPPP or the SWPPP shall contain written documentation of the off-site records storage location.

2151.15 Records: The Contractor shall maintain all permit required records during the job and shall transmit all necessary records to the Engineer at the completion of the work, including all Contractor and Subcontractor certifications and site inspection records, as well as other records requested by the Engineer.

2151.16 Site Access for Inspections: The Contractor shall allow authorized representatives of federal, state, or local agencies having jurisdiction of this permit, upon presentation of proper credentials, to enter the site where construction activities are located, to obtain samples of any discharge water, to have access to and copy at reasonable times, any records which shall be kept, and to inspect any facilities or equipment.

2151.17 Maximum Areas of Disturbance at One Time: The surface area of erodible earth material exposed by site operations shall be limited by the Engineer according to the Contractor's capability and progress in keeping with the approved schedule. Existing vegetation shall be preserved or retained as long as practical and the time period for soil areas to be without permanent surface or vegetative cover shall be minimized. The maximum surface area of erodible earth exposed at one time shall not exceed ten (10) acres unless approved in writing by the Engineer or otherwise provided for in the plans. The Contractor shall pay close attention to the grading and disturbance limits indicated on the plan or authorized by the Engineer.

2151.18 Measures Where Construction has Ceased: Soil stabilizing erosion control measures as detailed in Sections 2153 shall be implemented within 14 calendar days after construction activities have temporarily or permanently ceased on any portion of the site. Exceptions to this requirement are as follows: (a) if implementation of erosion controls is precluded by snow cover, such measures shall be taken as soon as practical after snowmelt, or (b) a waiver to this requirement is justified and approved by the Engineer in writing, in which case a specific deadline for installing erosion controls shall be established.

2151.19 Duration Limits for Select Activities: For certain items of work, the plans or standard sequences may contain specific time limits for the maximum duration of exposure, typically stated as "Item A construction shall have a maximum exposure time of X days." Where such limits are specified, the time shall be measured from the date in which stabilized ground cover is first disturbed in the work area until the specified construction is complete and permanent or temporary stabilization shown on the Plans is applied. Contractor shall be responsible for documenting the elapsed time on all such work, typically by noting the time in their inspection logs, taking time-stamped photographs, and/or by marking the area with a wooden stake documenting beginning and ending dates. The Engineer may grant extensions of time requested by the Contractor when justified and suitable interim stabilization measures are provided.

2151.20 Construction near Rivers, Streams, and Waterbodies: Construction operations in or near rivers, streams, and other water impoundments shall be restricted to those areas essential for construction. Unless otherwise provided for in the plans, a minimum 50 feet buffer of undisturbed vegetation shall be maintained between construction operations and defined drainage courses. Where such buffers are not provided, work shall not be initiated until all materials and equipment necessary to complete the work are on site and such operations shall be completed as quickly as possible once the work has begun. When no longer required, all falsework, pilings, temporary crossings, and other obstructions shall be promptly removed. Stream crossings shall be limited to those detailed in the plans or as approved by the Engineer.

2151.21 Culverts, Ditches and Storm Sewers: Construction of major elements of the proposed storm sewer or other drainage systems shall be coordinated to minimize the duration of time over which stormwater would run through temporary, erodible channels. Unless otherwise indicated on the plans, construction of the major elements of this system shall be among the first activities on the project. Once begun, construction shall proceed expeditiously to completion, including placement of all final headwalls, end structures, rip-rap and other end treatments. Temporary or permanent ditches which are graded on the project shall either be stabilized or have temporary sediment controls installed within seven (7) days of their grading.

2151.22 Methods of Measurement: No separate measurements will be made for the general requirements covered by this Section.

2151.23 Basis of Payment: Compliance with the general requirements of this section will not be paid separately, but shall be subsidiary to other items listed in the contract. (Note: Some Owner's may elect to pay for Administration of erosion control requirements as a separate line item. Consult the contract and job special provisions if that is the case.

SECTION 2152 CHEMICAL AND WASTE CONTROLS

2152.1 Summary: This section describes specific requirements to control non-sediment related pollutant discharges from chemicals and wastes from the site, including requirements for chemical handling, spill prevention, spill response, and waste disposal.

2152.2 Solid, Liquid, and Hazardous Wastes: All trash shall be placed in dumpsters or trash barrels provided by the Contractor and accumulated trash shall be hauled offsite and properly disposed. Floating debris found in any waterbody on or immediately adjacent to construction shall be removed immediately, regardless of source. Hazardous wastes shall be stored, transported offsite, and disposed of properly.

2152.3 Sanitary Wastes: Sanitary facilities shall be made available and their use enforced by the Contractor.

2152.4 Leak Prevention: All equipment used onsite shall be free of leaks, receive regular preventative maintenance, and be inspected daily to reduce chance of leakage. No fueling, servicing, maintenance, or repair of equipment shall be done within 50 feet of a stream, drainage way, lake, storm sewer manhole or other water body. Onsite fuel tanks shall be in good condition, free of leaks or drips, painted brightly for visibility, and monitored daily. All fuel tanks, including mobile trailers, shall be protected by a secondary containment system or earthen berm sized to contain 110% of the full tank volume.

2152.5 Concrete Washout: Concrete wash or rinse water from concrete mixing equipment, tools and/or ready-mix trucks, tools, etc., shall not be discharged into or be allowed to run directly into any existing water body or storm inlet. One or more locations for concrete wash out shall be designated on site and installed in accordance with the Standard Drawings.

2152.6 Chemical Handling and Storage: Chemicals or materials capable of causing pollution shall only be stored onsite in their original container. Materials stored outside shall be in closed and sealed water-proof containers and located outside of drainage ways or areas subject to flooding. Manufacturer's data regarding proper use and storage, potential impacts to the environment if released, spill response, and federally-defined reportable quantities for spill reporting shall be maintained by the field superintendent onsite at all times. Locks and other means to prevent or reduce vandalism shall be used.

2152.7 Herbicides, Pesticides and Fertilizers: Herbicides, pesticides and fertilizers used as part of the work shall be applied only in accordance with manufacturer recommendations. Direct spray into water bodies is prohibited. Such chemicals shall not be used if rain is forecast within 24 hours, unless they are approved for wet weather application.

2152.8 Spill Clean-up and Management: If it is safe to do so, Contractor shall stop the source of any spills or leaks and shall contain spills immediately with an appropriate device, earthen berm, sawdust, sand, kitty litter, rags or other absorbents. Manufacturer recommendations shall be followed. Leaks from broken hoses shall be immediately contained with hose clamps, plugs, or drained into leak-proof containers. Contractor shall have the tools, equipment, and supplies necessary for spill response onsite at all times and ready for immediate use. Contractor personnel shall be trained to properly respond immediately to a leak or spill. All spills shall be cleaned up and disposed of in accordance with applicable federal, state, and local regulations. Local hazardous materials response units shall be called if assistance is needed in stopping or containing the spill.

2152.9 Spill Reporting: All spills in excess of reportable quantities shall be reported to the appropriate federal, state, and local agencies within 24 hours of their occurrence. The Contractor shall maintain a listing of all such agencies onsite within the SWPPP and in easy reference for onsite personnel. Spills that pose an immediate threat to public safety or contamination of a water body shall be reported immediately to designated first response authorities. A current listing of applicable phone numbers for the jurisdiction shall be placed at the front of the SWPPP and posted conspicuously on the jobsite.

2152.10 Methods of Measurement: No separate measurements will be made for the requirements covered by this Section.

2152.11 Basis of Payment: Compliance with the requirements of this section will not be paid separately, but shall be subsidiary to other items listed in the contract.

SECTION 2153 EROSION CONTROLS

2151.1 Referenced Standards:

The following standards are referenced directly in this section. The latest version of these standards shall be used.

APWA, Kansas City Metropolitan Chapter (KC-APWA):

Standard Drawings, Division III of Standard Specifications and Design Criteria

Erosion Control Technology Council (ECTC):

Standard Specification for Rolled Erosion Control Products (RECPs).

Kansas Department of Transportation (KDOT):

Standard Specifications for State Road & Bridge Construction, 2015 Edition or later including all latest errata and adopted Special Provisions, as well as associated Standard Drawings.

Missouri Department of Transportation (MoDOT):

Missouri Standard Specifications for Highway Construction, 2011 edition or later including all supplemental specifications, as well as associated Standard Plans.

Texas Department of Transportation (TxDOT):

Approved Products List (APL) for Erosion Control. Based on testing and standards cited in the report "TXDOT / TTI Hydraulics, Sedimentation and Erosion Control Laboratory: Field Performance Testing of Selected Erosion Control Products".

US Composting Council (USCC):

STA – Seal of Testing Assurance Program; and TMECC - Test Methods for the Examination of Composting and Compost. Information available online at www.compostingcouncil.org.

2153.2 Summary: This section describes specific requirements for installation and maintenance of temporary measures to stabilize onsite soils and prevent erosion during construction.

2153.3 Materials: Materials used for erosion controls shall meet the requirements of the following subsections. Unless otherwise specified herein, the Contractor shall submit, for each material used, a certification prepared by the manufacturer which states that the materials meet all the requirements of this specification. The manufacturer shall also provide supporting documentation and testing results to validate this certification, if requested by the Engineer. Manufacturer's instructions for installation of materials (when applicable) shall be available onsite whenever work is occurring and a copy shall be submitted to the Engineer upon request.

2153.4 Permanent Seeding and Sodding: Final stabilization with vegetation by either permanent seeding or sodding is the most effective form of erosion control and shall be achieved as early in the construction process as possible.

- A. Materials, Construction Requirements and Maintenance:** Permanent seeding or sodding shall be provided as specified in Section 2400 of these Standard Specifications.

Contractor shall schedule work so that permanent seeding is conducted as early as practical in the construction process. Multiple mobilizations of seeding or sodding operations shall be expected.

- B. Out-of-Season Special Provision:** The Engineer may request that permanent seeding be conducted anytime between April 16 and August 14 and/or that sodding be conducted anytime between June 1 and September 1, even though such dates are outside the standard seasons established in Section 2400. If agreed to by the Contractor, then the Contractor shall conduct such seeding or sodding and shall be responsible for the establishment of a vigorous and healthy seed or sod cover. The Contractor will be paid, however, for all watering necessary during the period that falls outside the standard season.
- C. Measurement and Payment:** Shall be as specified in Section 2400. If out-of-season seeding or sodding has been authorized, then "Out of Season Watering" will be measured by the 1,000-gallon unit applied and paid for at the contract unit price.

2153.5 Temporary Seeding: Interim stabilization with annual vegetation to provide temporary cover to minimize erosion. This item only covers seeding installed by conventional drilling.

- A. Materials:** Seed and equipment used for temporary seeding shall meet all the criteria given for permanent seeding in Section 2400 of these Standard Specifications. Fertilizer is not required.

Mulch used for temporary seeding shall meet the same requirements as "mulch cover" in subsection 2153.6. Mulch is required unless erosion control blankets are being used instead.

The following seed mixtures and planting rates shall be used:

1. Type "TR" Seed: This mixture will normally be used when temporary seeding is conducted between February 15 and May 31, or between September 1 and October 31. The seed mixture will be as follows:

Kind of Seed	Minimum Pure	Rate of
	Live Seed (%)	Pure Live Seed
		(lbs per Acre)
Annual Rye Grass	83	90

2. Type "TM" Seed: This mixture will normally be used when temporary seeding requires heat tolerance, typically for planting anytime between May 1 and August 15. (Volunteer millet is aesthetically objectionable in turf grass lawns; therefore, some jurisdictions may restrict use of this mix. Confirm local requirements before use.) The seed mixture will be as follows:

Kind of Seed	Minimum Pure	Rate of
	Live Seed (%)	Pure Live Seed
		(Lbs per Acre)
Millet	77	65

3. Type "TW" Seed: This mixture will normally be used when temporary seeding requires cold tolerance, typically for planting anytime between September 15 and November 30. The seed mixture will be as follows:

Kind of Seed	Rate of	
	Minimum Pure Live Seed (%)	Pure Live Seed (Lbs per Acre)
Winter Wheat	83	120

- B. **Construction Requirements:** Preparation, planting and all other construction requirements for temporary seeding shall be as specified for permanent seeding in Section 2400, except as modified herein. Temporary seeding shall be drilled (see 2153.8 for hydraulic application of temporary seed). Prior to application, the soil shall be tilled to a depth of at least 2 inches and gullies, depressions, and large clods eliminated. Roller compaction of the seedbed is not required. Within 24 hours of seeding, mulch or erosion control blankets shall be applied. When mulch is used, it shall be applied in accordance with the same requirements given for "Mulch Cover" in subsection 2153.6. When erosion control blankets are used, they shall be installed in accordance with the requirements in subsection 2153.9. The Contractor shall initially water all areas of temporary seeding at least one-quarter inch as soon as the mulch is laid. Additional watering may be necessary for plant germination and adequate growth to provide cover. Contractor shall schedule work so as to provide temporary seeding as early as practical in the construction process. Contractor shall maintain a readiness to perform temporary seeding frequently during the progress of the project. No more than 7 calendar days shall elapse between the Engineer's request for temporary seeding and its application. Multiple mobilizations to seed areas as construction progresses shall be expected.
- C. **Maintenance:** Mulch shall be replaced or repaired as needed during germination and early growth. Bare spots shall be patched, by hand seeding if necessary. Vehicle and personnel traffic shall be minimized in areas seeded.
- D. **Measurement and Payment:** "Temporary Seeding" will be measured per acre or hundredth part thereof and paid for at the contract unit price. No differentiation shall be made for type of temporary seed used. Mulch and watering shall not be measured or paid for separately on any temporary seeding, but all such costs shall be subsidiary to the item. Erosion control blankets, when used, will be measured and paid separately as "Erosion Control Blanket."

2153.6 Mulch Cover: Mulch applied without seeding to protect the soil surface from raindrop impact and reduce wind erosion and dust. Mulch Cover (without seed) is generally used when ground cover is required and temporary or permanent seeding is not feasible.

- A. **Materials:** Mulch shall be vegetative type only, consisting of cereal straw from stalks of oats, rye, wheat or barley and shall be free of prohibited and noxious weed seeds.
- B. **Construction:** Prior to applying mulch, the soil shall be tilled to a depth of 2 inches to eliminate hard crust and allow rainwater intercepted by mulch to infiltrate the soil. Gullies, depressions, and large clods shall be eliminated.

Mulch shall be applied at the rate of 1.5 tons/acre (3,000 lbs/acre) and be anchored into the soil a minimum depth of 3 inches by use of a heavy disc harrow, set nearly straight, or a similar approved tool. Discs of the anchoring tool shall be set approximately 9

inches apart. Anchoring shall be accomplished by not more than two passes of the tool. If approved by the Engineer, a tackifier may be applied to the mulch to anchor it instead of using the disc harrow.

- C. Maintenance:** Mulch cover shall be replaced or repaired as needed. Bare spots shall be filled in, by hand if necessary. Vehicle and personnel traffic shall be minimized in areas mulched.
- D. Measurement and Payment:** "Mulch Cover" will be measured per acre or hundredth part thereof and paid for at the contract unit price. Mulch is not measured and paid separately when laid down in conjunction with seeding operations.

2153.7 Hydrocover (Standard): Hydraulic application of a standardized mixture of fiber mulch, tackifier, and temporary seed to provide temporary cover.

A. Materials:

1. **Fiber Mulch:** Fiber mulch shall be a manufactured, pre-packaged, biodegradable material. The material supplied shall meet the requirements of ECTC's Standard Specification for Hydraulic Erosion Control Products (HECPs) (version 2.4 dated April 2, 2014) for Type 3 products, having a functional longevity of 3 months, a maximum uninterrupted slope length of 50 feet, and applied to a slope that is flatter than 3:1. In addition, the material shall also be listed on the TxDOT Approved Products List for Erosion Control under the category "Mulches 4:1 or Flatter Slopes" and specified for use on "Clay or Tighter Soils".
2. **Tackifier:** Shall be food-grade hydrolyzed guar gum powder or alternate material as specified by the manufacturer. It shall be mixed with the cellulose fibers based on the manufacturer's recommendations.
3. **Water:** Shall be clean, potable water mixed at a rate suitable for the equipment being used and as recommended by the manufacturer.
4. **Seed:** Shall be Type TR, TM or TW seed as specified in Section 2153.5 and appropriate for the season. Seed shall be mixed to provide no less than the seeding rate per acre given in that section.
5. **Fertilizer:** Not required unless specified by the Engineer

- B. Construction Requirements:** The fiber mulch shall be added to the hydraulic seeder along with proportionate amounts of seed, tackifier, and water in accordance with the manufacturer's recommendation. It shall be applied to make a uniform coverage of the soil surface. Prior to application, the soil shall be tilled to a depth of at least 2 inches and smoothed to eliminate gullies, depressions, or large clods. The Standard Mix Hydrocover mix shall not be used on any slope steeper than 4:1. Contact the engineer for alternate specifications to be used on steeper slopes if there is a discrepancy.

Hydrocover shall be applied at a minimum rate of 2,000 pounds dry weight of fiber per acre (0.41 pounds per square yard), unless otherwise specified by the manufacturer. Once applied, the area shall be allowed to dry and vehicle and personnel traffic shall be

kept off the stabilized area. Water shall be applied as needed for seed germination and plant growth. The hydrocover operation shall be accomplished with hydraulic sprayers suitable for spreading and projecting the mixture and fitted with the appropriate nozzle tips. Sprayers shall be mechanically mixed or jet agitated.

Contractor shall maintain a readiness to provide hydrocover frequently during the progress of the project. No more than 7 calendar days may elapse between the Engineer's request for hydrocover and its application. Multiple mobilizations of hydrocover operations shall be expected.

- C. Maintenance:** Areas which are disturbed by construction shall be patched with additional application of slurry at the next available mobilization of equipment at no additional cost. Small areas of poor coverage may be stabilized through erosion control blankets, mulch for cover, straw wattle protection or other measures, at no additional cost.
- D. Measurement and Payment:** "Hydrocover (Standard)" will be measured per acre or hundredth part thereof and paid for at the contract unit price. No payment will be made for applications made outside the area intended for coverage.

2153.8 Hydrocover (Specialty Mix): Hydraulic application of specialized mixtures of fiber mulch, tackifiers, seed and other additives to provide temporary cover. Such specialized mixtures may provide for steeper slopes, more robust protection, longer durability, or enhanced vegetative growth, as compared to the Standard Mix.

- A. Materials:** When specialty mixtures are used, the particular mix design and ingredient requirements shall be given in the plans or special provisions. Such specialty mixtures may include additives for improved seed germination, mixtures of special polymer tackifiers and heavier rates of cellulose fiber or other cross-linking organic fibers to produce a more continuous cover (i.e. "Bonded Fiber Matrix"), or mixtures that contain polyacrylamides that chemically stabilize the underlying soils (i.e. "Stabilized Fiber Matrix"). Seed and additives shall conform to the requirements of standard hydrocover, except as modified in the plans, special provisions or by the manufacturer's recommendations for the specialty mix.
- B. Construction and Maintenance Requirements:** All construction and maintenance requirements shall be the same as for standard hydrocover, except as modified by the plans or the manufacturer's recommendation for the specialty mix. Equipment for specialty mixes shall conform to manufacturer's recommendations.
- C. Measurement and Payment:** "Hydrocover (Named Specialty Mix)" will be measured per acre or hundredth part thereof and paid for at the contract unit price. No payment will be made for applications made outside the area intended for coverage.

2153.9 Erosion Control Blankets (including Turf Reinforcing Mats): Blankets or mats of natural, synthetic, or composite materials that can be rolled onto bare earth and anchored in place to provide temporary or permanent cover and/or to stabilize bare earth or channels subject to overland or concentrated surface flow. This item of work includes the use of Turf Reinforcing Mats.

- A. Materials:** Erosion control blankets of the class and type specified in the contract shall be a "Rolled Erosion Control Product" as defined by the ECTC Standard Specification. Further, the material shall be listed in the current TxDOT Approved Products List for Erosion Control. Blankets are categorized by expected use and application, as follows:

Class 1: For use as Cover and Slope Protection from overland flow:

- Type A: On slopes 1:3 or flatter with clay soils.
Type B: On slopes 1:3 or flatter with sandy soils.
Type C: On slopes steeper than 1:3 with clay soils.
Type D: On slopes steeper than 1:3 with sandy soils.

Class 2: For use as Flexible Channel Liner under concentrated flow:

- Type E. For shear stresses below 2 lb/sq. ft.
Type F. For shear stresses below 4 lb/sq. ft.
Type G. For shear stresses below 6 lbs/sq. ft.
Type H. For shear stresses below 8 lb/ sq. ft.

Materials supplied for Type A, B, C, D, E and F blankets shall have a minimum expected longevity of 12 months, unless otherwise stated on the plans or approved by the Engineer. Materials supplied for Type G and H shall have a longevity of greater than 5 years. Materials for Type H shall be 100% synthetic. Expected longevity shall be evaluated based on the manufacturer's data.

- B. Construction Requirements:** The Contractor shall install erosion control blankets in the locations shown in the plans and in accordance with the Standard Drawings and manufacturer's recommendations.
- C. Maintenance:** Maintain blankets in accordance with the Standard Drawings and manufacturer's recommendations.
- D. Measurement and Payment:** "Erosion Control Blanket (Named Type)" will be measured per square yard of sloped surface area covered by the completed mat and paid for at the contract unit price for the given type. Excess blanket used for overlap at seams, anchoring, waste, repairs, etc. will not be included in the measurement. When blankets are used in conjunction with permanent or temporary seeding, erosion control blanket will be paid for at the contract unit price and the seeding operation shall be paid separately.

2153.10 Compost Cover: Organic compost applied with or without seeding to protect the soil surface from raindrop impact, absorb stormwater, facilitate vegetation growth and reduce wind erosion and dust.

- A. Materials:** *(Note: The material requirements in this subsection do not apply for compost filter berms and compost filter socks, and are described more fully in Sections 2154.10 and 2154.11.)*

All compost shall be mature, sanitized, well-composted organic matter free of identifiable feedstock constituents and offensive odors. Compost shall have been produced by the aerobic decomposition of organic material. Organic material sources may include leaves and yard trimmings, paper fiber, wood, bark, biosolids, food scraps, composted manures, or combinations of these products. Biosolids compost shall comply with the

Standards for Class A biosolids outlined in 40 Code of Federal Regulations (CFR) Part 503. The compost shall be free of any refuse, contaminants, and any material toxic to plant growth. Compost must not be derived from mixed municipal solid waste. Compost shall comply with all applicable state and federal regulations regarding production and distribution.

All compost material supplied shall be certified through one of the following programs:

- A. The USCC STA Program through a certified supplier, and wherein all testing procedures follow the USCC TMECC manual.
- B. The KDOT Specification found at Section 2105 for Soil Compost Materials, wherein all testing procedures are in accordance with the requirement listed there. Under this specification, however, compost sources from the State of Missouri are not excluded, provided that such sources are in compliance with Missouri regulations, satisfy the material and testing requirements found in the KDOT specification, and are otherwise found to be suitable by the Engineer.

Before delivering of the compost, the supplier shall provide a copy of the lab analysis and certifications as outlined for the applicable program. The supplier shall also document the feedstocks and sources used in the compost to be supplied.

- B. **Construction:** Prior to applying compost, the soil shall be tilled to a depth of 2 inches to eliminate hard crust and allow rainwater intercepted by the compost cover to infiltrate into the soil. Gullies, depressions, and large clods shall be eliminated.

Compost shall be applied to a depth of 1.5 to 2 inches when alone or 1 to 1.5 inches when used in conjunction with seeding operations. Compost shall be uniformly applied using an approved spreader unit, which may include mechanical or pneumatic (blower) devices. Compost shall extend at least 3 feet beyond the shoulder of any slope to ensure that runoff does not flow under the cover. Once applied, the compost shall be thoroughly watered to improve settling.

- C. **Maintenance:** Compost shall be replaced or repaired as needed. Bare spots shall be filled in, by hand if necessary. Vehicle and personnel traffic shall be minimized in areas covered.
- D. **Measurement and Payment:** "Compost Cover" will be measured per cubic yard of compost in the vehicle at the point of delivery to the project. When compost cover is used in conjunction with permanent or temporary seeding, compost cover will be paid at the contract unit price and the seeding operation shall be paid separately. The unit price for compost cover will include any deductions for standard mulching that is no longer required.

2153.11 Surface Roughening: Any rough graded slope that is not yet ready for seeding or other treatment and which will not be disturbed by ongoing construction for a period of 7 days or more shall be roughened by grooving, tracking, disking, or ripping it with a disc, tiller, spring harrow or other suitable implement. Such grooves shall be located traverse to the slope face and shall not be less than 3 inches deep nor spaced more than 15 inches apart. The requirement to roughen slopes by tracking or grooving shall apply to all slopes steeper than 6:1

horizontal to vertical. No measurement or payment shall be made for this item, but it shall be subsidiary to the earthwork.

2153.12 Dust Control: Contractor shall take effective measures to prevent blowing dust. Adequate moisture content shall be maintained in all exposed soils by application of water or other approved dust suppressant. Areas to be subsequently paved may be treated with asphalt emulsion. When dust produced by operations such as sand blasting, concrete grinding, and sawing of concrete or masonry would create a public nuisance, they shall be performed under a water spray or an alternate construction method shall be used. No measurement or payment shall be made for this item, but it shall be subsidiary to other work.

2153.13 Method of Measurement: Erosion controls will be measured in the manner specified in each applicable subsection.

2153.14 Basis of Payment: Erosion controls will be paid for at the contract unit price specified in each applicable subsection.

SECTION 2154 SEDIMENT CONTROLS AND DIVERSIONS

2154.1 Referenced Standards:

The following standards are referenced directly in this section. The latest version of these standards shall be used.

AASHTO:

M 288 - Geotextile Specification for Highway Applications

APWA, Kansas City Metropolitan Chapter (KC-APWA):

Standard Drawings, Division III of Standard Specifications and Design Criteria

ASTM:

D 3786 - Test Method for Hydraulic Bursting Strength of Textile Fabrics – Diaphragm Bursting Strength Tester Method

D 4355 - Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus

Kansas Department of Transportation (KDOT):

Standard Specifications for State Road & Bridge Construction, 2015 Edition or later including all latest errata and adopted Special Provisions, as well as associated Standard Drawings.

Missouri Department of Transportation (MoDOT):

Missouri Standard Specifications for Highway Construction, 2011 edition or later including all supplemental specifications, as well as associated Standard Plans.

2154.2 Summary: This section describes specific requirements for installation and maintenance of temporary measures to detain, filter, or cause settlement of sediment from runoff, as well as measures used to temporarily direct or divert runoff onsite or at the site perimeter.

2154.3 Materials: Materials used for sediment controls and diversions shall meet the requirements of the following subsections. Unless otherwise specified herein, the Contractor shall submit a certification prepared by the manufacturer for each material used which states that the materials meet all the requirements of this specification. The manufacturer shall also provide supporting documentation and testing results to validate this certification, if requested by the Engineer. Manufacturer's instructions for installation of materials (when applicable) will be available onsite whenever work is occurring and a copy shall be submitted to the Engineer upon request.

2154.4 Sediment Removal and Disposal: Removal of accumulated, settled sediment from behind barriers, traps, or within basins.

A. Materials: Not applicable.

B. Construction Requirements: Accumulated sediment shall be removed when it exceeds the volumes specified for any particular measure or would otherwise impede the proper operation of control measures. Sediments removed shall be mixed with other onsite materials and incorporated into project fills, spread loosely across the site, or

hauled offsite as necessary. Sediments shall not form an identifiable layer or seam in any fill. Sediments hauled offsite shall be dewatered first or hauled in a water tight truck. Sediments shall be located and compacted in a way which minimizes the likelihood of being resuspended in future rainfalls. Removal shall be by machine or hand work, whichever is most feasible.

C. Maintenance: Not applicable.

D. Measurement and Payment: Sediment removal is not measured or paid separately, but shall be subsidiary the other items in the contract. The proper and timely use of erosion controls will help reduce the quantity of sediment that must otherwise be cleaned out of downstream controls.

2154.5 Silt Fence: A temporary barrier of synthetic fabric embedded in the ground and supported by posts used to divert water or to maintain a trap for settlement.

A. Materials, Construction Requirements and Maintenance: Refer to the Standard Drawings.

B. Measurement and Payment: Silt fence will be measured by the linear foot and will be paid for at the contract unit price for "Silt Fence" Initial excavation of depressions on the upstream side of silt fence to create added storage shall be subsidiary.

2154.6 Straw Bales: Straw bales shall not be used.

2154.7 Rock Ditch Checks: Small temporary stone ditch checks used to form protect ditches with larger flows.

A. Materials: Rock shall be a clean aggregate free of deleterious substances, including earth, chert, cracks, seams, soapstone, shale or other easily disintegrated materials. Rock shall come from a primary run and be screened to remove the easily separated fines. It shall meet the gradation requirements below for the nominal size specified:

2-inch Rock: Fifty percent (50%) by weight of the particles shall be larger than 1.5 inches in diameter and none shall be larger than 4 inches. Total aggregate and fines smaller than ½ inch shall not exceed 2 % by weight.

4-inch Rock: Fifty percent (50%) by weight of the particles shall be larger than 4 inches in diameter and none shall be larger than 9 inches. Total aggregate and fines smaller than 1" shall not exceed 2 % by weight.

6-inch Rock: Fifty percent (50%) by weight of the particles shall be larger than 6 inches in diameter and none shall be larger than 12 inches. Total aggregate and fines smaller than 1" shall not exceed 2 % by weight.

The Engineer may approve modifications to these gradations to accommodate readily available stockpiles from local quarries.

B. Construction Requirements: See Standard Drawings.

- C. **Maintenance:** See Standard Drawings.
- D. **Measurement and Payment:** "Rock Ditch Checks (Named Rock Size)" will be measured per ton or tenth part thereof, as placed, and paid for at the contract unit price for the nominal size of rock indicated. Initial excavation of depressions on the upstream side of rock barriers to create added storage shall be subsidiary.

2154.8 Synthetic Sediment Barriers (Type): Any one of various proprietary ditch checks, primarily composed of synthetic materials, that can be used instead of the other measures specified herein to control velocities and erosion in ditches or swales.

- A. **Materials:** Materials for any given Type of Synthetic Sediment Barrier shall be as called out in the plans or Standard Drawings. In addition, this category may also include those measures called out as "Synthetic Sediment Barrier" in KDOT Specification Sections 902 and 2114 or those called out as "Alternate Ditch Checks" in MoDOT Specification 806.
- B. **Construction Requirements:** Install Synthetic Sediment Barrier's in accordance with manufacturer instructions. Pay particular attention to anchoring, protection of channel underneath, and to conditions at the ends to avoid bypassing.
- C. **Maintenance:** Remove silt when it accumulates to 20% of the height of the barrier or when the accumulation prevents the proper operation of the ditch check, whichever is less. If units are damaged or dislodged during the sediment removal process, repair and re-establish continuity.
- D. **Measurement and Payment:** "Synthetic Sediment Barriers (Type) " will be measured per linear foot and paid for at the contract unit price. Underlying erosion control blanket or geotextiles shall be subsidiary. If no specific type is given, then all such measures allowed for the job will be paid for at a uniform price.

2154.9 Biodegradable Logs (or Wattles): Circular tubes of netting filled with straw or other biodegradable fibers and used as a small height barrier for diversion of water or settlement.

- A. **Materials:** Biodegradable logs are manufactured using a variety of filler materials. For this specification, the following two classes of filler are specified:

Class A: Rice or wheat straw fibers Fiber material shall be certified as weed free in accordance with state standards. Fibers shall have an average length greater than 3 inches. Type A wattles shall have a durability in the field of no less than 3 months. Type A wattles shall be specified with dimensions and minimum weights of 9-inch diameter (1.7 lbs./lin ft.); 12-inch diameter (2.5 lbs/lin. ft.) or 20-inch diameter (3.5 lbs/lin. Ft.)

Class B: Excelsior wood fibers, coconut fiber (i.e. coir), jute, or other longer-lasting biodegradable materials. Such materials shall be free of deleterious substances, compacted tightly, and shown to have an in-field durability of 6-months or greater. Class B wattles shall be specified with dimensions 9-inch diameter, 12-inch diameter, or 20-inch diameter.

Containment netting shall be jute or light-weight plastic. The entire wattle unit shall be sufficiently durable to withstand weather, construction, and installation conditions for no less than the life of the filler material (see above), including multiple movements and

reinstallations. Wood posts of sufficient strength withstand installation and weather shall be used for anchoring.

- B. Construction Requirements:** Biodegradable logs shall be located as shown on the plans or directed by the Engineer. Individual units shall be installed in accordance with manufacturer's recommendations and the Standard Drawings.
- C. Maintenance:** Maintain as called out in the Standard Drawings.
- D. Measurement and Payment:** "Biodegradable Logs (Size and Class)" will be measured per linear foot and paid for at the contract unit price. When used without other qualifier, the phrase "Straw Wattle" shall be considered equivalent to a 9-inch Class A Biodegradable Log.

2154.10 Compost Filter Berm: A berm or dike of compost placed to trap pollutants and filter runoff from small areas of overland flow.

- A. Materials:** Compost to be used in filter berms shall meet the following requirements:

<u>Parameter</u>	<u>Range</u>
pH	5.0-8.5
Moisture Content	<60%
Organic Matter Content	>25% of dry weight
Particle Size	99% < 2", 30%-50% < 3/8"

- B. Construction Requirements:** Compost filter berms shall be constructed using specially designed pneumatic equipment (blowers) and a berm shaping device, or other equipment as approved by the Engineer. If a blower is used, compost shall be blown directly at the soil surface to help settle, compact and shape the berm. The berm shall be formed in a trapezoidal shape, having a typical dimension of 3 feet wide at the base and 1.5 feet high. Position the berm around designated soil areas and parallel to the contour. The ends of the berm shall be pointed up slope such that the bottom elevation at each end is higher than the top elevation throughout most of the slope, so as to prevent water from flowing around the end of the berms.
- C. Maintenance:** Berms shall be reshaped and compost added as necessary to maintain their function and dimensions. Breaches in the berm shall be repaired promptly. Compost may be added by hand and tamped in place. Unless otherwise directed by the final landscape plans or by the Engineer, removal of the compost berm shall be made by spreading the compost in a thin layer over adjacent planted areas.
- D. Measurement and Payment:** "Compost Filter Berm" will be measured per linear foot and paid for at the contract unit price.

2154.11 Compost Filter Sock: A compost filter encased in a geotextile tube that serves a similar purpose to compost filter berms, particularly in areas with more concentrated overland runoff.

- A. Materials:** Compost to be used in filter socks shall meet the respective requirements for compost specified in Section 2154.10 for Filter Berms.

Tubes used for compost filter socks shall be produced from a 5 mil thick continuous HDPE or polypropylene filament, woven into a tubular mesh netting material, with openings in the knitted mesh 1/8 in (3 mm) to 3/8 in (10 mm). Tubes shall have a diameter of either 8, 12, or 18 inches, as specified. The 12-inch tubes are for general use, the 8-inch tubes are typically for flat slopes, and the 18 inch tubes are typically for steep slope protection and minor check dams.

Stakes for securing filter socks shall be hardwood with a 2" by 2" nominal dimension. Steel or other non-biodegradable stakes shall not be used.

- B. Construction Requirements:** Compost filter socks shall be constructed on site or delivered to the jobsite. When assembled on site, the sock shall be filled using a pneumatic blower. The sock shall be formed continuously for the length needed, up to 200 feet long. When multiple socks are needed, the end of one sock shall be pulled over the second to create a "sleeved" overlap. Once overlapped, the second section is filled with compost to create a seamless unit. Once placed, the filter sock will settle into an oval shape. Trenching is not required. Existing soil in the vicinity of the filter sock shall remain undisturbed to the extent practical. The sock shall be anchored by driving stakes through the center of the filter sock at 10 foot intervals, at all sleeved overlaps, and at each end. Where an adjustable section of filter sock is necessary (such as to permit dry weather vehicle access), the stakes may be placed on the downhill side of the sock rather than through it. Filter socks may be seeded.
- C. Maintenance:** Compost filter socks shall be inspected to ensure the sock material is intact and to determine if runoff is bypassing or undermining the units. Additional filter socks may be stacked as needed. Breaches in the line shall be repaired promptly. Unless otherwise directed by the final landscape plans or by the Engineer, removal of the compost sock shall be made by spreading the compost in a thin layer over adjacent planted areas. The HDPE or polypropylene sock shall be sliced open longitudinally to release the compost and the sock disposed of.
- D. Measurement and Payment:** "Compost Filter Sock (Named Diameter)" will be measured per linear foot and paid for at the contract unit price for the nominal diameter indicated.

2154.12 Diversion Berms: Earthen berms temporarily graded and compacted to provide a diversion of overland flow. Can be used in conjunction with slope drains at the top of slopes to prevent sheet flow down the slope face.

- A. Materials, Construction and Maintenance:** Refer to the Standard Drawings.
- B. Measurement and Payment:** "Diversion Berms" will be measured per linear foot and paid for at the contract unit price. Such payment shall be full compensation for berm installation, maintenance, removal and any other work noted on the plans.

2154.13 Slope Drain: A flexible tubing or conduit used to convey concentrated water from the top of a slope down to the toe and thereby preventing erosion over the slope face.

- A. **Materials, Construction and Maintenance:** Refer to the Standard Drawings.
- B. **Measurement and Payment:** "Temporary Slope Drain" will be measured per linear foot and paid for at the contract unit price. Such payment shall include installation of outlet protection.

2154.14 Inlet Protection: Any one of a variety of devices or procedures used to allow water to enter an stormwater inlet while filtering or temporarily impeding the flow sufficiently to reduce the quantity of sediment carried.

- A. **Materials:** When used, biodegradable logs, compost filter socks, synthetic sediment barriers, silt fence, or rock ditch checks shall meet the material requirements given by other items of this specification. All other material specifications are as shown in the Standard Details or on the plans. Straw wattles are not allowed for curb inlet protection. Unless otherwise restricted in the plans, the Contractor may also use any applicable inlet protection system allowed by KDOT Specification 902 and 2114 and the Standard Drawings or pre-approved materials list under the category "Temporary Inlet Sediment Barriers (if in Kansas); or any applicable inlet protection system allowed by MoDOT Specification 806 and Standard Plans under the category "Inlet Checks" (if in Missouri).
- B. **Construction Requirements:** Use the inlet protection systems shown on the plan, as appropriate. Provide the given system in accordance with the Standard Drawings. Alternate inlet protection methods may be approved or specified by the Engineer. The appropriate details for a given inlet will change during the progress of the job and adjustments shall be made as inlet construction progresses. Each inlet shall be protected continuously from initial construction until final stabilization. The ultimate test of acceptability is performance in preventing the migration of sediments through the inlet.

When surrounding conditions are such that protection of the inlet would lead to an increased risk of flooding of adjacent structures or produce a hazard to motorists, the barriers shall be adjusted or eliminated to avoid such impacts. In those cases, extra attention shall be paid to minimize the degree of sediment carried in the flow that reaches the inlet.

The general cases of inlet protection and the performance expected from each are as follows:

1. All Inlets at Sump Conditions: Inlets at sump conditions shall remain accessible for flow at all times. Small barriers, depressions and/or filters are used to screen larger sediments and initiate settlement of the water prior to it entering the inlet by creating a ponding zone. Generally, stormwater will enter the inlet via weir flow over the top of the barrier. Such water is generally the least-sediment laden as it is decanted from the top of the ponded area.
2. Street Inlets on Grade: On-grade inlet shall be converted into a localized sump condition by installing a barrier downstream and around the inlet of sufficient height to produce ponding and prevent bypass, while a barrier, depression, and/or filter in front of the inlet induces settlement of solids. Bypassing of water

at the on-grade inlet shall not be allowed and the inlet shall remain open to accept flow without causing excessive flooding.

3. **Selected Inlets Closed to Flow:** In select locations, the plans may designate certain inlets as "closed to flow." In those situations, the objective is to provide sufficient blockage of permanent and temporary openings to prevent entry of stormwater into the inlet. Such locations will be clearly indicated on the plans, and the closed condition for flow may be designated for only a portion of the construction period. The Contractor shall notify the Engineer if they believe that the closure of such inlets would result in an increased risk of flooding or downstream erosion, and such concerns shall be resolved before closing an inlet to flow.

- C. **Maintenance:** Sediment shall be removed from each inlet after every rainfall event that exceeds 1/2" or which results in a visible accumulation of sediment. Particular attention shall be paid to prevent blockage of inlets or cases where resuspension of captured sediment is likely. Specific maintenance issues unique to each inlet protection type shall be addressed as outlined in the Standard Drawings.
- D. **Measurement and Payment:** "Inlet Protection" will be measured per each inlet protected and paid for at the contract unit price. Each inlet will be measured only one time for the duration of the project regardless of the number of phases or protection methods used to protect a single inlet. Unless otherwise specified in the plans or contract documents, inlet protection at all locations will be paid at the same unit price.

2154.15 Construction Entrance: A stabilized layer of large aggregate and other features, located in areas of high traffic and at the construction entrance and exit, intended to remove mud and silt embedded in tires, to prevent tracking sediments off the site.

- A. **Materials, Construction and Maintenance:** See Standard Drawings.
- D. **Measurement and Payment:** "Construction Entrance" will be measured by the square yard and paid for at the contract unit price. All other features required for the entrance shall be subsidiary.

2154.16 Sediment Trap: A temporary reservoir and embankment with a stone outlet that is constructed across a drainage way to intercept sediment-laden runoff and provide retention time sufficient to settle out a majority of solids. Used for smaller watersheds where the engineered outlet works of a sediment basin are not required.

- A. **Materials:** See Standard Drawings.
- B. **Construction Requirements:** See Standard Drawings. The construction of the sediment trap shall be carried out in a manner such that it does not result in sediment problems downstream. The embankment of the sediment trap shall be stabilized with temporary or permanent vegetation immediately after installation.
- C. **Maintenance:** See Standard Drawings.

- D. **Measurement and Payment:** "Sediment Traps" shall be measured per each trap constructed and paid for at the contract unit price. Unless otherwise specified in the plans or contract documents, each trap shall be paid for at the same unit price.

2154.17 Sediment Basin: A temporary reservoir and embankment with engineered outlet works that is constructed across a drainageway to intercept sediment-laden runoff from large areas and provide retention time sufficient to settle out a majority of solids.

- A. **Materials:** See Standard Drawings.
- B. **Construction Requirements:** See Standard Drawings. Where the plans indicate that a temporary sediment basin is to be converted into a permanent basin, pond, or other stormwater facility, the construction, use, and removal or alterations shall be coordinated to result in a final facility that is operational in the time frame specified in the plans and which causes a minimum amount of disruption to the sitework, downstream channel, or future facility and minimizes the amount of rework needed. The construction of the sediment basin shall be carried out in a manner such that it does not result in sediment problems downstream. The embankment and emergency spillway of the sediment basin shall be stabilized with temporary or permanent vegetation immediately after installation of the basin.
- C. **Maintenance:** See Standard Drawings.
- D. **Measurement and Payment:** "Sediment Basin" shall be lump sum, and no measurement for payment of any item will be made. If multiple basins are used on a project, then this item shall be lump sum for all basins collectively, unless the bidding list designates individual locations.

Eighty percent (80%) of the lump sum payment shall be made once the basin is complete, in-place and operational. The final twenty percent (20%) shall be made when the basin is removed. Such payment shall be full compensation for clearing, grubbing, grading, spillway installation, stabilization, maintenance, removal, and any other work noted on the plans, including installation of outlet protection. Routine removal of sediment shall be subsidiary

If the basin indicated on the plans is to be converted at the end of construction into a permanent pond, basin, or other stormwater facility, then this item shall include payment only for the incremental costs associated with its use as a temporary basin. Permanent embankments, excavations, spillways, or other appurtenances that are constructed will be handled by the other appropriate items of the Contract for the permanent facility.

2154.18 Temporary Stream Crossings: A temporary culvert constructed in a creek, river, or stream to allow construction access and crossing.

- A. **Materials:** See Standard Drawings.
- B. **Construction Requirements:** See Standard Drawings. Culvert sizing, number, and orientation shall be as dictated in the plans. Care shall be taken to ensure that the stream crossing does not cause inadvertent flooding of adjacent homes, buildings, or other structures. Concerns about adequacy of culvert sizing shall be brought to the

immediate attention of the Engineer and no installation made until such concerns are resolved.

C. Maintenance: See Standard Drawings.

D. Measurement and Payment: "Temporary Stream Crossing" shall be lump sum and such payment shall be full compensation for installation, maintenance, removal and any other work noted on the plans. If multiple crossings are used on a project, then this item shall be lump sum for all crossings collectively, unless the bidding list designates locations individually.

Eighty percent (80%) of the lump sum payment shall be made once the crossing is complete, in-place and operational. The final twenty percent (20%) shall be made when the crossing is removed.

2154.19 Diversion Channels: A temporary channel excavated and stabilized to divert flow from a stream around a culvert or other in-stream structure being constructed, so as to avoid excessive erosion in the construction zone.

A. Materials: See Standard Drawings.

B. Construction Requirements: See Standard Drawings. Diversions of streams shall only be allowed if covered by the plans and approved permits for the project. Such construction, stabilization, and restoration will conform the plans and Standard Drawings. Concerns about adequacy of culvert sizing shall be brought to the immediate attention of the Engineer and no installation made until such concerns are resolved.

C. Maintenance: See Standard Drawings.

D. Measurement and Payment: "Diversion Channels" shall be lump sum and such payment shall be full compensation for installation, maintenance, removal and any other work noted on the plans. If multiple crossings are used on a project, then this item shall be lump sum for all diversions collectively, unless the bidding list designates locations individually.

Eighty percent (80%) of the lump sum payment shall be made once the diversion is complete, in-place and operational. The final twenty percent (20%) shall be made when the crossing is removed.

2154.20 Turbidity Curtains: Floating barriers of synthetic fabric curtain suspended in the water and held in a vertical position, used in lakes and perennial rivers to slow, contain or direct the flow from disturbed areas allowing solids to settle out before spreading into the surrounding water.

A. Materials: All components shall conform to the requirements given for the specific turbidity curtain system specified in the plans.

B. Construction Requirements: Shall conform to the manufacturer's recommendations for the curtain system specified in the plans, plus such additional requirements as may be listed in the plans. A manufacturer's representative shall be onsite during installation of the system.

- C. Maintenance:** Anchor lines shall be kept secure and properly positioned. Fabric, cable, and other appurtenances shall be repaired immediately as needed and in accordance with manufacturer's instructions.
- D. Measurement and Payment:** "Turbidity Curtain" will be measured by the linear foot and paid for at the contract unit price.

2154.21 Dewatering Filter: A device for filtering sediments from water that is discharged during pumping or dewatering activities.

- A. Materials:** Dewatering filters shall be constructed of materials as shown on the Standard Plans. Proprietary devices that provide equal or better performance than filters in the Standard Plans may be approved by the Engineer.
- B. Construction Requirements:** Dewatering filters shall be used whenever sediment-laden effluent is discharged from pumps used during construction for dewatering or other activities. For proprietary devices, the manufacturer's recommendations shall be followed.
- C. Maintenance:** Filters shall be cleaned or replaced as necessary to maintain filtration capacity.
- D. Measurement and Payment:** No measurement or payment will be made for "Dewatering Filters," but the use of such devices shall be subsidiary to the dewatering activity or other items of the contract. Removal of sediments from dewatering devices shall also be subsidiary.

2154.22 Method of Measurement: Sediment controls and diversions will be measured in the manner specified in each applicable subsection.

2154.23 Basis of Payment: Sediment controls and diversions will be paid for as specified in each applicable subsection.

SECTION 2155 SCHEDULING AND STANDARD SEQUENCES

It is intended that future editions of this specification will contain guidelines and requirements for scheduling and standard sequences of work in order to minimize the duration of exposure and potential for sediment discharge. This section has been reserved for that purpose.

SECTION 2156 MEASUREMENTS AND PAYMENTS

2156.1 Summary: This section includes the method of measurement and the basis of payment, for furnishing all labor, equipment, tools and materials and for the performance of all related work necessary to complete any work covered in Section 2150. Unless otherwise indicated, the maintenance, repair, removal and disposal of all temporary measures shall be subsidiary to the initial installation.

2156.2 General: Unless specifically altered by the Contract Special Provisions, the methods of measurement and payment shall be as specified in each section herein, and as listed in the Proposal.

2156.3 Measurement: The Engineer or his representative will measure the work for payment. The method of measurement and computations used in determination of quantities of work performed will be those methods generally recognized as conforming to good engineering practice.

2156.4 Items not listed in the Proposal: There shall be no measurement or separate payment for any item of work not specifically identified and listed in the Proposal and all costs pertaining thereto shall be included in the contract unit prices for other items which are listed in the Proposal.

2156.5 Measurement and Payment Summary Table

Item Description	Ref. Section	Method of Measurement	Basis of Payment
General Requirements	2151	No measurement	Subsidiary to other items
Chemical and Waste Controls	2152	No measurement	Subsidiary to other items
Permanent Seeding or Sodding	2153.4	See Section 2400	See Section 2400
Out of Season Watering	2153.4	1,000 gallon unit	Unit Bid Price
Temporary Seeding	2153.5	0.01 acre	Unit Bid Price
Mulch Cover	2153.6	0.01 acre	Unit Bid Price
Hydrocover (Standard)	2153.7	1.0 lbs dry-weight of fiber	Unit Bid Price
Hydrocover (Named Specialty Mix)	2153.8	1.0 lbs dry-weight of fiber	Unit Bid Price
Erosion Control Blanket (Named Type)	2153.9	1.0 sq. yd.	Unit Bid Price
Compost Cover	2153.10	1.0 cu. yd.	Unit Bid Price
Surface Roughening	2153.11	No measurement	Subsidiary to earthwork items
Dust Control	2153.12	No measurement	Subsidiary to other items
Sediment Removal	2154.4	No measurement	Subsidiary to other items
Silt Fence	2154.5	1.0 lin. ft.	Unit Bid Price
Rock Barrier (Named Size)	2154.7	0.1 ton	Unit Bid Price
Open-Flow Ditch Check (Type)	2154.8	1.0 lin. ft.	Unit Bid Price
Biodegradable Logs (Size and Class)	2154.9	1.0 lin. ft.	Unit Bid Price
Compost Filter Berm	2154.10	1.0 lin. ft.	Unit Bid Price
Compost Filter Sock (Named Diameter)	2154.11	1.0 lin. ft.	Unit Bid Price
Diversion Berm	2154.12	1.0 lin. ft.	Unit Bid Price
Slope Drain	2154.13	1.0 lin. ft.	Unit Bid Price

Measurement and Payment Summary Table (continued)

Item Description	Ref. Section	Method of Measurement	Basis of Payment
Inlet Protection	2154.14	Each inlet	Unit Bid Price
Construction Entrance	2154.15	1.0 sq. yd.	Unit Bid Price
Sediment Trap	2154.16	Each trap	Unit Bid Price
Sediment Basin	2154.17	No measurement	Lump Sum
Temporary Stream Crossing	2154.18	No measurement	Lump Sum
Diversion Channels	2154.19	No measurement	Lump Sum
Turbidity Curtain	2154.20	1.0 lin. ft.	Unit Bid Price
Dewatering Filter	2154.21	No measurement	Subsidiary to other items

SECTION 2200 - PAVING

CITY OF LEE'S SUMMIT, MISSOURI STANDARD SPECIFICATIONS

The City of Lee's Summit hereby adopts Section 2200 of the Kansas City Metropolitan Chapter of APWA Construction and Material Specifications, current edition. The following additions, deletions and/or revisions are adopted as a part of Section 2200 for use within Lee's Summit. Text in bold italics indicates revisions or additions to the APWA standard.

2201 SUBGRADE PREPARATION:

2201.4.E Roll Testing of compacted Subgrade: ADD the following paragraph:

Roll testing shall be conducted on the finished layer of improved subgrade. Chemical stabilized subgrade shall be roll tested in accordance with Section 2202.7.1 or 7.2, whichever is applicable. Subgrade mechanically stabilized with geogrid or woven geotextile overlaid by aggregate base shall be roll tested on the finished aggregate base layer instead of the unimproved subgrade soils. Areas failing roll testing will be reworked and retested.

The City will have the final authority in approving or failing roll testing. The Contractor/Developer shall retain a qualified testing lab as described in Section 1000, Appendix B at no cost to the City.

2201.4 Subgrade Construction: ADD the following

F. Quality Control Testing:

TEST	FREQUENCY
<i>Density/Moisture Curve</i>	<i>1 per material Type</i>
<i>Gradation</i>	<i>1 per material Type</i>
<i>Plasticity Index</i>	<i>1 per material Type</i>
<i>In-Place Moisture Density</i>	<i>1 per 500 square yards of subgrade Minimum, 4 per day</i>
<i>Roll testing</i>	<i>Per Section 2201.4.E above</i>

2202.1 Scope: ADD the following:

Subgrade stabilization material shall be one of the following, as indicated on the plans.

A. Chemical Stabilization with either Fly ash, Portland Cement, hydrated lime, quicklime or Lime Kiln Dust (LKD).

B. Mechanical Stabilization will use Biaxial Geogrid, Triangular Geogrid, or Woven Polypropylene Geotextiles for roadway construction that are listed in the current Lee's

Summit Public Works Approved Products List.

2202.5 Thickness MODIFY as follows:

Minimum thickness for compacted soil mixture shall be 9 inches.

2202.7 Subgrade Stabilization: ADD the following

F. Quality Control Testing:

<i>TEST</i>	<i>FREQUENCY</i>
<i>Density/Moisture Curve</i>	<i>1 per material Type</i>
<i>Gradation</i>	<i>1 per material Type</i>
<i>Plasticity Index</i>	<i>1 per material Type</i>
<i>In-Place Moisture Density</i>	<i>1 per 750 square yards of subgrade Minimum, 4 per day</i>
<i>Roll testing</i>	<i>Per Section 2201.4.E above</i>

2203 UNTREATED COMPACTED AGGREGATE

2203.3.A. Materials: ADD the following sentence at the end.

MoDOT Type 5 aggregate may be used for untreated aggregate layer in lieu of the material specified in this paragraph.

2203.4.A.7. Untreated Compacted Aggregate Construction: ADD the following

7. Quality Control Testing:

<i>TEST</i>	<i>FREQUENCY</i>
<i>Density/Moisture Curve</i>	<i>1 per material Type</i>
<i>Gradation</i>	<i>1 per material Type</i>
<i>Plasticity Index</i>	<i>1 per material Type</i>
<i>In-Place Moisture Density</i>	<i>1 per 750 square yards of agg. base Minimum, 4 per day</i>
<i>Roll testing</i>	<i>Per Section 2201.4.E above</i>

Testing shall be performed by a qualified testing lab hired by the Contractor.

Any work by Contractor prior to test submittals and subsequent City's review and approval shall be work done at the Contractor's risk.

Test reports shall be submitted to the City daily. The reports shall clearly indicate the location of all tests by street name, station and/or lot number, type of subgrade material, and subgrade elevation of test. The reports shall include the results of all tests (pass or fail) and all re-tests.

2203 DRAINABLE BASE COURSE:

2203.4.C Plant Mix Bituminous Drainable Base Course: ADD the following:

6. *and handle, place and compact materials in accordance with the following.*
- a. *Contamination of the finished base material that affects the drainage capability of the product shall not be permitted. Any areas determined to be contaminated shall be completely removed without disturbing the adjacent or underlying material and replaced at contractor's expense.*
 - b. *Rutting or other displacement of the permeable base or the underlying base will not be permitted. If displacement occurs, the material shall be completely removed without disturbing the adjacent or underlying material and shall be replaced at the contractor's expense.*
 - c. *A minimum of three passes of a 5 to 10 ton steel wheel roller shall be made, compacting the material until no further displacement is noted. Compaction shall begin as soon after spreading the mixture as the mixture is able to bear the weight of the roller without undue displacement and shall be completed before the temperature of the mixture drops below 100 F. The compacted thickness of a single lift shall be a maximum of 4 inches.*

2205 ASPHALTIC CONCRETE SURFACE AND BASE

2205.3 Materials: ADD the following.

2205.3.A

<i>Asphalt location</i>	<i>Mix Type</i>	<i>Recycled Mix Allowed?</i>	<i>Upper PG Limit</i>	<i>Lower PG limit</i>
<i>Industrial/Arterial surface</i>	<i>5 or 6</i>	<i>no</i>	<i>70 or greater</i>	<i>-22 or less</i>
<i>Base courses greater than 2 inches below the surface on industrial and arterial streets</i>	<i>5</i>	<i>yes</i>	<i>64 or greater</i>	<i>-22 or less</i>
<i>Local and Collector surface</i>	<i>5 or 6</i>	<i>no</i>	<i>64 or greater</i>	<i>-22 or less</i>
<i>Base courses greater than 2 inches below the surface on local and collector streets</i>	<i>5</i>	<i>yes</i>	<i>64 or greater</i>	<i>-22 or less</i>

2205.9.E Density and Surface Requirements: DELETE the last sentence: “Tests shall be performed at intervals as directed by the Engineer” and

REPLACE with “*Test shall be performed as required by the DCM Section 1000 – Appendix A,*”
2201.4 Subgrade Construction: ADD the following

2206 ASPHALT CRACK SEALING, ASPHALT CRACK FILLING, CHIP SEALING, SLURRY SEALING, AND MICROSURFACING

2206.3 Crack Sealing/Filling: Delete paragraph A and replace with the following:

A. ***Crack Sealant and Filler Material: Material shall comply with ASTM D6690 Type II as shown below.***

<u>TEST</u>	<u>METHOD</u>	<u>SPECIFICATION</u>
<i>Cone Penetration at 25°C (77°F)</i>	<i>ASTM D5329</i>	<i>90 max</i>
<i>Softening Point</i>	<i>ASTM D36</i>	<i>80°C (176°F) minimum</i>
<i>Bond at -29°C (-20°F), 50% extension</i>	<i>ASTM D5329</i>	<i>Pass 3 cycles</i>
<i>Resilience</i>	<i>ASTM D5329</i>	<i>60% minimum</i>
<i>Asphalt Compatibility</i>	<i>ASTM D5329</i>	<i>Pass</i>

Additionally, material shall meet the following standards:

<u>TEST</u>	<u>METHOD</u>	<u>SPECIFICATION</u>
<i>Application Temperature Range</i>	<i>ASTMD5167</i>	<i>193 – 204°C (380 – 400°F)</i>
<i>Maximum Heating Temperature</i>	<i>ASTM D6690</i>	<i>204°C (400°F)</i>

2208 PORTLAND CEMENT CONCRETE PAVEMENT

2208.6 Repairing Defects: DELETE section 2208.10 in its entirety and replace with the following:
Any damaged concrete panel, or panels, with random cracking shall be removed and replaced at the Contractor’s expense. The minimum replacement area shall be one full panel. Any alternate repair methods shall be approved by the Owner.

2208.3.A Materials-Concrete: DELETE Paragraphs 1-4, and REPLACE with the following.

All concrete materials for paving curb and gutter, sidewalks, paths, commercial driveways and other pavements in the right of way shall conform to the KCMMB specifications. Note that KCMMB, although recommended, is not required for residential driveways.

2208.3.B Materials-Reinforcement: DELETE Paragraphs 1 and REPLACE with the following.

Bars: All bars shall be Epoxy coated and shall conform to ASTM A775.

2209 CURBING

2209.4.D Construction Details: Revise paragraph D to read as follows:

D. Curb Machine: *A slip-form curb machine shall be used to place any section of curb greater than 100 feet in length.* The machine must be equipped with mechanical internal vibrators and capable of placing curb to the correct cross section, line and grade within the allowable tolerances.

2209.4.E.2 Contraction Joints: Delete the first sentence of paragraph 2. and replace with the following:

Curbing for asphalt pavements shall have contraction joints at intervals of not more than 10 feet. They shall extend through the entire curb section from the top of the curb to a depth 2 inches below pavement surface

Curbing for concrete pavements shall have contraction joints aligned with transverse pavement joints, but no greater than 15-foot intervals.

2209.4.E.3 ADD the following

3. Longitudinal joints: Generally, longitudinal joint spacing should have the same spacing as the transverse joint spacing. The ratio between transverse and longitudinal joint spacing should not exceed 1.25. If monolithic curb is used, the width of the curb and gutter is included in the panel width along longitudinal joints. Maximum longitudinal spacing is shown in Table below:

<i><u>Thickness of PCC</u></i>	<i><u>Max. Longitudinal joint spacing</u></i>
<i><u>6 inch</u></i>	<i><u>12 feet</u></i>

<u>7 inch</u>	<u>14 feet</u>
<u>8 inch</u>	<u>14 feet</u>
<u>9 inch</u>	<u>15 feet</u>

2211 SMOOTHNESS

2211.4 Construction: *DELETE and replace with the following*

A. Arterials and Collectors:

1. *Pavement smoothness on major arterial and minor arterial streets will be measured at the Contractor's expense by a 25-foot California profilograph using a 0.2 inch blanking band. Run one trace three feet from the longitudinal joint between the lanes, and another three feet from the shoulder or curb edge of the lane (five feet from the back of curb). The profilograph and testing shall be performed by a trained and certified operator. A copy of the operator's profilograph certification shall be submitted to the City prior to testing. The Contractor shall provide the Engineer with the profilogram and its evaluation within two days after paving has been completed.*
2. *All pavements will be corrected at the Contractor's expense to less than 15 inches per mile. Pavement sections with a horizontal curve radius of less than 300 feet and/or vertical curves or transition areas with K values less than 30 will be excluded from the profilograph specification. Bumps greater than 0.25 inches in 25 feet shall be corrected to a bump height of less than 0.25 inches.*
3. *For asphalt pavements, the profiligraph shall be run on the top of the base course. Grinding and corrections shall be made on the base course before placing the final surface course.*

B. Local and Access Roads:

1. *Finished pavements on local roads, access roads and other areas exempted from profilographing shall be checked with a 10 foot straightedge placed parallel to the center line at any location within a driving lane. Areas showing high spots of more than 1/4 of an inch in 10 feet shall be marked and ground down with approved grinding equipment to an elevation where the area or spot will not show surface deviations in excess of 1/8 inch when tested with a 10 foot straight edge.*

2. *For asphalt pavements, the straight-edge smoothness shall be measured on the top of the base course. Grinding and corrections shall be made on the base course before placing the final surface course.*

C. Corrections.

1. *Smoothness corrections shall be made by diamond grinding. Grinding will be performed on the full width of the lane failing to meet the smoothness criteria. The cost of correcting the smoothness and associated traffic control shall be at Contractor's expense.*

D. Final Report:

The Contractor shall submit a final report to the Engineer with final profilograph results or straightedge measurements verifying compliance with the specified pavement smoothness requirements.

E. Measurement and Payment:

There is no measurement or payment for smoothness. These items shall be subsidiary to other pay items. There are no pay adjustments (incentive or disincentive) shall be made to the smoothness or pavement items based on the results of the profilograph testing.

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SECTION 2200 - PAVING

APPENDIX for CHEMICAL STABILIZATION OF SOIL

Using CEMENT or LIME KILN DUST

1.01 DESCRIPTION

- 1.01.1 This work shall consist of the addition of Portland Cement or Lime Kiln Dust, mixing the material, compacting to the required density, and weatherproofing to develop a stabilized subgrade section. This item applies to natural ground or fills and shall be constructed as specified herein and in conformity with the typical sections, lines and grades as shown on the plans or as established by the Engineer.

1.02 MATERIALS

- 1.02.1 **Cement:** Portland Cement, or Blended Hydraulic Cement, shall comply with the physical requirements of ASTM C-150, ASTM C-595, or ASTM C-1157
- 1.02.2 **By-Product Lime (non-hydrated) / Lime Kiln Dust (LKD):** LKD shall meet the following Criteria

Property		
Total Calcium and Magnesium Oxides		60% minimum
Available calcium hydroxide (rapid sugar test, ASTM C 25) plus total MgO content calculated to be equivalent Ca (OH) ₂		30% minimum
Free moisture (as-received basis)		4% Max.
As-received loss on ignition (carbon dioxide plus moisture, combined and free)		40% Max.
Sieve Size		Max. % Retained
#4 (4.75 mm)		5
#30 (600 µm)		10
#100 (150 µm)		25

1.03 WATER

- 1.03.1 The water use in the stabilized mixture shall be clean, clear, and free of sewage, vegetable matter, oil, acid and alkali. Water known to be potable may be used without testing. All other sources shall be tested in accordance with ASSHTO T26 and approved by the Engineer.
- 1.03.2 **SOIL.** The soil for this work shall consist of materials on the site or selected materials from other sources and shall be uniform in quality and gradation, and shall be approved

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by the Engineer. The soil shall be free of roots, sod, weeds, and stones larger than 2-1/2 inches. Asphaltic concrete or aggregate may be added to the soil during the mixing operation, provided the material can be pulverized and incorporated by the mixing equipment to meet such that 100% of the mixture passes a 1-inch sieve (No. 25) and at least 60% passes a No. 4 Sieve (4.75mm).

1.04 COMPOSITION

1.04.1 **Cement:** Application rate shall be based on percent of material added as a percentage of the dry unit weight of soil. The application rate shall be determined by a geotechnical engineer. The application rate shall be submitted to the City in the form of a written report prepared by a firm specializing in geotechnical engineering and sealed by a geotechnical engineer. The report shall be submitted at least 30 days prior to any subgrade stabilization work on site.

1.04.2 **By-Product Lime (non-hydrated) / Lime Kiln Dust (LKD):** Application rate shall be based on percent of material added as a percentage of the dry unit weight of soil. The application rate shall be determined by a geotechnical engineer. The application rate shall be submitted to the City in the form of a written report prepared by a firm specializing in geotechnical engineering and sealed by a geotechnical engineer. The report shall be submitted at least 30 days prior to any subgrade stabilization work on site.

1.04.2 **TOLERANCES.** At final compaction, the chemical and water content for each course of subgrade treatment shall conform to the following tolerances:

<u>Material</u>	<u>Tolerance</u>
Cement/LKD	At or above target application
Water	+2% to +4% over Optimum Moisture Content

If material application rate of cement or LKD exceeds the target application rate by 0.5% or more, then the Contractor shall provide new soil moisture-density tests to evaluate relative compaction and moisture content at the actual application rate in the field.

1.04.3 **THICKNESS.** The thickness of the completed, compacted chemical/soil mixture shall be no less than 9 inches, and meet or exceed the depths called out in the plans or specifications. If when checked for minimum thickness it is found to be less than the 1/2 inch tolerance the contractor shall correct the area represented by the checked location.

1.05 EQUIPMENT

1.05.1 **EQUIPMENT.** The machinery, tools, and equipment necessary for proper execution of the work shall be on the project and approved by the Engineer prior to beginning construction operations.

Blending of the soil-cement mixture shall be accomplished by self-propelled, high power

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rotary mixer capable of mixing to a depth of 16 inches. The cutting drum should be fitted with cutting teeth capable of trimming earth, aggregate, and bituminous mixtures. Mixing equipment shall be designed to accurately adjust vertical depth, hold vertical depth, and not develop center deflection of more than 1/8-inch across the width of the mixing drum.

Compaction shall be achieved using padfoot roller. Smoothing and shaping shall be accomplished using a motor grader. Finish rolling shall be done using a smooth steel wheel roller.

Spreaders and distributors shall be used to apply chemical shall be able to demonstrate consistent and accurate application rates, as well as dust control during application. Spreaders and distributors shall be equipped with screw-type augers that can evenly spread material over the width of the rotary mixing drum. Augers may typically feed into a rotary spreader, all spreading equipment shall be equipped with metering devices. Additional dust collection systems may be required at the direction of the Engineer.

All machinery, tools and equipment use shall be maintained in a satisfactory and workmanlike manner.

Cement and LKD shall be stored and handled in closed weatherproof containers until immediately before distribution. Materials exposed to moisture prior to mixing with soils shall be discarded.

1.06 CONSTRUCTION REQUIREMENTS

1.06.1 **GENERAL.** It is the primary purpose of this specification to secure a completed section of treated material which contains a uniform chemical/soil mixture with no loose or segregated areas; has a uniform density and moisture content: is well bound for its full depth. It shall be the responsibility of the Contractor to regulate the sequence of his/her work; to process a sufficient quantity of material to provide a completed section as shown on plans; to use the proper amounts of chemical; to achieve final compaction within the specified time; to maintain the work; and to rework the lifts as necessary to meet the above requirements.

1.06.2 **WEATHER LIMATATION.** The modified soil shall be constructed when the temperature of the soil, measured 6 inches below the surface, is above 50°F and the ambient air temperature is above 40°F. The compacted soil mixture shall be protected from freezing during the curing period.

The quantity of modified soil constructed shall be limited to that which can be covered by full thickness of PCC or AC pavement during the same construction season.

1.06.3 **PREPARATION OF SUBGRADE.** Before other construction operations are begun, the area where the chemical stabilization material will be placed shall be cut and shaped

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in conformance with the lines and grades shown on the plans. Grades shall accommodate potential volumetric expansion of stabilized material.

All areas shall be firm and able to support, without displacement, the construction equipment and the compaction hereinafter specified. Soft or yielding subgrade shall be corrected and made stable by scarifying, adding addition chemical, and compacting until it is of uniform stability.

- 1.06.4 **MOISTURE CONTROL.** Moisture control shall be achieved through use of a rotary mixer equipped with a spray bar in the mixing drum capable of applying sufficient quantities of water to achieve the required moisture content for the soil-chemical mixture. The system shall be capable of being regulated to the degree necessary as to maintain moisture contents within the recommended range.

Required moisture contents will be established by the Engineer based on laboratory tests with the site soils and chemical application rates to be used for the treatment. Final moisture content of the mix, immediately prior to compaction shall meet the specified range of moisture contents. If moisture content exceeds the specified limits, additional chemical may be incorporated to lower moisture contents to the required limits. Lowering moisture contents by aeration following addition of chemicals will not be allowed.

- 1.06.5 **APPLICATION OF PORTLAND CEMENT or LKD.** Immediately prior to application of Portland Cement or LKD, the areas shall be bladed to allow uniform distribution of material. The chemical shall be spread only on that area where the complete placement operation can be completed within 2 hours.

The chemical shall be spread uniformly over the top of the subgrade by an approved spreader truck. Dumping material on site and spreading with a blade shall not be allowed.

Material shall not be applied when wind conditions, in the opinion of the Engineer, are detrimental to a proper application or becomes objectionable to adjacent property owners or creates a hazard to traffic.

- 1.06.6 **MIXING.** The mixing procedure utilized shall be Dry Placing as hereinafter described.

The full depth of the treated subgrade shall be mixed with a rotary mixer to the full depth of stabilization as shown on the plans and specifications. Time from Portland Cement or LKD placement on the soil to the start of mixing shall not exceed 30 minutes.

In some cases, in situ moisture content is sufficient to meet specifications. If additional water is needed during mixing, water shall be injected directly into the mixing drum. The system shall be capable of being regulated to the degree as to maintain moisture contents within the recommended range.

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Mixing will continue until the material is uniformly mixed, moisture conditioned and form a homogeneous layer with particle sizes meeting the following requirements:

<u>Sieve Size</u>	<u>Minimum Percent Passing</u>
1" inch (25 mm)	100
No. 4 (4.75 mm)	60%

All chemicals and soils may require different mixing patterns, may require multiple passes, or may require different techniques to achieve optimal results.

- 1.06.7 **COMPACTION.** Compaction of the soil-chemical mixture shall begin immediately after mixing of the cement or LKD. Initial compaction shall be achieved using vibratory pad foot roller capable of compacting the entire depth of the mixture. Following the pad foot roller, the motor grader shall shape the area to consistent grade and cross slope in accordance with the project plans. Following the motor grader, a vibratory smooth drum roller compacts and seals the surface of the treated subgrade. Compaction shall be completed within one hour following incorporation of chemical.

A test for both density and moisture content of the soil-chemical mixture shall be taken for each 750 square yards of material placed. Stabilized soil shall be compacted to at least 95% of the soils maximum laboratory density (ASTM D698).

All irregularities, depressions, or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding or removing material as required and remixing and re-compacting with additional cement or LKD if beyond the 2 hour limit. The surface of the course shall be maintained in a smooth condition, free from undulations and ruts, until other work is placed thereon or the work is accepted.

In addition to the requirements specified for density and moisture, the full depth of the material shown on the plans shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section is completed, tests will be made by the testing lab. If the material fails to meet the density requirements, it shall be reworked to meet these requirements. Throughout this entire operation, the shape of the course shall be maintained by blading, and the surface upon completion shall be smooth and shall conform with the typical section shown on the plans and to established lines and grades. Should the material, due to any reason or cause, lose the required stability, density and finish before the work is accepted, it shall be reprocessed, re-compacted and refinished at the sole expense of the Contractor. Reprocessing shall follow the same pattern as the initial stabilization including the addition of cement or LKD.

- 1.06.8 **FINISHING AND CURING.** After the final layer or course of the chemically treated subgrade has been compacted and cured, it shall be brought to the required lines and grades in accordance with the typical sections. The finished surface shall not vary more than 3/8 inch when tested with a 16-foot straightedge applied parallel with and at right angles to the pavement centerline. Any variations in excess of this tolerance shall be

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corrected by the Contractor, at his/her own expense, in a manner satisfactory to the Engineer.

After the chemically treated course has been finished as specified herein, the surface shall be protected against rapid drying by either of the following methods for a period of not less than three days or until the pavement section is placed.

- 1) Maintain in a thorough and continuously moist condition by sprinkling.
- 2) Spray a quick setting, trackless tack coat over the entire surface.
- 3) Placement of the aggregate base layer

1.07 MAINTENANCE.

- 1.07.1 The contractor shall maintain, at his/her own expense, the entire treated subgrade in good condition from the start of work until all the work has been completed, cured, and the pavement is placed. Heavy equipment shall not be allowed on the treated subgrade until capable of supporting the loads.

1.08 TESTING & OBSERVATION.

- 1.08.1 Tests shall be performed by an independent, accredited testing lab meeting A2LA, AMRL, AASHTO, AWWA, CCRL, or meeting other governing accreditation agencies recognized by the MoDOT, MDNR, or USACE. The testing lab shall also provide testing of the constructed stabilization and provide a certification to the city stating that all stabilization meets or exceeds the requirements of the project. The certification report shall include testing reports that include the moisture/density curves for the mixture, in place moisture and density test results, results of re-tests, field notes assuring the correct quantity of cement or LKD was incorporated, that mixing and compaction were completed specified the time limits in this specification, temperature and weather requirements were met, the stabilized lay was not subject to freezing during the curing process, and that the minimum thickness was placed.

END OF SECTION

**DIVISION II
CONSTRUCTION AND MATERIAL SPECIFICATIONS
SECTION 2200 PAVING**

APPROVED AND ADOPTED THIS 15th DAY OF FEBRUARY, 2017

**KANSAS CITY METROPOLITAN CHAPTER
OF THE AMERICAN PUBLIC WORKS ASSOCIATION**

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SECTION 2201 SUBGRADE PREPARATION

2201.1 Scope

This section governs the furnishing of all labor, materials and equipment for the preparation of subgrade as shown on the Plans and in accordance with the Standard Drawings, the specifications and the Special Provisions. This section includes subgrade preparation at locations which have been previously graded in accordance with the requirements of Section 2100 "Grading and Site Preparation".

2201.2 Referenced Standards

The following standards are referenced directly in this section. The latest version of these standards shall be used. If conflicting standards are referenced, the more stringent standard shall apply.

ASTM

D 698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))

2201.3 Definitions

- A. Subgrade: Subgrade is defined as a well graded and compacted layer on which base and subsequent courses are placed.
- B. Subgrade Preparation: Subgrade preparation is the repeated operation of fine-grading and compacting the subgrade until the specified lines, grades, and cross-section, as indicated on the Plans are obtained and the materials are compacted to the specified depth and density.

2201.4 Construction

- A. General: The subgrade surface shall be brought to the specified lines, grades and cross-section by adding or removing material and compacting to the specified density. Tolerance allowed on all lines, grades and cross-sections shall be no more than 1/4 inch.
- B. Compacting the Subgrade: Unless otherwise specified, the top 6 inches of subgrade for pavements shall be compacted to 95% of the standard proctor maximum density for the material used as determined by ASTM D 698 and within a tolerance of plus 3% and minus 3% of the optimum moisture content. The tolerance applies only to the top 6 inches.
- C. Protection and Maintenance of Subgrade: The subgrade shall be protected from action of the elements or others. Any action (e.g. settlement or erosion) that damages the subgrade or any subgrade that has become unacceptable prior to placing the pavement thereon, shall be repaired and the specific lines, grades, cross-section, tolerance, density, and moisture content range reestablished.
- D. Cleanup: Subgrade cleanup shall follow the work progressively. The Contractor shall remove from the project site all rubbish, surplus or discarded material, unsuitable material, and any equipment, tools and temporary construction items used for the preparation of the subgrade.
- E. Roll Testing: Once the subgrade has been brought to the final plan elevation, but prior to approval of the

subgrade for paving, all lanes shall be roll tested in their entire length. The subgrade will not be acceptable if rutting, pumping, or deformation of the subgrade results from the roll test. This testing will be done by the contractor, and will be in addition to the applicable moisture and density testing.

Equipment for roll testing shall be a tandem dump truck (one front and two rear axles) carrying a minimum load of twenty (20) tons.

The truck shall proceed slowly along each traffic lane, allowing the Engineer to walk alongside and observe the results. Areas failing the roll test will be reworked and retested prior to approval of the subgrade for paving.

2201.5 Method of Measurement

Subgrade Preparation will generally not be listed in the Contract Documents as a separate item.

2201.6 Basis of Payment

Subgrade Preparation will generally be included in payment for other items in the Contract Documents.

SECTION 2202 SUBGRADE STABILIZATION

2202.1 Scope

This section governs the furnishing of all labor, materials and equipment for the stabilization of subgrade as shown on the Plans and in accordance with the Standard Drawings, the specifications and the Special Provisions. This work shall consist of the addition of self-cementing fly ash or lime to soil, mixing and compacting the material to the required density to develop a stabilized subgrade section. This applies to natural ground or fills and shall be constructed as specified herein and in conformity with the typical sections, lines and grades as shown on the Plans or as established by the Engineer.

2202.2 Referenced Standards

The following standards are referenced directly in this section. The latest version of these standards shall be used. If conflicting standards are referenced, the more stringent standard shall apply.

ASTM

- C 25 Standard Test Methods for Chemical Analysis of Limestone, Quicklime, and Hydrated Lime
- C 618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- D 698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
- D 1556 Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method
- D 5239 Standard Practice for Characterizing Fly Ash for Use in Soil Stabilization
- D 6938 Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

AASHTO

- T 99 Standard Method of Test for Moisture-Density Relations of Soils Using a 5.5 lb. Rammer and a 12 inch Drop
- M 216 Standard Specification for Lime for Soil Stabilization

2202.3 Materials

- A. Fly Ash: Fly Ash shall comply with the physical requirements of ASTM D 5239, paragraph 6.4 maintaining a minimum compressive strength of 500 psi at 7 days and the chemical requirements of ASTM C 618, Table 1 for Class C fly ash, unless otherwise shown on the Plans. The source of the ash shall be selected by the Contractor and approved by the Engineer in advance of stabilization operations in order that the required laboratory tests can be completed prior to construction without delaying the work. Certification shall be provided by the supplier that the fly ash used on the project meets the above criteria. Fly ash shall be stored and handled in closed weatherproof containers until distribution. Fly ash exposed to moisture prior to mixing with soils shall be discarded.
- B. Lime: Lime shall be hydrated or quicklime conforming to the requirements of AASHTO M 216. Contractor shall provide certification that the product complies. Hydrated lime shall contain not less than ninety (90) percent calcium hydroxide Ca(OH)_2 , and quicklime shall have a minimum available lime percentage (CaO) of 90%, as determined by ASTM C 25. Lime shall be introduced to the subgrade in a slurry form. When quicklime is used, slake it at the jobsite to manufacture hydrated lime slurry. The Contractor shall submit calculations to the Engineer that determines the amount of water needed to make a slurry with a percent solids between 20 and 40 percent. The Contractor will then determine the concentration strength of the lime slurry and the rate of application to obtain the lime percentage specified in the Contract Documents.
- C. Water: Water used for mixing shall be clean and potable. For lime stabilization, it shall be added during mixing, remixing and compaction operations, and during the curing period to keep the cured material moist until covered. If water is not included in the Contract Documents as a pay item, it is subsidiary to other Contract items.
- D. Soil: The subgrade soil to be stabilized shall be uniform in quality and gradation and free from rubble, rubbish, vegetation, and stones larger than 1" diameter.

2202.4 Composition

Fly ash shall be applied at a rate determined by laboratory testing using the materials from the site and the specific fly ash to be supplied unless otherwise designated by the Contract Documents. Testing shall be the responsibility of the Contractor and is subsidiary to other items. The minimum application rate shall be 15% unless testing indicates otherwise.

Lime shall be applied at a rate determined by laboratory testing using the materials from the site and the specific lime to be supplied unless otherwise designated by the Contract Documents. Testing shall be the responsibility of the Contractor and is subsidiary to other items. The minimum application rate shall be 5% (by weight) unless testing indicates otherwise.

2202.5 Thickness

The thickness of the completed, compacted soil mixture shall be 6 inches or as called out in the Plans or Special Provisions. The thickness shall not be less than the specified minimum. Check thickness and when found to be ½ inch or more out of tolerance, the contractor shall correct the area represented by the checked location at no additional cost.

2202.6 Equipment

The machinery, tools, and equipment necessary for proper execution of the work shall be on the project and approved by the Engineer prior to beginning construction operations. Utilize spreading equipment capable of producing a consistent

application rate. Blending of the soil mixture shall be accomplished by equipment with a recycling or mixing drum, positive depth control, and automatic water proportioning system that provides consistent results. Compaction shall be achieved using pneumatic or vibratory sheepsfoot or padfoot rollers capable of meeting the compaction requirements. Final surface compaction may be completed with a steel wheel or rubber-tired roller.

All machinery, tools and equipment use shall be maintained in a satisfactory and workmanlike manner.

2202.7 Construction

- A. General: It is the primary purpose of this specification to secure a completed section of treated material which contains a uniform mixture with no loose or segregated areas, has a uniform density and moisture content and is well bound for its full depth. It shall be the responsibility of the Contractor to regulate the sequence of his/her work, to process a sufficient quantity of material to provide a completed section as shown on plans, to use the proper amounts of fly ash or lime, to achieve final compaction within the specified time, to maintain the work, and to rework the lifts as necessary to meet the above requirements.
- B. Weather Limitations: The soil mixture shall not be mixed while the soil is frozen, the temperature is below 40°F or when conditions indicate that the atmospheric temperatures may fall below 40°F within 24 hours.
- C. Preparation of Subgrade: Before other construction operations are begun, the area to be stabilized shall be cut and shaped in conformance with the lines and grades shown on the plans. All areas shall be firm and able to support, without displacement, the construction equipment and the compaction hereinafter specified. Soft or yielding subgrade shall be corrected by the Contractor using a method approved by the Engineer.
- D. Moisture Control: Moisture control shall be achieved through use of a controllable water additive system capable of being regulated to the degree necessary to maintain moisture contents within the recommended range.
 - 1. For fly ash, the required moisture content will be established by laboratory tests with the site soils and specific fly ash to be used, determined in accordance with ASTM D 698 or AASHTO T 99. Laboratory testing shall be the responsibility of the Contractor and is subsidiary to other items. Final moisture content of the mix, immediately prior to compaction shall be +/- 3 percentage points of the optimum moisture content as determined by laboratory testing unless otherwise specified in the Contract Documents. If moisture contents exceed the specified limits, additional fly ash may be incorporated to lower moisture contents to the required limits. Lowering moisture contents by aeration following addition of fly ash will not be allowed.
 - 2. For lime, the required final moisture content of the lime-soil mix will be established by laboratory tests with the site soils and specific lime to be used, determined in accordance with ASTM D 698 or AASHTO T 99. Laboratory testing shall be the responsibility of the Contractor and is subsidiary to other items. During mixing and compaction operations, the moisture content of the mix shall be a minimum of 3 percentage points above the optimum moisture content as determined by laboratory testing, unless otherwise specified in the Contract Documents. After completion of the preliminary mixing operation and during the aging period, the surface shall be kept moist by spraying with water. Following the final mixing operation and compaction, the surface shall be kept moist by spraying with water until covered by a subsequent layer of material or sealed with a bituminous prime coat applied at a minimum rate of 0.15 gallons per square yard. Other curing methods may be submitted by the Contractor for consideration by the Engineer.
- E. Application of Material

1. Fly Ash: Immediately prior to application of fly ash, the areas shall be scarified to allow for uniform distribution. The use of scarification equipment with positive depth control is required and should be performed to a depth between four inches (4") and one inch (1") less than the specified depth of treatment. The fly ash shall be spread only on that area where the placement, mixing and compaction operations can be completed within 2 hours.

The fly ash shall be spread uniformly over the top of the subgrade – the use of a controlled application system approved by the Engineer is preferred but the Contractor may submit an alternate method of spreading for approval that provides uniform distribution at the specified rate of application. The amount of fly ash spread shall be the amount required for mixing to the specified depth which will result in the percentage determined by laboratory testing as described in section 2202.4 Composition.

The fly ash shall be distributed in a manner that reduces the scattering of fly ash by wind to a minimum. Fly ash shall not be applied when wind conditions, in the opinion of the Engineer, are detrimental to a proper application or becomes objectionable to adjacent property owners.

The mixing operation shall be completed within 30 minutes of the addition of water to the subgrade.

2. Lime: Immediately prior to the application of the lime, the areas shall be scarified to allow for uniform distribution. The use of scarification equipment with positive depth control is required and should be performed to a depth between four inches (4") and one inch (1") less than the specified depth of treatment.

Lime slurry is to be applied with equipment that can regulate the amount passing through the nozzles and the speed of travel to place the specified amount on the soil with a uniform lime distribution. The concentration of the lime slurry should allow for the application of the correct quantity of lime without adding an undue amount of excess moisture. The Contractor is responsible for testing the concentration of the lime suspension a minimum of once per day or once per batch, whichever is greater.

Application of the lime slurry should occur on the same day the slurry is produced. Continuously agitate the lime slurry once it is produced.

F. Mixing

1. Fly Ash: The full depth of the treated subgrade shall be mixed with a rotary pulvamer which utilizes a direct hydraulic drive. Fly ash shall not be left exposed for more than 30 minutes after distribution. Water shall be added through a spray bar in the mixing drum capable of uniformly applying sufficient quantities of water to achieve the required moisture content of the soil-fly ash mixture. The system shall be capable of being regulated to maintain moisture contents within the recommended range.

Mixing shall continue until a homogeneous, friable mixture with zero clods greater than 1-1/2" in size remain and no more than 50% of the mixture is retained on a 1/2" sieve.

2. Lime: The mixing process for lime includes preliminary mixing, aging, and final mixing. The preliminary mixing should occur immediately following the introduction of the lime slurry to the subgrade. The equipment used for mixing shall have positive depth control with a visual depth indicator and be capable of mixing the full specified depth of treatment to within 1/2" tolerance. The mixing equipment should also have a travel speed indicator and controllable water additive system. Preliminary mixing shall continue until the material is uniformly mixed, at a minimum moisture content of 3% above

optimum and with zero clods greater than 2" in size remaining. Perform a minimum of two passes over all treated areas with the mixer. Upon completion of the preliminary mixing, seal the mixture to prevent moisture loss by lightly rolling with a pneumatic or steel drum flat roller.

Aging should occur for a minimum of 24 hours and a maximum of 72 hours unless approved otherwise by the Engineer.

Following the aging period, the final mixing is performed by re-mixing the entire treated area until the mixture contains zero clods greater than 1.5" and has 95% of the mixture passing the 1" sieve and 60% of the mixture passing the No. 4 sieve. The mixture should be brought to a moisture content of a minimum of 3% above optimum for compaction.

G. Compaction

1. Fly ash: Compaction of the soil-fly ash mixture shall begin immediately after mixing of the fly ash and be completed within two hours following incorporation of fly ash. Compaction of the mixture shall continue until the entire depth of mixture is uniformly compacted to the specified density using vibratory sheepsfoot or pad foot rollers. A pneumatic rubber tire or smooth wheel steel drum roller may be used to complete the compaction of the surface. A test for both density and moisture content of the soil-fly ash mixture shall be taken for each 750 square yards of material placed with a minimum of one test per day of production. The field density of the compacted mixture shall be at least 95 percent of the maximum density established by laboratory tests using the site soils and specific fly ash to be used, determined in accordance with ASTM D 698. Laboratory testing shall be the responsibility of the Contractor and is subsidiary to other items.

The in-place field density shall be determined in accordance with ASTM D 1556 or ASTM D 6938. When ASTM D 6938 is utilized for testing purposes, the nuclear gauge shall be calibrated within the last year. Calibration and operation of the gauge shall be in accordance with the requirements of the manufacturer. The operator of the nuclear gauge must show evidence of training and experience in the use of the instrument. The gauge shall be standardized daily in accordance with ASTM D 6938, paragraph 8.

Final acceptance of the compaction is dependent upon passing visual roll testing. This will be observed and approved by the Engineer. All irregularities, depressions, or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding or removing material as required and remixing and re-compacting with additional fly ash if beyond the 2 hour limit. The surface of the course shall be maintained in a smooth condition, free from undulations and ruts, until other work is placed thereon or the work is accepted.

Should the material, due to any reason or cause, lose the required stability, density and finish before the work is accepted, it shall be reprocessed, recompact and refinished at the sole expense of the Contractor. Reprocessing shall follow the same pattern as the initial stabilization including the addition of fly ash.

2. Lime: Compaction of the soil-lime mixture shall begin immediately after final mixing. Compaction of the mixture shall continue until the entire depth of mixture is uniformly compacted to the specified density using vibratory sheepsfoot or pad foot rollers. A pneumatic rubber tire or smooth wheel steel drum roller may be used to complete the compaction of the surface. A test for both density and moisture content of the soil-lime mixture shall be taken for each 750 square yards of material placed with a minimum of one test per day of production. The field density of the compacted mixture shall be at least 95 percent of the maximum density established by laboratory tests using the site soils and

specific lime to be used, determined in accordance with ASTM D 698. Laboratory testing shall be the responsibility of the Contractor and is subsidiary to other items.

The in-place field density shall be determined in accordance with ASTM D 1556 or ASTM D 6938. When ASTM D 6938 is utilized for testing purposes, the nuclear gauge shall be calibrated within the last year. Calibration and operation of the gauge shall be in accordance with the requirements of the manufacturer. The operator of the nuclear gauge must show evidence of training and experience in the use of the instrument. The gauge shall be standardized daily in accordance with ASTM D 6938, paragraph 8.

Final acceptance of the compaction is dependent upon passing visual roll testing. This will be observed and approved by the Engineer. All irregularities, depressions, or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding or removing material as required and remixing and re-compacting.

The surface of the course shall be maintained in a smooth condition, free from undulations and ruts, until other work is placed thereon or the work is accepted.

Should the material, due to any reason or cause, lose the required stability, density and finish before the work is accepted, it shall be reprocessed, recompact and refinished at the sole expense of the Contractor.

H. Finishing (Trimming) & Curing

1. Fly ash: After each layer or course of the fly ash treated subgrade has been compacted, it shall be brought to the required lines and grades in accordance with the typical sections. The finished surface of the final layer shall not vary more than 3/8 inch when tested with a 10-foot straightedge applied parallel with and at right angles to the pavement centerline. Any variations in excess of this tolerance shall be corrected by the Contractor, at his/her own expense, in a manner satisfactory to the Engineer.

After the fly ash treated course has been finished as specified herein, the surface shall be protected against rapid drying by one of the following methods for a period of not less than three days or until the pavement section is placed.

- a. Maintain in a thorough and continuously moist condition by sprinkling with water.
- b. Apply an asphalt prime coat emulsion curing seal approved by the Engineer at a rate of 0.15 gallons per square yard.
- c. Other options for maintaining moisture may be submitted in writing for approval by the Engineer.

Restrict construction traffic from operating on the treated subgrade until it can withstand the loads without damage or deformation.

Protect the treated subgrade from freezing throughout the protection period.

2. Lime: After each layer or course of the lime treated subgrade has been compacted, it shall be brought to the required lines and grades in accordance with the typical sections. The finished surface of the final layer shall not vary more than 3/8 inch when tested with a 10-foot straightedge applied parallel with and at right angles to the pavement centerline. Any variations in excess of this tolerance shall be corrected by the Contractor, at his/her own expense, in a manner satisfactory to the Engineer. After the lime treated course has been finished as specified herein, the surface shall be cured by one of the

following methods for a period of not less than three days and maintained until placement of the subsequent course (base or pavement) or up to seven days, whichever occurs first:

- a. Maintain in a thorough and continuously moist condition by sprinkling with water.
- b. Apply an asphalt prime coat emulsion curing seal approved by the Engineer at a rate of 0.15 gallons per square yard.
- c. Other options for a curing seal may be submitted in writing for approval by the Engineer.

Restrict all construction traffic (except watering equipment) from operating on the treated subgrade during the curing period. Restriction may be lifted after three days if treated subgrade has gained sufficient strength to withstand the loads without damage or deformation.

Protect the subgrade from freezing throughout the curing period.

- I. Maintenance: The contractor shall maintain, at his/her own expense, the entire treated subgrade in good condition from the start of work until all the work has been completed, cured, and the pavement is placed.

2202.8 Method of Measurement

The amount of completed and accepted work will be measured or determined as follows:

- A. Lime: Per ton or tenth part thereof for the specified depth.
 1. For bag lime, use the net weight on the bag.
 2. For certified truck or rail car quantity, use the net weight of lime.
 3. For hydrated lime slaked at the jobsite, use the quantity calculated in Section 2202.4, correcting for purity and inert material.
- B. Fly Ash: Per ton or tenth part thereof for the specified depth.
- C. Manipulation (Lime Treated Subgrade or Fly Ash Treated Subgrade): Per square yard or tenth part thereof.
- D. Water: Per M Gallon (1,000 Gallons) using calibrated tanks or water meters.
 1. For lime treated subgrade, measure water used for mixing, moisture control and curing but do not measure water used for slaking the lime, dust control, or excess water used due to Contractor negligence.
 2. For Fly Ash treated subgrade, measure water used for mixing, moisture control and protection but do not measure water used for dust control or excess water used due to Contractor negligence.
- E. Alternate curing (lime) and protection (fly ash) of subgrade: No measurement will be made if the Contractor elects to use asphalt prime coat emulsion or other alternative method for curing or protection of subgrade. These are subsidiary to other Contract Documents.

2202.9 Basis of Payment

Payment for the completed and accepted work will be made as follows when included in the Contract Documents:

- A. Lime will be paid for by one of the following:
 - 1. Contract unit bid price.
 - 2. Contract lump sum bid price.
- B. Fly Ash will be paid for by one of the following:
 - 1. Contract unit bid price.
 - 2. Contract lump sum bid price.
- C. Manipulation (Lime Treated Subgrade or Fly Ash Treated Subgrade) will be paid for by one of the following:
 - 1. Contract unit bid price.
 - 2. Contract lump sum bid price.
- D. Water will be paid for by one of the following:
 - 1. Contract unit bid price.
 - 2. Contract lump sum bid price.

SECTION 2203 AGGREGATE BASE COURSE

2203.1 Scope

This section governs the furnishing of all labor, materials and equipment for the placement of aggregate base course and underdrains, including pipe, geotextiles and granular filter material as shown on the Plans and in accordance with the Standard Drawings, the specifications and the Special Provisions.

2203.2 Referenced Standards

The following standards are referenced directly in this section. The latest version of these standards shall be used. If conflicting standards are referenced, the more stringent standard shall apply.

ASTM

C 31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
C 33	Standard Specification for Concrete Aggregates
C 39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
C 88	Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
C 117	Test Method for Materials Finer than 75 μm (No. 200) Sieve in Mineral Aggregates by Washing
C 131	Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
C 136	Test Method for Sieve Analysis of Fine and Coarse Aggregates
C 142	Test Method for Clay Lumps and Friable Particles in Aggregates
C 150	Standard Specification for Portland Cement
D 75	Practice for Sampling Aggregates

D 695	Test Method for Compressive Properties of Rigid Plastics
D 1621	Test Method for Compressive Properties Of Rigid Cellular Plastics
D 2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
D 3034	Specification for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings
D 3666	Specification for Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials
D 4318	Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
D 4716	Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
D 4791	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
D 5821	Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
F 758	Standard Specification for Smooth-Wall Polyvinyl Chloride (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage

AASHTO

M 252	Corrugated Polyethylene Drainage Tubing
T 99	The Moisture-Density Relations of Soils Using a 5.5-lb. (2.5 kg) Rammer and a 12-in. (305 mm) Drop

2203.3 Materials

- A. Untreated Compacted Aggregate: This base course material shall consist of crushed stone aggregate with not more than 1.0% clay lumps and friable particles in accordance with ASTM C 142, and free from vegetable or other deleterious substances. The abrasion loss shall be no more than 35% when tested in accordance with ASTM C 131. That fraction passing the 1 inch sieve and retained on the No. 4 sieve shall have a loss not greater than 18% by weighted average for magnesium sulfate method (12% maximum loss if tested using sodium sulfate method) of ASTM C 88 Soundness Test at 5 cycles. That fraction of the material passing the 1-inch sieve and retained on the No. 4 sieve shall contain less than 20% by weight of flat and elongated particles when tested in accordance with ASTM D 4791 (flat being a ratio of 1 to 3 between thickness and least width and a ratio of 1 to 3 between the least width and length). The material shall consist of angular particles with no less than 90% of particle count having two or more fractured surfaces. The gradation in percentages by weight passing square mesh sieves shall be in accordance with ASTM C 136 and as follows:

Sieve Designation (Square Opening)	Percentage by Weight Passing Sieve
1-1/4 in (31.5 mm)	100
1 in (25.0 mm)	72 – 100
3/4 in (19.0 mm)	60 – 90
3/8 in (9.5 mm)	43 – 74
No. 4 (4.75 mm)	28 – 60
No. 10 (2.00 mm)	16 – 40
No. 40 (425 um)	3 – 22
No. 200 (75 um)	0 – 15

In addition to the above limits, the difference between the "Percent Passing Square Mesh Sieve" of successive sieve sizes shall not exceed 25 percent.

That fraction of the material passing the No. 40 sieve shall have a plasticity index not to exceed 8 when tested in accordance with ASTM D 4318.

- B. Drainable Base: All drainable base materials shall have a minimum coefficient of permeability of 1000 ft/day as

determined by the test method described in 2203.4.E Permeability Test Procedure.

1. Portland Cement Concrete Drainable Base: This item shall consist of an open-graded drainable base composed of mineral aggregate, Portland cement and water mixed in a central mixing plant and placed on a prepared course in accordance with these specifications and shall conform to the lines, grades, thicknesses and typical cross sections shown on the Plans.
 - a. Coarse Aggregate
 - i. General: Coarse aggregate shall be 3/4 inch maximum size consisting of crushed gravel or crushed stone and shall meet the requirements of ASTM C 33 and quality requirements of 2203.3.A.
 - ii. Gradation shall be ASTM C 33, Size 67.
 - b. Fine Aggregate: Fine aggregate shall consist of natural sand or manufactured sand meeting the requirements of ASTM C 33.
 - c. Cement: Portland cement shall conform to the requirements of ASTM C 150, Type I or Type II. Substitution of fly ash or other pozzolan for Portland cement shall be in conformance with Section 2208.
 - d. Water: Water used in mixing or curing shall be clean and free of oil, salt, acid, alkali, sugar, vegetable or other substances injurious to the finished product as possible. Water known to be of potable quality may be used without testing.
 - e. Admixtures: The use of any material to be added to the mixture shall be approved by the Engineer.
 - f. The Contractor shall furnish vendor's certified test reports for the materials used in the project. The report shall be delivered to the Engineer as part of the mix design before permission to use the materials is granted.
 - g. Proportions: The Contractor shall submit a mix design containing the quantity of each material to the Engineer including certifications of materials used. The Contractor will be responsible for preparing the drainable base mix design at no cost to the Owner. The testing laboratory preparing the mix design shall comply with Section 2203.3.B.2.e. The mix design shall include the following:

Cement Content
Water-Cement Ratio - Approximately 0.36
Coarse Aggregate
Fine Aggregate
All Admixtures
Coefficient of Permeability - Tested per Section 2203.4.E
 - h. Compressive Strength: Proportions will be such to produce a compressive strength of 800 psi in 28 days as determined by test cylinders made in accordance with ASTM C 31 and tested in accordance with ASTM C 39. A strength of 500 psi will be required prior to any traffic being allowed on the surface.
2. Plant Mix Bituminous Drainable Base: This item shall consist of an asphalt stabilized drainable base course composed of mineral aggregate and bituminous material mixed in a central mixing plant and placed on a prepared course in accordance with the specifications and shall conform to the lines, grades, thicknesses, and typical cross sections shown on the Plans. Each course shall be constructed to the depth, typical section, or elevation required by the Plans and shall be rolled, finished, and approved before the placement of the next course. A prime coat will be used on the subbase prior to placement of the first course, and no tack coat will be used between courses.

- a. Aggregate: Aggregate shall consist of crushed stone or crushed gravel and be free of organic materials.
 - i. Coarse Aggregate: Coarse aggregate shall comply with Section 2303.3.A except wear may not exceed 50 % in accordance with ASTM C 131.
 - ii. Aggregate shall contain at least 70% by weight of individual pieces having two fractured faces and 85% by weight having at least one fractured face as determined by ASTM D 5821.
 - iii. The aggregate shall not contain more than 8%, by weight, of flat and elongated pieces, when tested in accordance with ASTM D 4791 (ratio = 5:1).
 - iv. Sampling: ASTM D 75 shall be used in sampling the coarse aggregate.
- b. Bituminous Material: The asphalt cement shall be in conformance with Section 2205.3.A. The type and grade of asphalt used shall be specified in the mix design but shall not be lower than a PG 64-22.
- c. Preliminary Material Acceptance: Prior to delivery of materials to the job site, the Contractor shall submit certified test reports to the Engineer for the following materials:

Coarse Aggregate - Percent of wear, soundness.

Bituminous Material - The certification(s) shall show the appropriate ASTM test(s) for each material, the test results, and a statement that the material meets the specification requirements.

- d. Job Mix Formula. (JMF): No bituminous mixture for payment shall be produced until the Engineer has approved a JMF in writing. The method of determining the proper asphalt content is to store the mix trial batches in the laboratory overnight (15-18 hrs) at 140°F. The proper asphalt content will then be selected visually.

The asphalt content mix is selected from the batch from which a small amount of asphalt drains to the bottom of the pan and the mix still appears glossy. A heat resistant, clear glass dish may be used for better visibility of the drained asphalt. The asphalt content may be varied as necessary during construction to meet this requirement.

The aggregate shall be of such size that the percentage composition by weight will conform to the gradation of gradations specified in Table 2, when tested in accordance with ASTM C 117 and C 136. The gradation shall be on the coarse side of the Master Band.

TABLE 2. PLANT MIX BITUMINOUS DRAINABLE BASE MASTER GRADATION	
Sieve Designation (Square Opening)	Percent by Weight Passing Sieve
1-1/2 in (37.5 mm)	100
1 in (25.4 mm)	90 – 100
3/4 in (19.0 mm)	75 – 100
1/2 in (12.5 mm)	70 – 90
3/8 in (9.5 mm)	50 – 70
No. 4 (4.75 mm)	20 – 40
No. 8 (2.36 mm)	15 – 25
No. 30 (637 um)	5 – 15
No. 200 (75 um)	0 – 3

Recommended Asphalt Cement Content 2.0% – 3.5%

The gradations in Table 2 represent the limits that shall determine the suitability of aggregate for use from the supply source.

The job mix tolerance shown in Table 3 shall be applied to the JMF to establish a job control-grading band. The resulting job control grading band must comply with the Master Gradation criteria.

TABLE 3. JOB MIX FORMULA TOLERANCES (Based on Single Test)	
Material	Tolerance Plus or Minus
Aggregate passing No. 4 (4.75 mm) sieve or larger	5.00%
Bitumen*	0.40%
Temperature*	20 degrees F

*Unless otherwise approved by the Engineer.

The aggregate gradation may be adjusted within the limits of Table 2 as directed, without adjustments in the Contract unit prices.

Should a change in sources of materials be made, a new JMF shall be established before the new material is used.

Dry aggregate gradations will be made at least twice daily. The aggregate gradation shall be tested by the Contractor in accordance with ASTM C 117 and C 136 and the results submitted to the Engineer within 24 hours.

The JMF shall be submitted in writing by the Contractor and approved by the Engineer prior to the start of paving operations. The job mix shall have been prepared no more than 12 months prior to submittal and shall include as a minimum:

- Percent passing each sieve
- Percent of asphalt cement
- Asphalt designation and certifications
- Mixing temperature
- Compaction temperature
- Temperature of mix when discharged from the mixer
- Percent fractured faces
- Percent elongated particles

The Contractor shall submit samples to the Engineer, upon request, for job mix formula verification testing.

- e. Testing Laboratory: The laboratory used to develop the JMF formula shall meet the requirements of ASTM D 3666.

C. Underdrains: Underdrains shall consist of the following materials unless otherwise specified in the Plans, Standard Drawings, or Contract Documents.

- 1. Aggregate: Blanket underdrain aggregate and pipe underdrain aggregate shall be clean or washed

aggregate and conform to requirements of Section 2203.3.A with the following gradations:

TABLE 4. BLANKET UNDERDRAIN AGGREGATE	
Sieve Designation (Square Opening)	Percent by Weight Passing Sieve
1-1/2 in (37.5 mm)	100
1 in (25.4 mm)	90 – 100
3/4 in (19.0 mm)	60 – 90
3/8 in (9.5 mm)	-----
No. 4 (4.75 mm)	20 – 40
No. 8 (2.36 mm)	-----
No. 16 (1.2 mm)	0 – 10
No. 30 (0.6 mm)	-----
No. 50 (0.3 mm)	0 – 7
No. 100 (150 um)	0 – 2

TABLE 5. PIPE UNDERDRAIN AGGREGATE	
Sieve Designation (Square Opening)	Percent by Weight Passing Sieve
1-1/2 in (37.5 mm)	-----
1 in (25.4 mm)	-----
3/4 in (19.0 mm)	100
3/8 in (9.5 mm)	85 – 100
No. 4 (4.75 mm)	-----
No. 8 (2.36 mm)	40 – 60
No. 16 (1.2 mm)	-----
No. 30 (0.6 mm)	5 – 30
No. 50 (0.3 mm)	-----
No. 100 (150 um)	1 – 2

2. Underdrain Pipe

- a. Polyvinyl chloride pipe shall meet the requirements of ASTM F 758/D 3034.
- b. Corrugated Polyethylene Tubing may be used only outside of traffic areas and driving surfaces. The tubing shall be the heavy duty type and shall meet the requirements of AASHTO M 252. In addition, the tubing shall have a minimum pipe stiffness of 30 psi at 10% deflection.
- c. All underdrain pipes shall have a nominal minimum inside diameter of six inches unless shown otherwise on the Plans.
- d. Perforations shall be approximately circular and cleanly cut; shall have nominal diameters not less than 3/16-inch nor more than 3/8-inch; and shall be arranged in at least two rows parallel to the axis of the pipe.
- e. Fittings shall be of the same composition and have the same physical properties as the pipe and shall not restrict flow.

3. Geocomposite Edge Drain

- a. Edge drain shall consist of a plastic core completely surrounded by geotextile. The core shall provide a minimum of 10 percent open area to facilitate water entry or cross flow and shall be composed of plastic which is physically and chemically stable under a normal range of

- conditions.
 - b. The edge drain shall have nominal dimensions of 1 to 1-1/2 inches in thickness and 12 inches in height.
 - c. The edge drain shall have a minimum flow capacity of 15 gallons per minute per foot of width as determined by ASTM D 4716 when tested under a confining stress of 10 psi or more at a gradient of 0.1 or less.
 - d. The edge drain shall have a minimum compressive strength of either 7,000 psf at a maximum deformation of 10 percent of the original thickness when tested in accordance with ASTM D 1621, or 8,000 psf at a maximum deformation of 20 percent when tested in accordance with ASTM D 695.
 - e. Geotextile shall have an apparent opening size (AOS) corresponding to a U.S. sieve number greater than 50 but not exceeding 100.
4. Geotextile: Geotextile for use with pipe and edge underdrains shall be a nonwoven geotextile and shall meet the requirements of Section 2605.2.C.

2203.4 Construction

A. Untreated Compacted Aggregate

1. Subgrade: Prior to placement of base course material the previously prepared subgrade surface shall be cleared of all foreign substances and restored in shape, tolerance and density as specified in Section 2201 entitled "Subgrade Preparation".
2. Material Placement: The material shall be uniformly spread in successive layers to such depth that when compacted, the base will meet the minimum thickness specified. The Contractor may construct the base in any number of layers that he chooses except that in no case shall any individual layer have a compacted thickness of more than 6 inches. Each layer shall be compacted as hereinafter specified before any succeeding layer is placed.
3. After spreading a layer of material, water in an amount sufficient to insure the desired compaction shall be added and uniformly mixed with the aggregate in a manner to prevent segregation. Excess moisture resulting in runoff shall be avoided. If for any reason, the material and subgrade become too wet to permit satisfactory work, they shall be allowed to dry to a moisture content that will permit satisfactory work.
4. The material shall meet the required specifications immediately before compaction operations are commenced. If, for any reason, segregation occurs in excess of 10% variation from the gradation required by this specification or the materials become contaminated, such segregated or contaminated materials shall be removed and replaced with suitable materials at the expense of the Contractor. The limited segregation of 10% variation will be ascertained by a sieve analysis of a minimum 100 pound sample taken from the in-place base course.
5. However, for untreated compacted aggregate base, segregated surface areas may be corrected by adding limestone screenings of such gradation and quantity as required to fill the surface voids and firmly bind the loose material in place. Screenings so used in correcting segregated surface areas will be subsidiary.
6. Shaping and compacting shall be carried on continuously until a true, even and uniform surface of proper grade and cross-section is obtained, and until the density of the complete base is at least 95%

of maximum density as determined by AASHTO T 99. The proper moisture content shall be maintained by wetting the surface as required during shaping and compacting operations. Final rolling shall be accomplished by use of a self-propelled smooth-wheeled roller.

B. Portland Cement Concrete Drainable Base

1. Spreading: The base material shall be spread to the lines and grades shown on the Plans. Any material which becomes mixed with soil or other contaminants shall be removed and replaced with fresh mixture.
2. Compaction: After spreading and/or trimming, the base material shall be uniformly compacted by making a minimum of 2 coverages with a steel wheeled roller meeting the requirements of Section 2205.8.B. The compaction process may be adjusted on the project by the Contractor with approval of the Engineer to assure uniform compaction of the drainable base material. In areas not accessible by the roller, the base material shall be compacted by mechanical hand methods. Compaction must be completed within 2 hours of the time water is introduced to the mixture.
3. If after spreading and compacting the base is not to the required lines and grade, the Contractor shall trim the base by means of an electronically controlled machine utilizing string line controls for grade. The Engineer reserves the right to direct the Contractor to suspend all operations if the Contractor produces excessive fines in the trimming process which are viewed by the Engineer to be detrimental to the permeability of the base. Appropriate corrections to the trimming process shall be made by the Contractor prior to beginning again.
4. After compaction of the drainable base, the Contractor shall protect the surface from damage and/or contamination. If the integrity of the drainable base is disturbed at any time prior to placement of the succeeding pavement course the area shall be removed and replaced with new material and compacted to conform to the original lines and grades at the Contractor's expense. Any removed material shall not be reincorporated into the drainable base or other drainage features.
5. Curing Of The Drainable Base Material: The Contractor will be required to provide a curing plan to the Engineer.
6. Temperature Limitations: The air temperature must be between 50°F and 90°F for drainable base construction. The Engineer may order operations to cease in hot windy conditions if it appears the mixture is drying out prior to achieving initial set.
7. Construction Joints: The formation of all joints shall be made in such a manner as to ensure a continuous bond between old and new sections of the course. All joints shall present the same texture and smoothness as other sections of the course.
8. All contact surfaces of previously constructed courses shall be cleaned of all dirt or other objectionable materials, and thoroughly moistened with water prior to placing the new material.
9. Thickness: The thickness of the base course may be measured by cores taken at intervals determined by the Engineer.

C. Plant Mix Bituminous Drainable Base

1. Test Section: Prior to full production, the Contractor shall prepare and place a section of drainable base according to the JMF. The amount of mixture should be 80 tons and may be placed as part of the

project. The underlying grade or pavement structure upon which the test section is to be constructed shall be the same as the remainder of the course represented by the test section. The equipment used in construction of the test section shall be the same type and weight to be used on the remainder of the course represented by the test section.

2. Two random samples of mixture may be taken at the plant and tested for aggregate gradation and asphalt content. The test section shall be considered acceptable if the gradation and asphalt content are within the limits specified in Tables 2 and 3.
3. If the initial test section should prove to be unsatisfactory to the Engineer, the necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made. A second test section shall then be placed. If the second test section also does not meet specification requirements, both sections shall be removed at the Contractor's expense. Additional test sections, as required, shall be constructed and evaluated for conformance to the specifications. Any additional sections that do not conform to specification requirements shall be removed at the Contractor's expense. Full production shall not begin until a satisfactory section has been constructed and accepted by the Engineer. The test sections that meet the specification requirements shall be paid for in accordance with project quantities.
4. The Contractor shall perform job mix control testing at the start of plant production and in conjunction with the calibration of the plant for the JMF. It should be recognized that the aggregates produced by the plant may not satisfy the gradation requirements or produce a mix that exactly meets the JMF. In those instances, it will be necessary to reevaluate and redesign the mix using plant-produced aggregates. Specimens should be prepared and the optimum bitumen content determined in the same manner as for the original design tests.
5. Weather Limitations: The bituminous mixture shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than 40 degrees F or the wind chill factor is less than 35 degrees F. The temperature requirements may be waived by the Engineer; however, all other requirements including compaction shall be met.
6. These materials will be placed, handled, hauled and accepted based on requirements of Section 2205.

D. Underdrains

1. General: Underdrains shall be constructed as shown on the Plans or Standard Drawings. The exact location and layout of underdrains and/or edge drains as shown on the Plans shall be subject to revision by the Engineer during construction.
2. Excavation
 - a. Trenches for all lateral and longitudinal underdrains shall be excavated to the dimensions, depths and elevations shown on the Plans or Standard Drawings or as ordered by the Engineer. In case of a conflict, where the actual elevation of the strata or stratum to be intercepted is found to vary from Plan elevation, the stratigraphy shall govern in the installation of underdrains.
 - b. Trench bottoms for perforated pipe underdrain and edge drain shall be in firm material (no mucky or soupy condition existing) and constructed to permit the placing of three inches (3") of aggregate underneath the pipe. If unstable material is encountered in the bottom of the trench, the trench shall be over excavated to firm material.
 - c. Minimum width of trench shall be as shown in the Plans or in the specifications or the

Standard Drawings.

3. Laying Pipe

- a. All underdrain pipe shall be laid carefully to Plan line and grade.
- b. All pipe shall be laid on a minimum grade of one percent unless otherwise shown on the Plans.
- c. All dead ends of pipe underdrains shall be completely closed with a cap of the same material as the pipe.
- d. All junctions and turns shall be made with wyes, tees, and bends as supplied by the manufacturer of the pipe.
- e. Perforations shall be laid down unless otherwise indicated on the Plans.

4. Installing Edge Drain

- a. Installation shall be in accordance with manufacturer's instructions.
- b. Each length of drain shall be joined to the adjacent length prior to installation. Splices shall keep adjoining lengths in proper alignment, shall not separate during installation, shall have the same or greater compressive strength than the geocomposite drain, and shall be sealed against infiltration of backfill material.
- c. Drain shall be placed in the center of the trench and held in place with a temporary support while blanket underdrain aggregate backfill is placed.
- d. The placement of the edge drain and the first lift of backfill shall be accomplished in a single continuous operation.

5. Backfilling

- a. Backfilling the trenches of lateral and longitudinal underdrains shall not be started until approved by the Engineer.
- b. The trenches shall be backfilled to the specified elevations and in accordance with the Plans, specifications or Standard Drawings.
- c. The backfill material shall be placed in such a manner as to prevent formation of large cavities in the backfill and walls of the trench.
- d. Overbreakage due to blasting of rock in trench excavation and widening due to caving of trench walls or overbreakage at construction outcrops shall be backfilled with aggregate approved by the Engineer.

E. Permeability Test Procedure for Drainable Base

This test method is used to determine the permeability of unbound and bound aggregate base material. Bound base material will use Portland cement or asphaltic cement as a cementing agent.

1. Unbound Base and Base Bound with Portland Cement

- a. Apparatus
 - i. Mold: A cylindrical metal mold with an approximate inside diameter of 6" and a minimum height of 6". The mold shall be equipped with a removable collar at least 2" in height and a removable base plate. The base plate may be used as part of the permeability test equipment. If so, the base plate must exceed the permeability of the material being tested. A #40 screen shall be placed on top of the base plate to prevent test material from being lost through the base plate during compaction and

- permeability testing.
- ii. Standpipe: A standpipe with the same diameter as the removable collar for the mold with a minimum height of 8.5". The standpipe shall be equipped with an overflow outlet.
- iii. Rammer: A mechanically operated metal rammer equipped to control the height of drop to 12" plus or minus 1/16" above the elevation of the sample. The rammer shall be equipped to distribute the blow uniformly over the sample surface. The rammer shall have a rigid flat faced "pie shaped" foot and a nominal weight of 5.50 lbs. The "pie shaped" foot shall be a sector of 6" diameter circle and shall have an area equal to that of a 2" circular foot.
- iv. Straight edge: A rigid steel straight edge with one edge beveled, at least 8" in length.
- b. Sample preparation
 - i. Obtain a 50 lb. to 60 lb. sample, dry if necessary.
 - ii. Mix a sufficient amount of aggregate and cementing agent, if required, to fill the mold 1 and 1/2 times.
 - iii. Add the appropriate amount of water and thoroughly mix.
 - iv. Place the assembled mold on the rigid base and fill approximately 1/2 full of the loose moist material. Compact the layer with 25 blows of the rammer with the blows being distributed uniformly over the surface of the layer. Place three additional approximately equal layers of material in the mold and compact each layer in a similar manner (four layers total).
 - v. After the fourth layer has been compacted, remove the collar and trim excess material level with top of the mold.
 - vi. Cure Portland cement treated specimens by covering with plastic, to prevent drying for 3 days at room temperature.
 - vii. Unbound specimens do not need to be cured before testing.

2. Asphalt Bound Aggregates

- a. Apparatus
 - i. Mold: A cylindrical mold with an inside diameter of approximately 6" and a minimum length of 4.5". The mold is open at each end and is equipped with a removable collar and a base plate about 0.5" thick.
 - ii. Specimen Mold Holder: The specimen mold holder has a semi-circular base and a flanged top to hold the specimen mold in place during the compaction process. Any equivalent hold down device that performs the same function is satisfactory.
 - iii. Compaction Hammer: The compaction hammer consists of a hammer having a flat circular tamping face 5.88" in diameter and appropriate extension rod with handle which acts as guide for a free falling weight. The weight shall weigh 22.5 lbs. and have a free fall of 18" plus or minus 0.1". The hammer may be operated manually or be driven with a motor.
 - iv. Compaction Pedestal: The compaction pedestal is a wood block approximately 12" x 12" x 18". A 12" x 12" x 1" steel plate is securely fastened to the top of the block. The pedestal is set on and securely fastened to a solid concrete slab with the vertical axis plumb and the top level.
 - v. Heating Equipment: Ovens or hot plates for heating aggregates, bituminous material, specimen molds, compaction hammers and other associated items required for mixing and molding. It is recommended that, when possible all heating units be thermostatically controlled to maintain the required temperature within $\pm 5^{\circ}\text{F}$. Suitable shields, thick steel plates or pans of sand shall be used on the surfaces of hot plates to minimize locally overheating.

- vi. **Mixing Apparatus:** Mechanical mixing is recommended. Any type of mechanical mixer may be used provided it will produce a well coated, homogeneous mixture of the required amount in the allowable time and further that the mixing paddle or whip does not fracture or pulverize aggregate fractions during the mixing process. The bowl employed with the mixer shall be such a nature that essentially all of the batch can be removed. More than one mixing bowl is recommended unless the mixer is equipped with a heating jacket to keep the bowl heated during the mixing process.
- b. **Determination of Mixing and Compacting Temperature**
 - i. The temperature to which the asphalt cement must be heated to produce a viscosity of 85 ± 10 SFS shall be the mixing temperature.
 - ii. The temperature to which the asphalt cement must be heated to produce a viscosity of 130 ± 15 SFS shall be the compacting temperature.
- c. **Sample Preparation for Laboratory Prepared Mix**
 - i. Combine the dry individual aggregates to produce desired combined aggregate with a batch weight of approximately 8.9 lbs. This should be sufficient to produce a compacted specimen 3.75 ± 0.125 inches thick. Adjust the weight of the batch as needed to produce a compacted specimen of 3.75 ± 0.125 inches thick.
 - ii. Prepare a minimum of two aggregate and asphalt specimens. The first specimen shall be mixed and thrown away. This sample is to "butter" the mixing bowl and paddle and thus reduce material loss when mixing the test specimen.
 - iii. Heat the aggregate and asphalt within the limits of mixing temperature determined in Section 2203.4.E.2.b. Charge the mixing bowl with the heated aggregate and form a crater in the top. Add the required amount asphalt and mix the aggregate and asphalt until coated at least 2 minutes. Care should be taken to keep all of the sample in the mixing bowl during this process.
- d. **Compaction of Specimen**
 - i. Prior to the addition of the asphalt to the batches, thoroughly clean the specimen mold assembly and the face of the compaction hammer and heat the mold assembly and hammer to a temperature between 200°F and 350°F. Assemble the mold, base plate and collar and place a paper disc cut to size in the bottom of the mold.
 - ii. Place the hot batch of aggregate-asphalt mixture in the mold, spade vigorously with a heated spatula or trowel 15 times around the perimeter and 10 times over the interior of the mold. Smooth the surface of the mix to a slightly rounded shape. The temperature of the mix prior to compaction shall be within the limits in Section 2203.4.E.2.b. Place a paper disc on top of the mix.
 - iii. Place the mold assembly, including the collar, on the pedestal, fasten securely with the mold holder and apply 20 blows with the compaction hammer. Each blow must have the prescribed free fall of 18" with the axis of the compaction hammer held perpendicular to the base of the mold assembly during the compaction process. Remove the base plate and collar, and reverse and reassemble the mold. Apply the specified number of blows to the reversed specimen. After compaction remove the mold assembly from the pedestal, remove the collar and base plate and cool the specimen in the mold until the mold can be handled comfortably with bare hands. Asphalt treated samples do not need to be cured before testing, only cool to the touch.

3. Test Procedure

- a. Assemble test equipment, base plate, mold with specimen, and standpipe.
- b. Prior to conducting the test, allow a sufficient amount of water to pass through the specimen to cause all air to be expelled from the specimen. (Establish reservoir around the base with

- water open to atmospheric pressure.)
- c. Conduct Constant-Head Permeability test and report coefficient of permeability "k". Repeat a minimum of two additional times until two runs agree reasonably well.
 - d. Constant-Head Permeability:

$$k = \frac{QL}{Aht}$$

Q = quantity of water discharged (volume)

L = length of specimen

A = cross-sectional area of specimen

h = hydraulic head (height column of water above discharge)

t = elapsed time of test

k = coefficient of permeability (length/time)

Note: For very permeable material, maintain elevation of water above the sample for 3 minutes then measure Q (flow).

2203.5 Method of Measurement

- A. Untreated Compacted Aggregate Base will be measured by one of the following:
 - 1. Per square yard or tenth part thereof for the specified depth.
 - 2. Per ton or tenth part thereof.
- B. Portland Cement Concrete Drainable Base may be included in the Contract Documents as a single item or as separate items (Portland Cement and Base Aggregate) and measured by one of the following:
 - 1. Per square yard or tenth part thereof for the specified depth.
 - 2. Per ton or tenth part thereof.
- C. Plant Mix Bituminous Drainable Base may be included in the Contract Documents as a single item or as separate items (Asphaltic Cement and Base Aggregate) and measured by one of the following:
 - 1. Per square yard or tenth part thereof for the specified depth.
 - 2. Per ton or tenth part thereof.
- D. Pipe and Edge Underdrains will be measured per lineal foot or tenth part thereof. Pipe Underdrain and Edge Underdrain aggregate shall be subsidiary.
- E. Blanket Underdrains will be measured by the actual quantities used as follows:
 - 1. Per square yard or tenth part thereof for the specified depth.
 - 2. Per ton or tenth part thereof.

2203.6 Basis of Payment

- A. Untreated Compacted Aggregate Base will be paid for by one of the following:
 - 1. Contract unit bid price.
 - 2. Contract lump sum bid price.
- B. Portland Cement Concrete Drainable Base will be paid for by one of the following:
 - 1. Contract unit bid price.
 - 2. Contract lump sum bid price.
- C. Plant Mix Bituminous Drainable Base will be paid for by one of the following:
 - 1. Contract unit bid price.
 - 2. Contract lump sum bid price.
- D. Pipe and Edge Underdrains will be paid for by one of the following:
 - 1. Contract unit bid price.
 - 2. Contract lump sum bid price.
- E. Blanket Underdrains will be paid for by one of the following:
 - 1. Contract unit bid price.
 - 2. Contract lump sum bid price.

SECTION 2204 PRIME AND TACK COAT

2204.1 Scope

This section governs the furnishing of all labor, materials and equipment for the application of liquid asphalt to a prepared pavement (concrete, asphaltic concrete), or granular base as shown on the Plans and in accordance with the Standard Drawings, the specifications and the Special Provisions.

2204.2 Referenced Standards

The following standards are referenced directly in this section. The latest version of these standards shall be used. If conflicting standards are referenced, the more stringent standard shall apply.

ASTM

D 140 Practice for Sampling Bituminous Materials

2204.3 Materials

- A. The type and grade of asphalt material to be used as prime or tack coat shall be designated by the Engineer in the Plans or in the Special Provisions. If not specified in the Plans or Special Provisions, the Contractor shall

submit proposed type and grade of asphalt material to the Engineer for approval. The liquid asphalt material to be used for surface preparation shall be as listed in the following table:

Material to be Treated	Application Usage	Type of Emulsion of Grade of Cutback	Application Rate (Gal/SY) (L/SM)	Application Temperature °F (°C)	Cure Time at 70°F (21°C)
Existing Asphalt or Concrete Surface	Tack	RC-70	0.05-0.10 Gal/SY (0.23-0.46 L/SM)	150 – 225 (65 – 107)	1 – 6 hrs
	Tack	SS-1 SS-1h CSS-1 CSS-1h	0.05-0.15 Gal/SY (0.23-0.69 L/SM)	70 – 160 (22.5 – 42)	1 – 3 hrs
Treated Base (lime, flyash, cement)	Prime	MC-30 MC-70	0.1-0.3 Gal/SY (0.46-1.38 L/SM)	85 – 120 (29 – 49)	12 – 24 hrs
	Prime	SS-1 SS-1h CSS-1 CSS-1h	0.1-0.3 Gal/SY/in (0.46-1.38 L/SM/mm)	70 – 160 (20 – 70)	24 – 48 hrs
Untreated Aggregate Base w/ Fines	Prime	MC-30 MC-70	0.1-0.3 Gal/SY (0.46-1.38 L/SM)	85 – 120 (29 – 49)	12 – 24 hrs
Untreated Aggregate Base w/o Fines	Prime	MC-250	0.2-0.5 Gal/SY (0.92-2.30 L/SM)	85 – 120 (29 – 49)	12 – 24 hrs
Untreated Aggregate Base	Prime	SS-1 SS-1h CSS-1 CSS-1h	0.1-0.3 Gal/SY/in (0.46-1.38 L/SM/mm)	70 – 160 (20 – 70)	24 – 48 hrs
	Prime	EAP PAE, or PEP	0.1-0.3 Gal/SY (0.46-1.38 L/SM)	70 – 160 (20 – 70)	12 – 24 hrs

The asphalt material shall conform to the latest ASTM specifications for "Asphalt Cements and Liquid Asphalts." Sampling shall be in accordance with ASTM D 140.

- B. Sand Cover, if used, shall be any clean granular mineral meeting the following grading requirements. When tested with laboratory sieves 100% shall pass the No. 4 (4.75 mm) sieve and not more than 2% shall pass the No. 200 (75 um) sieve. The moisture content of the sand shall not exceed 3% by weight.
- C. Asphalt materials shall be approved by the Engineer prior to use in the work. The Engineer may accept a certified analysis by the material supplier laboratory when a copy of the certified analysis accompanies each shipment of asphalt to the project. The Engineer reserves the right to perform tests of the asphalt received on the job.

2204.4 Construction

- A. Pressure Distributor: The distributor shall be so designed, equipped, maintained and operated that liquid

asphalt at even heat may be applied uniformly on variable widths of surface up to 15 feet at readily determined and controlled rates from 0.02 to 1.00 gallon per square yard, with uniform pressure, and with an allowable variation from any specified rate not to exceed 0.02 gallons per square yard. Distributor equipment shall include a tachometer, pressure gauges, a calibrated tank and a thermometer for measuring temperatures of tank contents. Distributors shall be equipped with a power unit for the pump, and full circulation spray bars adjustable laterally and vertically. The calibration of all distributors must be approved by the engineer, and the contractor shall furnish all equipment, material and assistance necessary if calibration is required.

B. Preparation of Existing Surface

1. For tack coats: The existing surface shall be free of dust, loose material, grease or other foreign material at the time the tack is applied. Preparation of the surface is to be performed by the contractor before the tack is applied and is subsidiary to other items in the Contract.
2. For prime coats: the surface to be primed shall be shaped to the required grade and cross section, shall be free from ruts, corrugations, segregated material or other irregularities, and shall be uniformly compacted by rolling. The surface shall be firm and slightly damp when primer is applied. Delays in priming may necessitate reprocessing or reshaping to provide a smooth compacted surface.

C. Application of Asphalt Material

1. For Tack Coats: Asphalt emulsion shall be applied uniformly with a pressure distributor at the rate specified in the Contract, or as revised by the Engineer to be within a minimum of 0.05 and a maximum of 0.15 gallons per square yard. Water may be added to the asphalt emulsion and mixed therewith in such proportion that the resulting mixture will contain no more than 50% of added water, the quantity of added water to be approved by the Engineer. The application of the resulting mixture shall be such that the original emulsion will be spread at the specified rate. The asphalt emulsion shall be heated at the time of application to a temperature in accordance with the limits provided in Sec 2204.3, or as specified in the Contract Documents. The tack shall be properly cured and the tacked surface shall be cleaned of dirt and other foreign material before the next course is placed.

The tack coat shall be applied in such manner as to cause the least inconvenience to traffic and to permit one-way traffic without pickup or tracking of the asphalt emulsion.

2. For Prime Coats: Bituminous material shall be applied to the width of the section to be primed by means of a pressure distributor in a uniform, continuous spread. The subgrade shall be moistened before the prime is applied. The application rate shall be as specified in the Contract Documents or as approved by the Engineer between 0.1 and 0.5 gallons per square yard. The primer shall be heated at the time of application to a temperature in accordance with the limits provided in Sec 2204.3, or as specified in the Contract Documents.

Care shall be taken that the application of bituminous material at overlap locations is not in excess of the specified quantity, per square yard. Building paper shall be placed over the end of the previous applications and the joining application shall start on the building paper. Building paper used shall be removed and satisfactorily disposed of. Pools of primer material remaining on the surface after the application shall be removed.

When traffic is maintained, not more than one half of the width of the section shall be treated in one application and one-way traffic will be permitted on the untreated portion of the roadbed. As soon as the bituminous material has been absorbed by the surface and will not pick up, traffic shall be routed to the treated portion and the remaining width of the section will be primed.

The primer shall be properly cured, and the primed surface shall be cleaned of dirt and surplus sand before the next course is placed.

- D. Application of Sand Cover: If the asphalt material is not completely cured within the maximum specified curing time, sufficient sand shall be spread over the surface with a mechanical spreader to blot up the excess asphalt. The rate of application shall be specified or approved by the Engineer. Prior to placing an asphalt paving course, all loose sand shall be swept from the primed surface.

2204.5 Method of Measurement

Asphalt Prime and Tack Coat will be measured per gallon.

2204.6 Basis of Payment

Asphalt Prime and Tack Coat will be paid for at the Contract unit bid price.

SECTION 2205 ASPHALTIC CONCRETE SURFACE AND BASE

2205.1 Scope

This section governs the furnishing of all labor, materials and equipment for the construction of asphalt concrete base and/or asphalt concrete surface as shown on the Plans and in accordance with the Standard Drawings, the specifications and the Special Provisions.

2205.2 Referenced Standards

The following standards are referenced directly in this section. The latest version of these standards shall be used. If conflicting standards are referenced, the more stringent standard shall apply.

ASTM

- C 88 Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
- C 117 Test Method for Materials Finer than 75- um (No. 200) Sieve in Mineral Aggregates by Washing
- C 127 Test Method for Specific Gravity and Absorption of Coarse Aggregate
- C 128 Test Method for Specific Gravity and Absorption of Fine Aggregate
- C 131 Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- C 136 Test Method for Sieve Analysis of Fine and Coarse Aggregates
- C 142 Test Method for Clay Lumps and Friable Particles in Aggregates
- D 75 Practice for Sampling Aggregates
- D 140 Practice for Sampling Bituminous Materials
- D 979 Practice for Sampling Bituminous Paving Mixtures
- D 1188 Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
- D 2041 Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures (comparable to AASHTO T209)
- D 2172 Test Methods for Quantitative Extraction of Bitumen From Bituminous Paving Mixtures
- D 2726 Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
- D 2950 Test Method for Density of Bituminous Concrete in Place by Nuclear Methods

- D 3666 Specification for Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials
- D 4552 Practice for Classifying Hot-Mix Recycling Agents
- D 4791 Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
- D 5444 Test Method for Mechanical Size Analysis of Extracted Aggregate
- D 6307 Test Method for Asphalt Content of Hot-Mix Asphalt by Ignition Method
- D 6373 Specification for Performance Graded Asphalt Binder

AASHTO

- T 166 Standard Method of Test for Bulk Specific Gravity (Gmb) of Compacted Hot Mix Asphalt (HMA) Using Saturated Surface-Dry Specimens
- T 245 Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
- T 269 Standard Method of Test for Percent Air Voids in Compacted Dense and Open Asphalt Mixtures (ASTM Designation: D 3203/D 3203M-11)
- T 283 Resistance of Compacted Bituminous Mixture to Moisture Induced Damage
- T 312 Standard Method of Test for Preparing and Determining the Density of Asphalt Mixture Specimens by Means of the Superpave Gyratory Compactor

Asphalt Institute

"Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types", MS-2, latest edition

Kansas Department of Transportation

Standard Specifications for State Road and Bridge Construction, 2015 Edition

Missouri Highways and Transportation Commission

Missouri Standard Specifications for Highway Construction, 2011 Edition

National Institute of Standards and Technology

Handbook #44, "Specifications, Tolerance and other Technical Requirements for Commercial Weighing and Measuring Devices"

2205.3 Materials

No material shall be used until it has been approved by the Engineer. All costs associated with material testing, certification and the preparation of trial mixes to determine the job mix formula shall be the responsibility of the Contractor. Representative samples of all materials proposed for use under these specifications shall be submitted by the Contractor to a properly certified testing laboratory approved by the Owner, at the Contractor's expense, for testing and the preparation of trial mixes to determine the job-mix formula. Tests required by this specification for field verification of the mix shall be the responsibility of the Contractor at the Contractor's expense, unless specified otherwise. The Engineer reserves the right to perform additional testing to verify conformance with the requirements specified herein. These tests will be performed under the supervision of the Engineer without cost to the Contractor, unless specified otherwise in the Contract Documents.

- A. Asphalt: Asphalt cement used in the manufacture of asphalt paving mixtures shall conform to the Performance Graded system. The PG graded material used shall conform to the provincial grade used by the local DOT or as designated by the Engineer. In the Kansas City Metropolitan area, the provincial grade is a PG64-28 but PG 64-22 is commonly used so either is deemed acceptable.
- B. These general usage guidelines may not address all project conditions. APWA strongly recommends that the Engineer apply sound pavement design principles when designating mix type and selecting asphalt cement

grade based upon individual project conditions. The Federal Highway Administration makes available LTPPBIND software that will assist with asphalt grade selection for specific projects.

The asphalt cement shall conform to ASTM D 6373. Sampling shall be in accordance with ASTM D 140.

The Contractor or asphalt supplier shall submit a temperature-viscosity chart showing the recommended mix and compaction temperatures for non-modified asphalts, and shall provide the specific gravity of the asphalt.

- C. Aggregate: The quality of aggregates used in Asphaltic Concrete shall conform to the following:

Coarse Aggregate (Retained on the No. 4 Sieve)

LA Abrasion (ASTM C 131)	40% loss (maximum)
Soundness using Mag. Sulfate (ASTM C 88, 5 cycles)	18% loss (maximum)
Soundness using Sodium Sulfate (ASTM C 88, 5 cycles)	12% loss (maximum)
Total shale, clay, coal and lignite content (ASTM C 142)	1.0% by weight (max)

Fine Aggregate (Passing the No. 4 Sieve)

Organic content 1% maximum

The parent material of manufactured sand must also meet the requirements for coarse aggregate shown above.

Sampling shall be in accordance with ASTM D 75. Gradation analysis shall be in accordance with Standard Method of Test for Material Finer than No. 200 (75 um) Sieve in Mineral Aggregates by Washing, ASTM C 117 and Standard Method Test for Sieve Analysis of Fine and Coarse Aggregate, ASTM C 136. All aggregate quality tests must have been run within 12 months of the submission date of a mix design.

- D. Commercial Mix: Providing a commercial mix will only be permitted when specified in the Contract Documents or approved in writing by the Engineer. Contractor shall adhere to the most current State Department of Transportation standard specifications governing commercial mix asphalt for the state the work is being performed in. Example: for Kansas, Standard Specifications for State Road and Bridge Construction, 2015 Edition, Section 611, or for Missouri, Missouri Standard Specifications For Highway Construction, 2011 Edition, Division 400.

2205.4 Mixing and Proportioning

- A. Composition of the Mix: Asphaltic concrete mixtures shall consist of Mineral Aggregates and Asphalt Cement within the following limits for the type specified.

ASPHALTIC CONCRETE-TYPE						
	1-01	2-01	3-01	4-01	5-01	6-01
<u>Percent by Weight of Total Mixture</u>						
Asphalt Cement	4-6	4-7	4-7	5-7.5		
Aggregate - U.S. Standard						
<u>Square Sieve Size Total Percent Passing by Weight</u>						
1 ½" (37.5 mm)	100	--	--	--	--	--
1" (25.0 mm)	75-100	100	--	--	100	--
¾" (19.0 mm)	60-85	80-100	100	--	95-100	100
½" (12.5 mm)	--	--	85-100	100	--	86-100
3/8" (9.0 mm)	40-65	60-80	70-90	85-100	--	75-100
No. 4 (4.75 mm)	30-50	48-65	50-70	55-75	--	--
No. 8 (2.4 mm)	19-36	35-47	37-47	39-50	28 min	28 min
No. 16 (1.2 mm)	13-26	25-36	26-36	27-38	--	--
No. 30 (0.6 mm)	--	18-30	18-30	19-30	--	--
No. 50 (0.3 mm)	--	12-22	12-22	11-23	--	--
No. 100 (150 µm)	4-12	6-14	6-15	6-16	--	--
No. 200 (75 µm)	2-10	3-10	4-10	4-10	2-6	2-6

In addition to the above limits, the difference between the "Percent Passing Square Mesh Sieve" of successive sieve sizes shall not exceed 25 for types 1-01, 2-01, 3-01, and 4-01.

That fraction of material retained on the No. 4 (4.75-mm) Sieve shall be composed of particles with not less than 75% having two or more fractured faces for asphalt types 1-01, 2-01, 3-01, and 4-01, and not more than 20% by weight of that fraction shall be composed of flat or elongated particles based on a ratio of 5:1 when tested in accordance with ASTM D 4791. For Asphalt Types 5-01 and 6-01 only, the total aggregate (coarse aggregate, fine aggregate, and the material passing the No. 200 sieve (75µm) shall contain not less than 85% crushed material for intermediate course and surface course.

It shall be noted that when the gradation varies appreciably from the single point gradation used in the mix design, the test properties of the mix will be out of specification. This condition can occur even though the gradation meets the tolerances below.

The job-mix formula shall be within the limits specified above. The maximum permissible variation from the job-mix formula, within the specification limits, shall be as follows:

Permissible Gradation Variation from Mix Design Percent by Wt. of Total Mix:

<u>U.S. Standard Sieve Size</u>	<u>Type 1-01, 5-01, 6-01</u>	<u>Type 2-01, 3-01, 4-01</u>
No. 4 and larger	5.0	4.0
No. 8, 16, 30, 50	4.0	3.0
No. 200	2.0	1.0

Permissible Oil Content Variation from Mix Design:

Type 1-01, 5-01, 6-01 – 0.5%

Type 2-01, 3-01, 4-01 – 0.3%

B. Asphalt Mix General Usage:

	<u>Surface</u>	<u>Base</u>
Arterial	5-01, 6-01	5-01
Collector	5-01, 6-01	5-01
Local/Access	5-01	5-01
Paved Trail	2-01, 3-01, 4-01, 5-01	1-01, 2-01, 5-01
Recreational Surface	4-01	1-01, 2-01, 5-01
Parking Lot	2-01, 3-01, 5-01	1-01, 2-01, 5-01

Generally, mix types 1-01, 2-01, 3-01 and 4-01 are composed of local materials and are appropriate for general use other than roadways. **Unless specified otherwise in the Contract, Plans or Special Provisions, only mixes 5-01 and 6-01 should be used for roadways.** The Contractor may submit a written request to use mix 1-01 for pavement base or mix 3-01 for pavement surface.

Mix type 2-01 is acceptable for surfacing, but is generally more open-graded than the other surface mixes, and may not provide a tightly sealed surface.

Mix type 4-01 is very susceptible to rutting and is only recommended for non-vehicular use.

C. Asphalt Hot-Mix Recycling

1. General: Except as modified herein, Recycled Asphaltic Concrete (RAC) shall be equal to that produced as new material. Reclaimed Asphalt Pavement (RAP), Fractionated Reclaimed Asphalt Pavement (FRAP) and/or Reclaimed Aggregate Materials (RAM) shall represent no more than 30% of the composition for all surface mixtures and no more than 40% of the composition for all base mixtures. However, for base mixtures using FRAP, the composition may be no more than 50%.

Recycled Asphaltic Concrete may contain combinations of FRAP, RAP, RAM, coarse aggregate, fine aggregate, mineral filler, asphalt cement, recycling agent, anti-stripping agent and approved additives to produce an acceptable mixture. Recycled Asphalt Shingles (RAS) are not allowed. Recycled Asphaltic Concretes shall be designated by prefacing the type with "RC," such as "RC Type 1-01".

2. FRAP is defined as having two or more stockpiles, where RAP is processed into coarse and fine fractions. The fine FRAP stockpile will contain only material passing the ¼ inch screen. The coarse FRAP stockpile will contain milled material retained on the ¼ inch screen and passing the ¾ inch screen. FRAP may be comprised of coarse or fine FRAP or a combination thereof. Utilize a separate cold feed bin for each stockpile of FRAP used. Do not blend coarse and fine FRAP either in the stockpile or in a cold feed bin. Add FRAP to the mix through the RAP collar. Sources and types FRAP must be recorded and submitted to the Engineer upon request. The FRAP used in production shall be similar in composition (extracted gradation and asphalt content) to the source used for design.

3. Materials Evaluation: All recycled materials shall have the following tests performed in addition to those required in Section 2205.4.D:
 - a. A sieve analysis shall be performed on FRAP, RAP and/or RAM in accordance with ASTM C 117, "Standard Test Method for Material Finer than No. 200 Sieve (75 um) in Mineral Aggregates by Washing" and ASTM C 136, "Standard Method for Sieve Analysis of Fine and Coarse Aggregates" after extraction of asphalt.
 - b. Asphalt content analysis shall be performed for FRAP or RAP in accordance with Method "A" of ASTM D 2172, "Standard Test Methods for Quantitative Extraction of Bitumen from Bituminous Paving Mixtures" where the FRAP or RAP content exceeds 30%. For mixtures

with FRAP or RAP contents less than 30%, asphalt content may be determined using ASTM D 6307.

- c. The asphalt cement used shall be determined as follows:
 - i. For FRAP or RAP contents of up to 20%, the asphalt grade shall be as specified in the mix design.
 - ii. For FRAP or RAP contents from 20% up to 30%, the asphalt grade shall be decreased one temperature range. For example, a design PG 64-22 would be decreased to a PG 58-28.
 - iii. For FRAP or RAP contents from 30% to 50%, the asphalt grade of the new asphalt shall be determined using the procedures outlined in MS-2, latest edition, Appendix A. This would likely result in a PG 52-34.
- d. All sources of material for use in RAC must be approved by the Engineer prior to use.

4. Material Requirements

- a. New asphalt cements added to the aged asphalt shall meet the requirements of Section 2205.3.
 - b. Recycling Agents, if used, shall meet the requirements of ASTM D 4552, "Standard Practice for Classifying Hot Mix Recycling Agents".
 - c. The FRAP, RAP and/or RAM stockpiled at the plant site shall be maintained in stockpiles separated into surface and base. The RAP and/or RAM shall be processed such that 100% will pass the 1-1/2 inch (38 mm) sieve and 90% will pass the 1-inch (25.4 mm) sieve.
 - d. The final product shall be free of foreign matter (e.g., old planer teeth, ice, wood, soil, broken sewer castings, loop detector wire, protective membranes, rubberized joint filler materials and foil turn lane markers, trash, debris, etc.).
5. Mix Design Requirements: The necessary steps for a final mix design for recycled mixtures shall be done in accordance with the Asphalt Institute's Manual MS-2 latest edition in the appendix entitled "Mix Design Using RAP". If there is a change in the RAP and/or RAM percentage from the original amount of RAP and/or RAM in the mix design, a new mix design must be submitted.
6. Asphalt Plant Requirements: All delivery tickets shall designate the type of recycled mix, (RC-Type 1-01, RC-Type 2-01, RC-Type 3-01, etc.).

- D. Mix Design Criteria: Laboratory Test Specimen(s) of mixes 1-01, 2-01, 3-01 and 4-01, combined in proportions of the job-mix formula, shall be prepared and tested in accordance with AASHTO T 245 and the volumetric properties of the compacted paving mixtures as calculated by ASTM procedures using Chapter 4 of the Mix Design Methods for Asphalt Concrete and other Hot-Mix Types (MS-2), latest edition, Asphalt Institute referred hereafter as "MS-2". The Marshall procedure shall be as specified in Chapter 5 of the MS-2.

For mixes 5-01 and 6-01, the procedures outlined in Asphalt Institute's "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types (MS-2)", latest edition, must be used to prepare the asphalt samples for design and quality control testing. The gyratory values for the SuperGyratory Compactor (SGC) to be used for this purpose are $N_{\text{initial}} = 6$, $N_{\text{design}} = 50$, and $N_{\text{max}} = 75$. At N_{initial} , the specific gravity of the specimen must be 90.5% or less of G_{mm} , at N_{max} the specific gravity of the specimen must be 98.0% or less of G_{mm} . The Voids in the Mineral Aggregate (VMA) shall be as specified in Chapter 5 of the MS-2.

The material for the theoretical specific gravity (G_{mm} per ASTM D 2041) and the material for the Marshall specimens and Super Gyratory Compactor specimens (pucks) shall be cured at 285+/-5°F for four hours in a closed oven after the mix is produced in the laboratory. Also, the plant produced mixture shall be tested when the mix is four hours old when preparing a mix design but may be tested when at least two hours old for

production testing. The mixture shall be transported to the laboratory in an insulated container and then stored in a laboratory oven at 285 +/-5°F for the remainder of the curing period. This procedure shall be used when the water-absorption as determined by ASTM C 127 and ASTM C 128 of any aggregate in the mixture exceeds 1.25%. The mixture shall be compacted at 285 +/-5°F. If total mix aggregate absorption exceeds 2.0%, the laboratory may use the G_{mm} dryback option within the test method.

Test requirements and criteria for the paving mixes under these specifications shall be as follows:

Marshall Stability: 1500 lbs. (6672 N) minimum (Types 1-01, 2-01, 3-01, and 4-01)

No. of compaction blows: 50 (Types 1-01, 2-01, 3-01, and 4-01)

Flow: 0.08-0.16 inches maximum (Types 1-01, 2-01, 3-01, and 4-01)

<u>Air Voids:</u>	<u>Percent</u>
Base & Surface (Types 5-01 & 6-01)	3-5
Base & Surface (Types 1-01, 2-01, 3-01, and 4-01)	2-5

<u>Voids filled with asphalt (VFA)</u>	<u>Percent</u>
Types 5-01 & 6-01	65-75

Voids in Mineral Aggregate (VMA) for Types 5-01 & 6-01

<u>(Nominal Max Size as defined in MS-2)</u>	<u>Percent (min.)</u>
3/4" (19 mm)	13
1/2" (12.5 mm)	14
3/8" (9.5 mm)	15

The VMA for Mix Types 5-01 & 6-01 shall be the minimum value allowed. For these mixes, the asphalt content should be just to the left side of the low point on the VMA vs. Asphalt Percent curve, not to the "wet" or right (increasing) side of the curve. Nominal maximum sized as defined in MS-2 means the sieve size where the next smaller sieve size (from Table in Section 2205.4.A) retains at least 10% of the sample.

The VMA requirements shown represent values that may be higher than those obtained in the KC Metropolitan area using locally available materials. The minimum values are values recommended by the Asphalt Institute in MS-2, latest edition, for high quality asphaltic concretes, but may require the use of non-local aggregates. VMA values shown are for 4% air voids and should be used for the design of conventional roadway pavements.

During production, the air voids can be expected to vary plus or minus 1% of the design value of 4%. For Mix Types 1-01, 2-01, 3-01, and 4-01, 3% - 4% air voids may be used for design and production may be allowed to vary plus or minus 1% of the design value.

The ratio of minus 200 (75 um) material to % Effective asphalt cement (P_{eff}) based on the weight of the aggregate shall be between 0.6-1.4 for Mix Types 5-01 and 6-01.

The blend of FRAP, RAP and/or RAM and virgin aggregates or non-recycled asphalts shall be checked for resistance to stripping using AASHTO T 283 to determine if an anti-stripping agent is needed. The index of retained strength shall exceed 75% for Mix Types 1-01, 2-01, 3-01, and 4-01, and 80% for Mix Types 5-01 and 6-01.

- E. Sampling and Testing of the Mixture: All Mix Types shall be sampled in accordance with ASTM D 979 and tested in accordance with AASHTO T 245, ASTM C 136, ASTM C 117, AASHTO T 312, AASHTO T 269,

AASHTO T 166, AASHTO T 283, ASTM D 2041, ASTM D 2726, ASTM D 1188, ASTM D 2950, ASTM C 127 and ASTM C 128, as specified herein. The mixtures will be tested for binder content in accordance with ASTM D 2172 or D 6307. The recovered aggregate will be sieved in accordance with ASTM D 5444.

- F. Mixture Temperature Requirements: The temperature of the completed mix at the plant and at the paver shall be set by the Contractor/Producer who shall consider hauling and placing conditions, asphalt specifications as set forth in Section 2205.3, and weather limitations set forth in Section 2205.9.B. The temperature of Mix Types 5-01 and 6-01 shall not exceed 315° F at the point of discharge from the asphalt plant.

When the mix is produced in a batch-type plant, the aggregate shall be weighed accurately in the designated proportions to provide the specified batch weight. The temperature of the aggregate at the time of introduction into the mixer shall be determined by the Contractor/Producer, with a tolerance of + or - 25° F. In no case, however, shall the temperature of the mixture exceed the maximum temperature recommended by the manufacturer or supplier of the asphaltic cement (generally 350° F).

- G. Control of Mixing Time: The Contractor/Producer shall control mixing time to produce asphaltic concrete that is uniformly and thoroughly coated with asphaltic cement.

- H. Preparation of Asphalt Cement: The asphalt shall be heated so that it can be distributed uniformly throughout the mix. For mixing applications, the specified temperature generally will be such that the asphalt viscosity is within the range of 150-190 centistokes and shall not exceed 350° F. The material shall be sufficiently fluid to produce a complete coating on every particle of aggregate within the specified mixing time.

The Contractor/Producer shall maintain calibrated temperature monitoring equipment at the point of discharge from the asphalt plant and at the asphalt tank, and shall supply temperature records upon request.

- I. Preparation and Handling of Aggregate: Coarse and fine aggregate shall be stored at the plant in such a manner that the separate sizes will not become intermixed. Cold aggregates shall be carefully fed to the plant in such proportions that surpluses and shortages in the bins will not cause breaks in the continuous operation. When loading aggregate into stockpiles, and into cars, barges, and trucks, the material shall be placed in such a manner as to prevent segregation of aggregate sizes. Stockpiles shall be built in uniform layers not exceeding 5 feet in depth.

1. Samples of coarse and fine aggregate shall be submitted to the Engineer for testing upon request. The Contractor/Producer shall be responsible for the preparation and handling of aggregates to insure that the cold-feed gradations fall within the mix design limits. Cold-feed gradation tests shall be taken as requested by the Engineer.
2. Drying: The aggregate shall be thoroughly dried and heated to provide a paving mix temperature within a tolerance of + or - 25° F of that specified by the approved mix design. The moisture content of the heated and dried aggregate shall not exceed 0.5%. The quantity of material fed through the dryer shall in all cases be held to an amount which can be thoroughly dried and heated.

- J. Inspection and Control of Asphalt Mixing Plant

1. Tests: During production the plant shall have the specified tests performed by an approved laboratory. These may include: asphalt (binder) content, aggregate gradation after removal of asphalt, density, stability, % voids, VMA, VFA, theoretical specific gravity, bulk specific gravity, maximum theoretical density, maximum theoretical specific gravity, tensile strength ratio, etc. Properties of the plant produced mix shall be determined using uncompacted mix sampled behind the paver. Laboratories shall be approved if they are:

- a. Accredited in accordance with ASTM D3666; and/or
 - b. Approved for Superpave asphalt testing by the State Highway Department in the state where the plant is located.
 - i. The individual performing the test must carry a state certification for Superpave testing.
 - ii. The laboratory must have an annual certification by an independent testing agency of all testing equipment used for Superpave mix designs, and must also have the Marshall hammer weight and height of drop certified by that same agency.
2. Availability of test reports: The results of the latest current test report shall be furnished to the Engineer upon request. All test reports shall be kept at the plant, and shall be made available upon request. If the mix is found to be outside of tolerance, or outside the specification limits as specified in Section 2205.4, correction shall be made. Test reports shall be furnished on the appropriate attached "Asphalt Concrete Test" form or a similar form containing equivalent information.
3. Frequency of testing for mixes 1-01 through 4-01: the tests listed in paragraph 1 shall be performed a minimum of once for every 3000 tons of asphalt production (minimum of once per day when the plant has produced at least 200 tons and at discretion of Engineer if less than 200 tons produced) except during initial startup, or whenever the production asphalt fails one of the following conditions at which time they will be tested every 1000 tons until 4 consecutive tests show compliance with the specifications:
- a. Production void content measured at the plant discharge is less than 2% or more than 5%.
 - b. Extracted gradation of the production asphalt exceeds the permissible gradation variation for the mix type being produced.
 - c. Asphalt cement exceeds the content variation for the mix type being produced.
4. Frequency of testing for mixes 5-01 and 6-01: the tests listed in paragraph 1 shall be performed once per day of production, or every 1000 tons, whichever is less frequent except during initial startup (if less than 200 tons produced testing is at discretion of Engineer); or whenever the production fails one of the following conditions at which time they will be tested every 500 tons, or twice per day of production, whichever is less frequent until 4 consecutive tests show compliance with the specifications:
- a. Production void content measured at the plant discharge is less than 3% or more than 5%.
 - b. Extracted gradation of the production asphalt exceeds the permissible gradation variation for the mix type being produced.
 - c. Production VMA measured at the plant discharge is below the design minimum VMA.
 - d. Production VFA measured at the plant discharge is outside the allowable range.
 - e. Production dust to binder ratio is outside the allowable range.
5. Redesign of Asphalt mixes: If four consecutive tests performed as described in paragraph 3 or 4 above show noncompliance with the specifications as enumerated in the subparagraphs of paragraph 3 or 4 above, production of that type of asphalt will immediately cease, and may not be resumed until a new mix design is submitted and approved, or the plant can demonstrate to the Engineer an ability to meet specifications. Resumption of asphalt production after a mix redesign or failure of four consecutive tests to meet specifications will be treated as an initial startup for testing purposes.

MARSHALL ASPHALTIC CONCRETE TEST (Verified Mix Design)
(Types 1-01, 2-01, 3-01, 4-01)

Description:

APWA Type:

LAB ID:

Sample Date:

Sample ID:

Supplier:

		LOT	
	Belt		Tons
	Hot Mix		Tons

Sieve Size	Belt Sample	Hot-Mix Sample*	Single Point Job-Mix Formula	Job-Mix Formula Tolerances
1" (25 mm)				
3/4" (19 mm)				
1/2" (12.5 mm)				
3/8" (9.5 mm)				
No. 4 (4.75 mm)				
No. 8 (2.36 mm)				
No. 16 (1.18 mm)				
No. 30 (600 um)				
No. 50 (300 um)				
No. 100 (150 um)				
No. 200 (75 um)				

ASTM C 136,
C 117, D 5444

*Uncompacted
Behind Paver
**total mix basis
***total aggregate

EXTRACTION DATA - ASTM D6307 or D 2172	FRAP	Sample	Plant Setting	Recycled AC%
%AC**				
%AC**				

Aggregate Type	%***	Aggregate Type	%***

MARSHALL CHARACTERISTICS (ACCEPTANCE CRITERIA)			
Compaction Blows (average of 3 specimens) = 50			
	Sample*	Specifications*	
Stability, lbs (kg)		Min	AASHTO T 245
Flow, 1/100 in (mm)		Max	AASHTO T 245
% Voids		3-5	
% VFA			
Density, pcf (kg/cu.m)		-----	ASTM D 2950, D 2726, or D 1188
Max Theoretical Specific Gravity G_{mm}		-----	ASTM D 2041
Bulk Spec. Gr. of total Agg. G_{sb}		-----	ASTM C 127 & C 128
COMMENTS:			

LOT DENSITY SHALL BE TIED TO THE LOT AND DATE (Laboratories shall conform to ASTM D 3666)

SUPERPAVE ASPHALTIC CONCRETE TEST (Verified Mix Design)
(Types 5-01, 6-01)

Description:

APWA Type:

LAB ID:

Sample Date:

Sample ID:

Supplier:

		TIME	TONS
	Belt		
	Hot Mix		

Sieve Size	Belt Sample	FRAP/RAP Sample*	Hot-Mix Sample*	Master Grade Limits	Cal. Single Point
1" (25 mm)					
3/4" (19 mm)					
1/2" (12.5 mm)					
3/8" (9.5 mm)					
No. 4 (4.75 mm)					
No. 8 (2.36 mm)					
No. 16 (1.18 mm)					
No. 30 (600 um)					
No. 50 (300 um)					
No. 100 (150 um)					
No. 200 (75 um)					

ASTM C 136,
C 117, D 5444

*Uncompacted
Behind Paver
**total mix basis
***total aggregate

EXTRACTION DATA - ASTM D6307 or D 2172	FRAP	Sample	Plant Setting	Recycled AC%
%AC**				
%AC**				

Aggregate Type	%***	Aggregate Type	%***

VOLUMETRIC DATA 6" NOMINAL SIZE Gyratory Specimens			
Gyrations (avg. of 2 specimens) @ 280-290 deg F – AASHTO T312			
Ndes = 50 Nini = 6 Nmax = 75	Sample*	Specifications*	
Mix bulk specific gravity @ Ndes, Gmb		---	
% Voids @ Ndes		3.0-5.0	AASHTO T 269
% VMA @Ndes, Gsb basis			
% VFA @ Ndes		9.0-11.0	=%VMA-%Voids
% Gmm @ Nini		85-91	AASHTO T 166
Ratio (-) 75 um (No. 200) to % Eff. Binder		0.6-1.4	
Tensile Strength Ratio, %		80 minimum	AASHTO T 283
Max Theoretical Specific Gravity Gmm		-----	ASTM D 2041
Max Theoretical Density, pcf		-----	
Effective Specific Gravity Agg., Gse		-----	
Bulk Specific Gravity of Total Agg., Gsb		-----	ASTM C 127 & C 128
Specific Gravity of Asphalt, Gb		-----	
COMMENTS:			

2205.5 Asphalt Mixing Plant

Plants used by the Contractor for preparation of the asphalt paving mix shall conform to the following requirements:

- A. Field Testing Laboratory: The Contractor shall provide a laboratory building or room at the plant site, for the exclusive use of the Engineer for performing tests, keeping records, and making reports at such times as the Engineer is performing those actions.

The Contractor shall also furnish necessary laboratory sieves and a powered shaker device for sieve analysis, scales, ignition oven and supplementary equipment to make aggregate sieve analysis, asphaltic concrete paving mixture analysis, and paving mixture density tests. This equipment shall be in good working condition and properly calibrated.

- B. The asphalt producer shall establish a quality control plan and shall maintain records. The quality control plan required by the state highway agency is a suggested standard. Upon request by the Engineer, the quality control plan shall be submitted for review and approval.

2205.6 Transportation of Mix

The mix shall be transported to the job site in vehicles with tight metal bottoms, clean of all foreign material which may affect the mix. If a release agent is used, it must comply with State and Federal environmental regulations.

The dispatching of the vehicles shall be so scheduled that all materials delivered may be placed in daylight unless the Engineer approves artificial light. Delivery of the material to the paver shall be at a uniform rate and in an amount within the capacity of the paving and compacting equipment.

Haul trucks shall be provided with covers of sufficient size and weight to completely cover the truck bed to protect the load and to prevent cooling of the upper surface. Failure to have the load completely covered shall be sufficient cause for rejection of the entire load. The load shall remain covered until the truck is next in line to be unloaded. In no case shall a load remain uncovered for more than 10 minutes before starting to use the load. If for any reason there is a delay in completely using a load, the remaining part of the load shall be recovered until it can be used. It shall be the responsibility of the Contractor to inform all truck drivers of these provisions before starting work.

2205.7 Scales and Weighing of Vehicles

The vehicle's tare and gross weight shall be established by weighing the vehicle on a certified scale. The tare weight will be established at least twice each day. The vehicle, when establishing tare, shall be clean, bed empty, fuel tanks filled and shall have all side and back boards in place.

- A. Measurement by weight: Measurement will be made by weighing each truck load on scales conforming to the requirements of Section 2205.7.B "Vehicle Scales".
- B. Vehicle Scales: Vehicle scales shall be approved by the Engineer and shall conform to the requirements specified herein. The specifications, tolerances, and other technical requirements for weighing and measuring devices as recommended by the National Conference on Weights and Measures and published in the National Institute of Standards and Technology Handbook 44, Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices, and supplements thereto or revisions thereof, shall apply to all vehicles scales used.
- C. Scale acceptance shall be based on one of the following:

1. A valid certification or seal of approval by the Division of Weights and Measures from the state.
 2. A certification of calibration from a commercial scale service company showing that the scale meets the requirements of these specifications. The Contractor shall furnish the certification of calibration to the Engineer.
- D. Scale Calibration: Scales shall have been calibrated within the nine month period prior to any material being delivered, or at any time the Engineer has cause to question the accuracy of the scale. Scales shall meet the requirements of Accuracy Class III L as defined in Handbook 44 (above).

Verification of a vehicle scale may be required by weighing a hauling unit on another recently calibrated and certified scale.

If equipment to be weighed is of such length that all axles cannot be weighed simultaneously, a level paved surface shall be provided permitting those axles not on the scale platform to be supported by the paved surface. The approach shall be at least as wide as the platform and of sufficient length to insure the level positioning of vehicles during weight determinations. The weighing shall be performed with all brakes released. If equipment to be weighed is equipped with an air bag suspension unit on any axle, the equipment including semi-trailers or pup trailers shall be weighed on vehicle scales of sufficient size to weigh all axles of the combination simultaneously.

All costs incurred in obtaining a certification of calibration or verification shall be borne by the Contractor.

2205.8 Asphalt Paving Equipment

All asphalt paving equipment used by the Contractor shall meet the requirements of this section and shall be maintained in acceptable mechanical condition. Equipment shall be serviced and lubricated away from the paving site. Units that drip fuel, oil, grease or other fluids shall be removed from the project until such leakage is corrected.

- A. Pavers and Laydown Machines: Mechanical self-powered pavers shall be capable of spreading the mix within the specified tolerances, true to the line, grade and crown indicated on the Plans.

Pavers shall be in good working condition, equipped with quick and efficient steering devices and shall be capable of traveling both forward and in reverse. They shall be equipped with hoppers and distributing screws that place the mix evenly in front of the adjustable screeds. They shall be equipped with either a vibrating screed or a tamping bar immediately preceding a static screed. There shall be sufficient auxiliary attachments for the paving machine so that it may be operated to lay the necessary width as determined in the field by the Engineer. Vibrating screed or tamp bars shall be provided for the full width of all paving operations.

The screed shall include a strike-off device which is effective on mixes at workable temperatures without tearing, shoving or gouging them, and which produces a finished surface of an even and uniform texture. The screed shall be adjustable as to the height and crown and shall be equipped with a controlled heating device for use when required. However, for irregular width paving, hydraulic extensions without tamping bars or a vibrating screed may be used only along the curb or outer edge of pavement.

1. Automatic Screed Controls: The paver shall be equipped with and use an approved system capable of automatically controlling the elevation and transverse slope of the paver screed unless otherwise directed by the Engineer. An erected stringline, traveling stringline or other approved device operating on the roadbed being paved or the surface of the previously placed lane shall be used to establish the grade reference. The grade reference device shall operate on either or both sides of the paver as

required and shall be capable of maintaining the desired transverse slope regardless of changes in the screed elevation.

2. The traveling stringline shall be constructed in such a manner that it does not vibrate or cause the sensor to make erroneous readings during the laydown operation. The length of the beam to be used shall be approved by the Engineer and shall be between 20 feet and 40 feet.
 3. The use of the automatic screed control devices on asphalt pavers will not be required for paving small irregular areas, entrances, approaches, or side street connections.
 4. Automatic screed control devices will be required for matching the joint with all previously laid strips, except for those areas noted above.
- B. Rollers:** Compaction equipment shall consist of vibratory steel wheel, static steel wheel and pneumatic-tired rollers unless otherwise directed by the Engineer. They shall be self-propelled and equipped with such controls that starting, stopping and reversing direction can be accomplished without displacing the hot asphaltic concrete pavement.
- Rollers shall be equipped with adjustable scrapers to keep the wheel surfaces clean and with efficient means of keeping them wet to prevent mixes from sticking. The roller surfaces shall have no flat areas, openings or projections that will mar the surface of the pavement.
1. **Steel-Wheeled Rollers:** Steel-Wheeled Rollers shall be self-propelled, vibratory two-axle tandem rollers. These rollers shall develop contact pressure of 250 to 350 pounds per inch of width (vibratory mode) or 150 to 180 pounds per inch of width (static). Rollers shall be in good working condition.
 2. **Pneumatic-Tired Rollers:** Heavy pneumatic-tired rollers shall be self-propelled and shall consist of two axles on which are mounted an odd number of pneumatic-tired wheels. The roller shall have at least nine pneumatic-tired wheels mounted in such a manner that the rear group of wheels will not follow in the tracks of the forward group, but shall be spaced to give essentially uniform coverage with each pass. Axles shall be mounted in a rigid frame provided with a loading platform or body suitable for ballast loading. Tires shall be smooth, inflated to 90 psi. Construction of the roller shall be such that each wheel is loaded to a minimum of 2,300 pounds.
 3. In lieu of the above requirements, consideration will be given to use other types of equipment that are capable of producing equivalent results consistent with the requirements of the specifications. Any roller not meeting the requirements of paragraphs 1 and 2 above must be approved by the Engineer prior to use.
- C. Pressure Distributor:** The pressure distributor shall meet the requirements of Section 2204.4.A entitled "Pressure Distributor".
- D. Hand Tools:** The Contractor shall provide sufficient lutes, rakes, shovels, and other equipment as required to produce results consistent with the specifications.

2205.9 Construction

- A. Preparation of the Area to be Paved:** The area to be paved shall be true to line and grade, and shall have a properly prepared surface prior to the start of the paving operations. It shall be free from all loose or foreign material.

Where a base is rough or uneven, a leveling course shall be placed and properly compacted before the placing of subsequent courses.

When leveling course is not required, depressions and other irregularities shall be patched or corrected, and the work approved by the Engineer before the paving operation begins.

The area to be paved shall be primed or tacked uniformly in accordance with the provisions of Section 2204 entitled "Prime and Tack Coat".

The surfaces of curbs, gutters, vertical faces of existing pavements and all structures in actual contact with asphalt mixes shall be painted with a thin, complete coating of tack to provide a closely bonded joint.

- B. Weather Limitations: When the moisture of the aggregate in the stockpile or from the dryer interferes with the quality of mix production, or with normal plant operations, the mixing and placing of hot-mix asphalt will not be permitted without the permission of the Engineer. No mixture shall be placed on wet or frozen surface.

Hot Mix asphalt paving shall not be mixed or placed when the ambient air or base temperature is below the temperatures shown in the following table, or when there is frost in the subgrade or any other time when weather conditions are unsuitable for the type of material being placed without expressed approval of the Engineer.

<u>Paving Course</u>	<u>Thickness (inches)</u>	<u>Air Temperature (Degrees F)</u>	<u>Road Surface Temperature (Degrees F)</u>
Surface	All	50	55
Base	Less than 3	40	45
Base	3 or more	30	35

All bituminous mixtures shall be delivered to the paver at a temperature sufficient to allow the material to be placed and compacted to the specified density and surface tolerance. Minimum allowable temperature for the asphalt mix to be placed into the paver is 235° F. Regardless of the temperature, final acceptance of the asphalt mat shall be based on density determined in accordance with Section 2205.9.E.

- C. Spreading and Finishing: The spreading and finishing of each course shall be to the thickness, cross slope, and width indicated on the Plans or Special Provisions. The thickness of individual layers shall not exceed the following for the respective type of mixture. The suggested minimum lift thickness shall be three times the nominal maximum size of the mix. Nominal maximum is defined as the first sieve size larger than the sieve which retains at least 10% of the aggregate by weight.

<u>Asphalt Type</u>	<u>Max. Compacted Lift Thickness</u>
Type 1-01	4"
Type 2-01	4"
Type 3-01	3"
Type 4-01	2"
Type 5-01	4"
Type 6-01	3"

Spreading and finishing shall be conducted in the following manner:

1. Mechanical Pavers: The base and surface courses shall be spread and struck-off with a mechanical paving machine meeting the requirements of Section 2205.8.A entitled "Pavers and Laydown

Machines". The paving machine shall be operated so that the material does not accumulate and remain along the sides of the receiving hopper. The wings of the spreader hopper shall not be emptied (flipped) between truck loads.

- a. Equipment which leaves tracks or indented areas which cannot be corrected in normal operation, or which produces other permanent blemishes or fails to produce a satisfactory surface, shall not be used.
 - b. The screed auger shall be operated approximately 3/4 full and the hopper conveyor shall not be allowed to run out of material during the paving operation. Sufficient trucks shall be used to continuously supply asphalt to the paver. Delays in the paving operation shall be kept to a minimum.
 - c. When using pavers in echelon, the second paver shall follow the edge of the material placed by the first paver. The length of each laydown pass shall be limited, depending on weather conditions, to assure a hot joint and obtain proper compaction.
2. Longitudinal joints and edges shall be constructed to true lines. Lines for the paver to follow in placing individual lanes will be established parallel to the centerline of the proposed roadway. The paver shall be positioned; and operated to follow closely the established line. Offset the longitudinal joint in successive courses by 6 to 12 inches. Longitudinal joints in the final surface layer shall be at the lane lines of the traveled way, but shall be offset to prevent lane separation pavement markings from falling on the joint. Any irregularities in alignment left by the paver shall be corrected directly behind the paver, prior to compaction. Distortion of the pavement during this operation shall be avoided. Edges against which additional pavement is to be placed shall be placed on a 30° (2:1) bevel, or as specified by the Engineer.
 3. Transverse joints in succeeding courses shall be offset at least 2 feet.
 4. The Contractor shall make every effort to minimize the number of passes heavy equipment makes over uncompleted roadway sections. The Contractor shall schedule and route his hauling operation to minimize hauling over a final course as much as feasible.
 5. As soon as the first load of material has been spread, the texture of the unrolled surface shall be checked to determine its uniformity. Segregation of materials shall not be permitted. If segregation occurs, the spreading operation shall be immediately suspended until the cause is determined and corrected by the Contractor.
 6. Any irregularities in the surface of the pavement course shall be corrected directly behind the paver. Excess material forming high spots shall be removed by a shovel or lute. Indented areas shall be filled with hot mix and smoothed. Broadcasting of material shall not be permitted.
 7. Hand Spreading: In small areas where the use of mechanical finishing equipment is not practical, the mix may be spread and finished by hand. The material shall be distributed uniformly to avoid segregation of the coarse and fine aggregate. Broadcasting of material shall not be permitted. During the spreading operation, all material shall be thoroughly and uniformly distributed by lutes or rakes. Material that has formed into lumps and does not break down readily shall be removed. Following placing and before rolling, the surface shall be checked with templates and straightedges and all irregularities corrected.

D. Compaction

1. General: The Contractor is responsible for development of a compaction procedure that will obtain the

required density. A minimum of three rollers shall be used for compacting mixes on roadways (2 steel drum and 1 pneumatic tire) unless otherwise approved by the Engineer. For uses other than roadways, a minimum of two rollers shall be used unless otherwise approved by the Engineer. Rollers shall meet the requirements of Section 2205.8.B entitled "Rollers".

Immediately after spreading, each course of the pavement mixture shall be uniformly compacted by rolling. The initial or "breakdown" rolling shall be accomplished with a steel-wheeled vibratory roller and shall take place as closely behind the laydown machine as the temperature and condition of the mat will allow. The pneumatic-tired roller shall be used to knead and compact the pavement mixture following the initial rolling and preceding the final rolling. Care shall be exercised in the use of the pneumatic-tired roller to ensure that the pavement mixture is sufficiently cooled to avoid "picking up" of the mixture on the tires of the roller, and also to ensure that the pneumatic-tired rolling is completed before the mixture becomes too cool to allow satisfactory finish rolling. Final, or finish rolling, shall be done with a steel-wheeled roller in static mode. The sequence of rolling operations may be changed with the approval of the Engineer. Rolling shall be longitudinal, starting near the low or unconfined edge of the pavement, then to the other edge and finally progressing towards the center. Alternate trips of the roller shall be of slightly different lengths.

The motion of the roller shall be slow enough at all times to avoid displacement of the hot mixture (generally 3mph). Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected immediately by the use of rakes and fresh mixture when required. To prevent adhesion of the mixture to the roller, the wheels shall be kept properly moistened, but excess water will not be permitted.

The surface of the mixture after compaction shall be smooth and true to established section and grade. Any surface which is segregated, or is in any way defective, shall be removed and replaced with fresh hot mixture at the Contractor's expense, and shall be immediately compacted to conform to the surrounding area.

2. Rolling Procedure: The Contractor is responsible for determining an acceptable rolling procedure that will provide a product that is uniformly compacted to the required density and true to line and grade. There are many possible variations that may accomplish this but the general order for rolling is:
 - a. Transverse joint
 - b. Longitudinal joint (if in echelon)
 - c. Unconfined or low side edge
 - d. Other edge
 - e. Middle
 - f. Intermediate rolling; same procedure as breakdown rolling but pneumatic roller should stay the thickness of the lift from the free edge
 - g. Finish rolling

When paving in echelon, 2-3 inches of the first mat shall be left unrolled, and rolled when the joint between the lanes is rolled, after the 2nd mat is placed. Edges shall not be exposed more than fifteen minutes without being rolled. Particular attention shall be given to the construction of transverse and longitudinal joints in all courses.

In laying a surface mix adjacent to any finished area, it shall be placed sufficiently high so that, when compacted, the finished surface will be true and uniform. Where the grade is slight a level will be used to insure drainage to the desired outlet.

3. Transverse joints: The Contractor shall use a method of making a transverse construction joint that provides a thorough and continuous bond with acceptable surface texture and meeting the density requirements. The surface elevation should not vary more than 3/16" in 10' when tested across the joint. If the joint has been distorted, it shall be trimmed to a line. The joint face shall be tacked before the fresh material is placed against it.
 4. Longitudinal joints: When paving against existing asphalt pavement, the edge to be joined shall be tack coated. The paver screed shall be set to overlap the first mat by 1-2 inches. The elevation of the screed above the surface of the first mat should be equal to the amount of roll-down expected during compaction of the new mat. For large aggregate mixes, the coarse aggregate in the material overlapping the cold joint should be carefully removed and wasted, leaving only the finer portion of the mixture. The overlapping material should be pushed with a lute or rake onto the side of the joint where the new pavement is located prior to compaction.

When paving against existing concrete pavement, curb and gutter or other structure, the edge to be joined shall be tack coated. The elevation of the screed above the surface of the first mat should be equal to the amount of roll-down expected during compaction of the new mat. Where drainage of stormwater will flow from the new mat onto abutting curb and gutter, add an additional 1/8" - 1/4" of thickness to the new mat.
 5. Breakdown Rolling: Steel wheel rollers as specified in Section 2205.8.B entitled "Rollers" shall be used for breakdown rolling. Breakdown rolling shall be performed as close behind the paver as necessary to obtain adequate density without causing undue displacement. The breakdown roller shall be operated with the drive wheel nearest the laydown machine. Exceptions may be made by the Engineer when working on steep slopes or super-elevated curves. Breakdown rolling sequencing is to be determined by the Contractor and approved by the Engineer.
 6. Intermediate Rolling: Pneumatic-tired rollers as specified in Section 2205.8.B entitled "Rollers" shall be used for intermediate rolling unless otherwise approved by the Engineer. The intermediate rolling shall follow the breakdown rolling as closely as possible and while the paving mix is still of a temperature that will result in maximum density from this operation. Pneumatic-tired rolling shall be continuous after the initial rolling until all of the mix placed has been compacted to the required density. Turning of pneumatic-tired rollers on the hot paving mix which causes displacement shall not be permitted.
 7. Finish Rolling: The finish rolling shall be accomplished before the material falls below a temperature of 175° F to allow for the removal of roller marks. All roller marks shall be removed by the finish rolling operation. All rolling operations shall be conducted in close sequence.
 8. In places inaccessible for the operation of standard rollers as specified, compaction shall be performed by other means meeting the requirements of Section 2205.8.B entitled "Rollers." The Contractor shall ensure that the material is thoroughly compacted to the satisfaction of the Engineer. If approved by the Engineer, hand tamping, manual or mechanical, may be used in such areas, if the required density is met.
- E. Density and Surface Requirements: The completed asphalt concrete paving shall have a density equal to or greater than 95% for Types 1-01 and 5-01 Asphalt Concrete Base and 96% for Types 2-01, 3-01, 4-01, 5-01, and 6-01 Asphalt Concrete Surface. Density is based on the density of laboratory specimens from plant produced mix prepared as specified in Section 2205.4.D entitled "Mix Design Criteria" and made from a sample representing the material being tested. Density testing shall conform to ASTM D 2950, ASTM D 2726, or ASTM D 1188.

If cores are used to determine density, one or more tests (one test equals three cores) will be taken for each tonnage lot and averaged to determine acceptance. The cores will be taken from random locations within the lane being paved, a minimum of 1' from any joint or edge. The Engineer will mark the locations of all cores.

All unsatisfactory work shall be repaired, replaced or corrected. The surface of the final course shall be of a uniform texture and conform to line and grade shown on the Plans. Allowable tolerance for the final surface of roadway pavement shall conform to the requirements of Section 2211 entitled "Smoothness". Tests for Plan grade conformance and surface smoothness shall be performed by the Contractor in the presence of the Engineer. Tests shall be performed at intervals as directed by the Engineer.

2205.10 Method of Measurement

Asphaltic concrete base, asphaltic concrete surface, or asphaltic concrete base and surface may be included in the Contract Documents as separate items, or as a single item, and may be measured by one of the following:

- A. Per square yard or tenth part thereof for the specified depth.
- B. Per ton or tenth part thereof.
- C. If pavement smoothness is required in the Contract, payment shall be in accordance with Section 2211.

2205.11 Basis of Payment

Asphaltic Concrete Surface, Asphaltic Concrete Base, or Asphaltic Concrete Base and Surface whether used for paving, patching, or leveling courses will be paid for by one of the following:

- A. Contract unit bid price.
- B. Contract lump sum bid price.
- C. Testing described in Section 2205 is subsidiary to the price bid for asphalt unless otherwise provided for in the Contract.

SECTION 2206 ASPHALT CRACK SEALING, ASPHALT CRACK FILLING, CHIP SEALING, SLURRY SEALING, AND MICRO-SURFACING

2206.1 Scope

This section governs the furnishing of all labor, materials and equipment for the performance of asphalt crack sealing, asphalt crack filling, chip sealing, slurry sealing and micro-surfacing as shown on the Plans and in accordance with the Standard Drawings, the specifications and the Special Provisions.

2206.2 Referenced Standards

The following standards are referenced directly in this section. The latest version of these standards shall be used. If conflicting standards are referenced, the more stringent standard shall apply.

ASTM

- C 88 Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
- C 117 Test Method for Materials Finer than 75- um (No. 200) Sieve in Mineral Aggregates by Washing
- C 131 Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- C 136 Test Method for Sieve Analysis of Fine and Coarse Aggregates
- C 142 Test Method for Clay Lumps and Friable Particles in AggregatesD 36 Standard Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)
- D 140 Practice for Sampling Bituminous Materials
- D 242 Standard Specification for Mineral Filler For Bituminous Paving Mixtures
- D 244 Standard Test Methods for Emulsified Asphalts
- D 946 Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction
- D 977 Standard Specification for Emulsified Asphalt
- D 1073 Standard Specification for Fine Aggregate for Bituminous Paving Mixtures
- D 2027 Standard Specification for Cutback Asphalt (Medium-Curing Type)
- D 2028 Standard Specification for Cutback Asphalt (Rapid-Curing Type)
- D 2397 Standard Specification for Cationic Emulsified Asphalt
- D 2419 Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
- D 3381 Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction
- D 3910 Standard Practices for Design, Testing, and Construction of Slurry Seal
- D 5078 Standard Specification for Crack Filler, Hot-Applied, for Asphalt Concrete and Portland Cement Concrete Pavements
- D 6372 Standard Practice for Design, Testing, and Construction of Micro-Surfacing
- D 6690 Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements

AASHTO

- T 53 Softening Point of Bitumen (Ring-and-Ball Apparatus)
- T 59 Testing Emulsified Asphalts
- M 208 Standard Specification for Cationic Emulsified Asphalt

ISSA Bulletin #139 "Test Method to Classify Emulsified Asphalt/Aggregate Mixture Systems by Modified Cohesion Tester Measurement of Set and Cure Characteristics"

Manual of Uniform Traffic Control Devices, latest Edition (MUTCD)

2206.3 Crack Sealing/Filling

- A. Crack Sealant Application: Material used for crack sealing shall be a modified asphalt product selected to be compatible with the environment of application and found to meet the criteria of ASTM D 6690 with a modified resilience value between 30 and 60 percent, or material meeting the requirements of ASTM D 5078. Crack Sealing shall be understood to be the process of placing an asphaltic material into and/or above working cracks to prevent the intrusion of surface water and/or incompressibles into the crack. A working crack shall be understood to correspond to cracks that sustain more than 0.1 inch of movement during the course of the year.
- B. Crack Filling Application: Material used for crack filling shall be a viscosity graded AC-20 asphalt product meeting the criteria of ASTM D 3381 Table 1, a penetration-graded asphalt product having a penetration number in the range of 85-100 measured in accordance with ASTM D 946, or material meeting the criteria of ASTM D 5078. Crack filling material may contain polyester or polypropylene fibers.
- C. Material satisfying the criteria of a crack sealant may also be used as a crack filling material. Crack filling shall

be understood to be the process of placing an asphaltic material into non-working cracks to substantially reduce water infiltration and reinforce adjacent cracks. Crack filling materials shall not be used for sealing pavements in preparation for an overlay.

D. Equipment

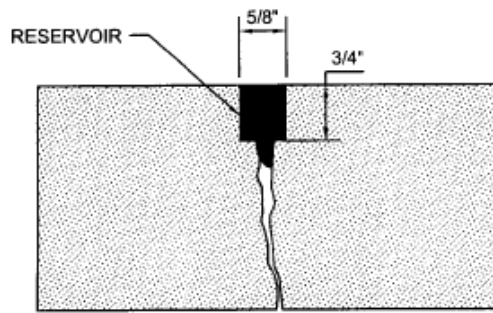
1. Router: This machine shall be an impact cutter head with a minimum of 6 tungsten-carbide cutters. The router blades shall be driven with a minimum 25-hp gasoline engine.
2. Compressor: The compressor shall be a two-stage compressor rated as a minimum 40 CFM unit capable of delivering compressed air to the nozzle at a minimum pressure of 100 psi. The compressor shall be equipped with a filter trap to eliminate oil and moisture from the air line.
3. Hot-Air Lance (HCA): The hot air lance shall be capable of delivering super-heated air at an exit temperature in excess of 1500 degrees F and at a velocity in excess of 1000 ft/sec against the side walls of the crack. The hose shall be wrapped with reflective tape to keep hoses together and to protect workers in low light situations.
4. Melter/Applicator
 - a. The melting pot shall consist of double-boiler type jacket and shall be equipped with a full sweep agitator that promotes proper mixing and maintains uniform heat distribution throughout the melting pot. The melting pot shall have sufficient capacity of the heat transfer oil reservoir that heat transfer oil is able to come in contact with 100 percent of the outside area of the jacket. The melting pot shall be equipped with a drain plug to permit 100% of the heat transfer oil to drain from the boiler. The heat transfer oil shall consist of ISO grade 68.
 - b. The heat transfer oil shall be heated with a properly sized vapor fuel LP or diesel fuel burner. The heat shall be applied directly to the bottom of the heat transfer tank. The burner shall be lit by an electric spark igniter controlled by a sensor, which detects a lack of burn or ignition and subsequently shuts down the fuel supply. The unit must be capable of starting at ambient temperature and bringing the sealant up to the required applications temperature within the period of approximately one hour while continuously agitating and recirculating the sealant. The unit shall have the capability of independently monitoring both the transfer oil and melting pot temperatures. The unit shall be capable of heating a variety of application materials within a range of temperatures between 200 ° F and 425 ° F. The sealant should not be heated to a temperature in excess of that specified by the manufacturer.
 - c. The agitator and material pump shall be actuated by hydraulic motors driven by a single, pressure-compensated hydraulic pump. Hydraulic fluid should only be pumped to the agitator or material pump motor on demand.
 - d. The sealant shall be applied to the pavement through an application system consisting of a pressure feed hose and wand. The hose shall be specially manufactured to handle liquid asphalt products up to 450 ° F at 350 psi working pressure. The hose shall not be less than 15 feet in length. The hand wand shall be constructed of steel of sufficient strength to withstand normal day-to-day operations. Material flow through the wand shall be controlled with a toggle switch. A squeegee shall be used to distribute the asphalt evenly and uniformly in the recommended configuration.
 - e. All equipment shall be in good working order, as determined by the Engineer, on a day-to-day basis. The Engineer shall not be responsible for payment of labor or rental charges on days when the equipment is not in good working order.

E. Preparation

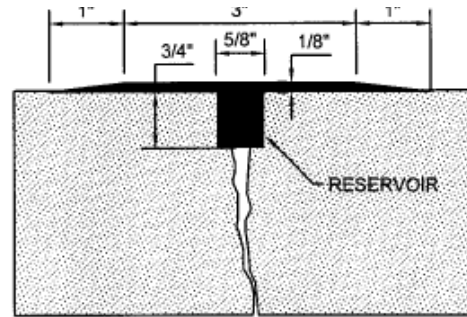
1. Crack sealing shall be limited to working, transverse and longitudinal cracks that are more than 1/8-inch in width. Cracks 1/8- to 5/8-inches in width requiring sealing shall be routed to 5/8-inches in width. Cracks 5/8- to 1-inch in width requiring sealing do not require routing but shall be thoroughly cleaned and sealed. Cracks shall be sealed using either the Standard Reservoir and Flush or Standard Recessed Band-Aid configurations. Cracks greater than 1-inch in width shall be filled with either an emulsion slurry and sand, widened and backfilled with Hot-Mix Asphalt (HMA) in compliance with Section 2205, or repaired in a manner approved by the Engineer. Cracks requiring filling do not require any routing but simply thorough cleaning. Cracks shall be filled using either the Simple Band-Aid, Simple Flush Fill, or Capped configurations.
2. Cracks shall be clean and free of all deleterious materials, including any old sealant, incompressibles, and organic material. The crack shall be free of any standing water and any moisture along the sidewalls of the crack as evidenced by a darker color than the adjacent pavement. This shall be accomplished in one of three manners: wire-brushing – where the crack channels are cleaned with a mechanical wire brush followed by high-pressure compressed air; hot air blasting – where the crack channels are cleaned, heated, dried with hot compressed air (HCA) lance connected to a high pressure air compressor; or high-pressure air blasting – where the crack channels are cleaned with high-pressure compressed air. Pavement cracks to be sealed or filled shall be cleaned and dried using one of the methods described previously within 10 minutes of the application of the sealer/filler. Equipment for the two operations should be kept in a compact configuration such that not more than 50 feet separates equipment required by the two operations. Additionally, not more than 10 minutes time shall pass between the cleaning of a crack and the filling of the crack with the appropriate sealing/filling material.

F. Installation

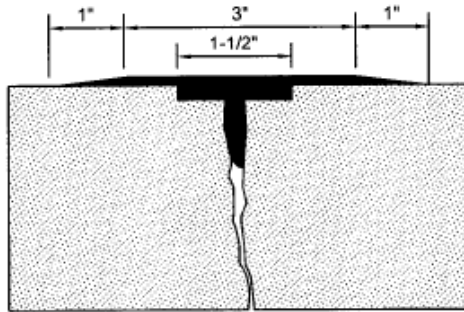
1. Sealer/filler materials should not be applied when the pavement surface is wet or when the pavement temperature is less than 40 ° F without the use of hot air blasting or the approval of the Engineer.
2. Sealant/Crack filler should be applied to fill the crack from the bottom to the top in order to prevent air bubbles from forming and creating a point of weakness in the sealant. Upon application, hot sealant/filler material should not make a hissing or popping noise indicative of moisture in the crack. Noises of this kind should indicate that additional drying of the crack is necessary in order to facilitate proper bonding of the material to the sidewalls of the crack. Application of the sealant/filler material shall be made in such a way as to completely fill the crack and provide enough excess to facilitate completion of the seal/fill consistent with the configuration selected. The use of a squeegee or applicator disk to shape the application material to conform to one of the material placement configurations shown on Figure 1 is required. Care shall be taken not to place any sealant/filler material on top of any pavement markings, manholes, or drainage castings. The Contractor shall be responsible to prevent tracking of the sealant/filler material onto the adjacent pavement surfaces to the satisfaction of the Engineer.
3. The manufacturer's technical representative shall be notified by the Contractor and shall be present during the initial installation. Prior to beginning the work, the Contractor will be required to demonstrate to the satisfaction of the Engineer and the manufacturer's representative his ability to apply the material in accordance with the manufacture's specifications. Operations and procedures which are considered by the Engineer as detrimental to the effectiveness of the material will not be permitted.



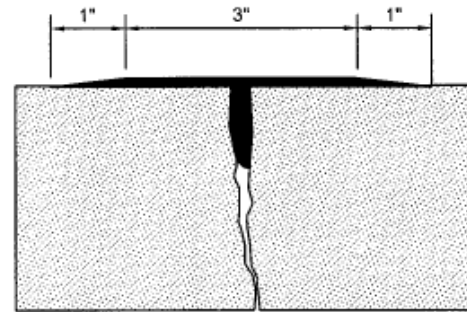
Configuration A
Standard Reservoir-and-Flush



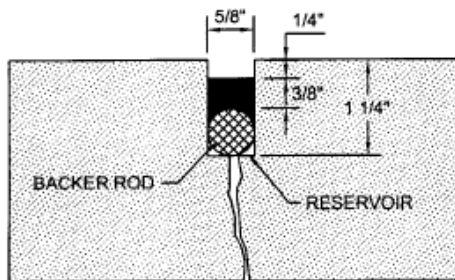
Configuration B
Standard Recessed Band-Aid



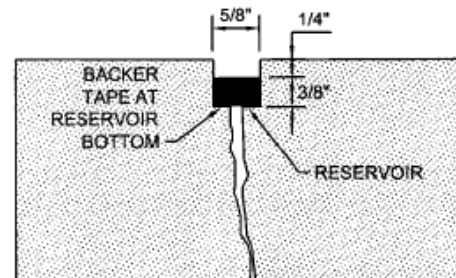
Configuration C
Shallow Recessed Band-Aid



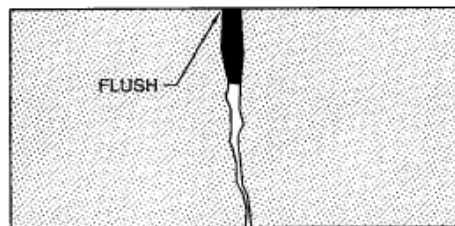
Configuration D
Simple Band-Aid



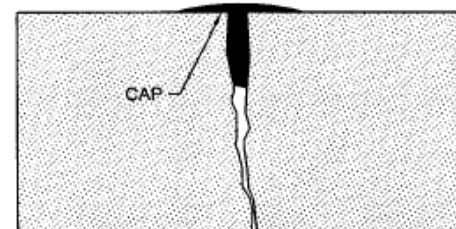
Configuration E
Deep Reservoir-and-Recess



Configuration F
Standard Reservoir-and-Recess



Configuration G
Simple Flush-Fill



Configuration H
Capped

Material placement configurations for crack treatments

Figure 1

2206.4 Improved Street Chip Seal

A. Description: This work shall consist of the application of a thin, uniform layer of emulsified asphalt to the existing pavement surface in order to universally seal cracks from the intrusion of surface water. Cover aggregate shall then be uniformly distributed upon the asphalt layer and seated in place with the use of a rubber-tired roller. Any excess aggregate material shall be removed, leaving a durable wearing surface.

B. Material Requirements

1. Emulsified Asphalt

- a. The asphaltic sealant material applied to the roadway surface shall consist of a rapid-setting emulsified asphalt either an anionic RS-2 meeting the criteria of ASTM D 977 or a cationic CRS-2 meeting the criteria of ASTM D 2397. These materials may be modified with rubber products in the form of liquid latex, styrene-butadiene-rubber, or styrene-butadiene-styrene to enhance performance of the material as approved by the Engineer. If a polymer-modified material is used, the emulsified asphalt shall meet the additional specification criteria required by the Engineer.
- b. A sample of the emulsified asphalt may be taken from any of the distributors or delivery tankers on the job site. Failure of the emulsified asphalt to meet the material specification criteria at the time of application shall require the Contractor, at his own expense, to correct all unsatisfactory areas. No additional areas shall be sealed until correction has been made to the satisfaction of the Engineer.

2. Cover Aggregate – Pre-coated Chips

- a. Materials: Aggregate materials shall consist of an approximately cubic and uniformly-graded, hard, durable 100 percent crushed and washed limestone, sandstone, lightweight aggregate, basalt/porphyry, granitic material, steel slag, gravel, or chat. Chat is a by-product from the production of lead and zinc from the area located in southwestern Missouri, northeastern Oklahoma, and southeastern Kansas. Lightweight aggregate shall consist of expanded shale. The application rates reported in these specifications is for the Bethany Falls Limestone in the Kansas City area. The specific gravity of this material is approximately 2.58.

- b. Physical properties required of the aggregate materials:

Los Angeles Abrasion (ASTM C131)	35% loss (maximum)
Soundness using Mag. Sulfate (ASTM C 88, 5 cycles)	18% loss (maximum)
Soundness using Sodium Sulfate (ASTM C 88, 5 cycles)	12% loss (maximum)
Total Shale, clay, coal, and lignite content (ASTM C 142)	0.5% by weight (max)
Absorption	4.0% (max)

- c. Gradation: Gradation of cover aggregates shall conform to the following percentages:

<u>Sieve Size</u>	<u>Percent Passing</u>
3/4" (19mm)	100
1/2" (12.5mm)	90-95
3/8" (9.5mm)	30-50
No. 4 (4.75mm)	0-5
No. 8 (2.36mm)	0

- d. Pre-coating of Chips: Aggregate chips shall be uniformly heated in a dryer until surface dry. All material shall be free of moisture, dust, and lumps and shall be approved by the Engineer prior to use. The aggregate chips shall then be pre-coated with 0.9%+ 0.025% a liquid asphalt cement having a viscosity of 2000 poise, +20%. The asphaltic material and hot aggregate shall be measured separately and accurately immediately before introduction into the mixer. Mixing shall be accomplished at a temperature between 275 ° F and 325 ° F, sufficient to produce a thoroughly and uniformly coated aggregate. The pre-coated chips shall be stockpiled at least 3 days prior to use.
 3. Weighing: Weighing of cover aggregate shall be accomplished by the Contractor on scales that he furnishes for the purpose of weighing the cover aggregate as required in Section 2205.7 entitled "Scales and Weighing of Vehicles." All loads of cover aggregate will be weighed and evidenced by approved delivery tickets showing the net weight in pounds for each load. Two copies of each ticket shall accompany the load to the work site. Upon the load being incorporated in the work, the Engineer will sign both copies and one of these copies will be returned to the Contractor.
- C. Spot Patching: Areas where base failure of the roadway has occurred, or where the surface is broken out shall be repaired prior to the sealing operation. The failed sections will be marked by the Engineer, and shall be removed by sawing a neat rectangular hole into the pavement. The failed material shall be removed without damage to the adjacent pavement. Where base failures have occurred, the pavement shall be removed to the subgrade which shall be corrected to the satisfaction of the Engineer prior to patching. Unstable material shall be overexcavated and replaced with base materials meeting the requirements of Section 2203. All surfaces shall be properly primed and tacked in accordance with Section 2204.
- The prepared hole shall be patched with hot-mix asphaltic patching material by placing in layers not to exceed 2 inches; each layer being thoroughly compacted before the next layer is placed. After the patching material is placed and raked to a uniform surface, it shall be thoroughly compacted by rolling with a roller meeting the requirements of Section 2205.8. The edges shall be well bonded with the old surface. The completed patch shall be in the same plane as the existing pavement.
- The asphaltic concrete used for patching at the different locations shall be as directed by the Engineer and shall conform to one of the mixes as set out in Section 2205.4.
- D. Sealing
1. Cleaning: After all holes and cracks have been repaired to the satisfaction of the Engineer, and immediately before sealing the Contractor shall thoroughly clean the area to be sealed with a mechanical pickup type sweeper to insure proper adhesion of the new seal coat to the existing pavement. The street shall be dry before applying the seal coat.
 2. Sealing: After the street has been prepared as set forth above the Contractor shall apply the emulsified asphalt by means of an approved distributor meeting the requirements of Section 2204.4. Provisions shall be made by the Contractor to properly protect the curbs and gutters from the asphaltic spray. Emulsified asphalt shall be applied at a rate between 0.28 and 0.35 gallons per square yard. The specific rate for each job will be determined by the Engineer in the field.

Immediately after the application of the asphalt, the Contractor shall, by means of a self-propelled mechanical spreader, apply a uniform layer of cover aggregate. This material shall be spread at the rate specified by the Engineer. This rate shall be between 18 and 25 pounds per square yard of pre-coated limestone chips. The application rate shall be set to prevent bleeding of the asphaltic material

through the cover aggregate. If material is spread on any area in excess of the amount specified by the Engineer, the surplus shall be immediately removed and placed elsewhere as directed. No payment will be made to the Contractor for the picking up and redistribution of such excess. Hand spreading will be permitted only in those areas not accessible to the mechanical spreader.

Immediately after spreading the cover aggregate, the entire surface shall be rolled with multiple-wheel, pneumatic-type rollers meeting the requirements of Section 2205.8. Rolling shall be continued until a thoroughly compacted surface with a uniform aggregate coverage has been obtained, a minimum of 6 passes. The Engineer may require additional rollers if one roller cannot keep up with the operations. The first pass of the rollers over the cover aggregate shall not exceed 3 miles per hour. The rollers shall not exceed 5 miles per hour during any rolling operation.

Forty-eight hours after spreading the cover aggregate, the entire surface shall be swept with a mechanical pickup type sweeper to remove any loose or excess cover aggregate.

During the sealing operation as described above, the Contractor shall cooperate with the Engineer in arranging a program and schedule of work so traffic may be handled or routed around or through the section being sealed. Whenever possible, the street will be closed; but when this is not possible, the sealing will be done in strips while traffic is diverted to the balance of the street. No traffic will be permitted on the sealed portion of the roadway until rolling is completed. All traffic control signage shall conform to the MUTCD handbook for traffic control in work zones.

When bleeding occurs or more material is required, additional cover aggregate shall be spread as directed. As soon as the cover material has adhered to the surface, and the emulsion is thoroughly cured all excess cover aggregate shall be removed with a mechanical pickup type sweeper. This curing period is generally 48 hours, but may be adjusted by the Engineer.

2206.5 Unimproved Street Chip Seal

A. Description: This work shall consist of the application of a thin, uniform layer of liquified asphalt to the surface of the existing roadway which may either consist of an existing surface of asphaltic concrete pavement or a gravel-surfaced road. Cover aggregate shall then be distributed uniformly upon the liquified asphalt and seated in place with the use of a rubber-tired roller leaving a durable wearing surface.

B. Requirements for Liquified Asphalt Materials

Asphaltic materials used for the sealing of unimproved streets shall be liquified either by the introduction of a diluent (cutback) or by emulsification. The particular grade of cutback material for use on a particular roadway shall be determined by the Engineer. Cutback asphaltic materials shall comply with the requirements of either ASTM D 2027 or ASTM D 2028. The particular grade of emulsified asphalt material for use on a particular roadway shall be determined by the Engineer. Anionic emulsified asphaltic materials shall comply with the requirements for either a rapid or medium-setting emulsion as described in ASTM D 977 while cationic emulsified asphaltic materials shall comply with the requirements for either a medium or rapid-setting emulsion as described in ASTM D 2397.

C. Requirements for Cover Aggregate Materials

1. Aggregate materials shall consist of an approximately cubical and uniformly-sized, hard, durable 100 percent crushed and washed limestone, sandstone, lightweight aggregate, basalt/porphyry, granitic material, steel slag, gravel, or chat. Chat is a by-product from the production of lead and zinc from the area located in southwestern Missouri, northeastern Oklahoma, and southeastern Kansas. Lightweight

aggregate shall consist of expanded shale. Due to the variation in specific gravities between these materials, the application rate will need to be adjusted to reflect the change in specific gravity. The application rates reported in these specifications is for the Bethany Falls Limestone in the Kansas City area. The specific gravity of this material is approximately 2.58.

2. Physical properties required of the aggregate materials:

Los Angeles Abrasion (ASTM C 131)	35% loss (maximum)
Soundness using Mag. Sulfate (ASTM C88, 5 cycles)	18% loss (maximum)
Soundness using Sodium Sulfate (ASTM C 88, 5 cycles)	12% loss (maximum)
Total Shale, clay, coal, and lignite content (ASTM C 142)	0.5% by weight (max)
Absorption	4.0% (max)

Aggregate chips applied to cutback asphalt shall be shown to have a moisture content less than 1 percent immediately prior to application. Aggregate chips applied to emulsified asphalt shall be shown to have a moisture content of 3 percent or less immediately prior to application.

Gradation for aggregate chips used for Single sealing:

<u>Square Sieve Size</u>	<u>Percent Passing</u>
1/2" (12.5mm)	100
3/8" (9.5mm)	80-100
No. 4 (4.75 mm)	0-26
No. 10 (2.00mm)	0-2

Gradation for aggregate chips used for the first application of a Double sealing:

<u>Square Sieve Size</u>	<u>Percent Passing</u>
3/4" (19mm)	100
1/2" (12.5mm)	90 to 100
3/8" (9.5mm)	40 to 70
No. 4 (4.75mm)	0 to 15
No. 10 (2.0mm)	0-2

Gradation for aggregate chips used for the second application of a Double sealing shall conform to the gradation for a Single sealing above.

The Contractor shall furnish scales for weighing cover aggregate as required in Section 2201.7 entitled "Scales and Weighing of Vehicles". All loads of cover aggregate will be weighed as required, and evidenced by approved delivery tickets showing the net weight in pounds for each load. Two copies of each ticket shall accompany the load to the work site. In order for the load to be received and incorporated into the work, both copies will be signed by the Engineer (or inspector) and one of these copies returned to the Contractor.

D. Sealing

Sealing shall be accomplished in the same manner as described in Section 2206.3.D except as modified herein. Where a seal coat is applied to a gravel-surface roadway the surface shall be prepared in accordance with Section 2204.4. The surface shall then be primed in accordance with Section 2204.4 prior to the application of the seal coat.

The application rate of cutback asphalt shall be in the range 0.25 to 0.45 gallons per square yard as directed by the Engineer or demonstrated to result in a satisfactory seal in a test strip provided by the Contractor. Anti-Strip agent may be added to Cutback Asphalt at a rate not to exceed 1 percent of the residual asphalt volume as directed by the Engineer in order to improve adhesion of the asphalt to the moist aggregates. The cutback agent shall be thoroughly mixed and blended with the cutback asphalt. The application rate of emulsified asphalt shall be in the range of 0.28 to 0.40 gallons per square yard as approved or directed by the Engineer. The distributor used shall meet the requirements of Section 2204.4.

Limestone materials shall be spread at the rate specified by the Engineer with the range of 16 to 24 pounds per square yard.

Where double sealing is indicated on the Plans or required by the Engineer, the area shall be treated with two seal coats. The application rate of the asphaltic material for the first application shall be approximately one-half of that used for a single seal with the remainder applied during the second seal application. The application rate of the first application of cover aggregate shall be within the range specified for a single seal. The application rate of the second application shall be approximately one-half the application rate of the first layer.

2206.6 Improved Street Slurry Seal

- A.** Description: This work shall consist of the application of Slurry Seal Material to an existing surface. The Slurry Seal shall consist of a mixture of emulsified asphalt, mineral aggregate and potable water, properly proportioned, mixed and spread on the surface in accordance with this specification and as directed by the Engineer.
- B.** Material
 - 1. Emulsified Asphalt: The emulsified asphalt shall conform to Grade SS-1h of ASTM D 977, for emulsified asphalt, or Grade CSS-1h of ASTM D 2397, for cationic emulsified asphalt. Quick-set emulsified asphalts QS-1h and CQS-1h may also be used. They shall conform to ASTM D 977 and ASTM D 2397 respectively, except that the test requirements for cement mixing and storage stability shall not apply. Refer to the International Slurry Surfacing Association (ISSA) Bulletin No. 139. The emulsified asphalt shall have not less than 60% residue after distillation when tested using ASTM D 244 and shall have a penetration of between 40 and 90 when tested using ASTM D 2397 at 77° F. Each load of emulsified asphalt delivered shall have a certificate of analysis/compliance matching the material used in the mix design.
 - 2. Aggregate for Slurry Seal: The mineral aggregate used for this work shall be natural or manufactured crushed granite, slag, or chat which is a byproduct of the milling of lead and zinc ores and shall conform to one of the following grading requirements when tested in accordance with ASTM C 136 and ASTM C 117. All aggregate shall conform to the quality requirements of ASTM D 1073.

GRADING REQUIREMENTS FOR AGGREGATE			
Sieve Size	Amount Passing Sieves, Weight %		
	Type I	Type II	Tolerance
3/8 inch (9.5 mm)	100	100	
No. 4 (4.75 mm)	100	90 – 100	+/- 5%
No. 8 (2.36 mm)	90 – 100	65 – 90	+/- 5%
No. 16 (1.18 mm)	65 – 90	45 – 70	+/- 5%
No. 30 (600 um)	40 – 65	30 – 50	+/- 5%
No. 50 (300 um)	25 – 42	18 – 30	+/- 4%
No. 100 (150 um)	15 – 30	10 – 21	+/- 3%
No. 200 (75 um)	10 - 20	5 – 15	+/- 2%

The percent passing the No. 200 (75 um) sieve shall be determined by ASTM C 117.

3. Mineral Filler: Mineral Fillers are of two types, chemically active and chemically inactive. Both shall conform to ASTM D 242. Chemically active mineral fillers such as Portland cement, hydrated lime, and ammonium sulfate are used to improve workability, regulate the setting time, and, in some cases, to alter the aggregate gradation. Chemically inactive mineral fillers such as limestone dust, fly ash, and rock dust are used mainly to alter aggregate gradation.
4. Water: All water used shall be potable and shall be free of harmful salts or contaminants.
5. Mix Design: The Engineer shall approve all slurry seal materials and methods prior to mixing and application. The Contractor shall submit a completed and tested slurry seal mix design for the Engineer's approval. The approved test method for emulsified asphalt slurry seal shall be found in ASTM D 3910. The mix design shall be made with the same materials the Contractor will be using on the project. The percentage of each material must be shown on the mix design. Proportions of the mixture shall be as follows unless variations are approved by the Engineer:

	TYPE I	TYPE II
Aggregate for Slurry Seal	8.0 to 12.0 lbs per sq yd 3.63 to 5.44 kg/m ² (dry basis)	13.5 to 16.5 lbs per sq yd 7.32 to 8.95 kg/m ² (dry basis)
Emulsified Asphalt (Residual Asphalt Content)	10.0 to 16.0% by weight of dry aggregate	7.5 to 13.5% by weight of dry aggregate
Mineral Filler	1.5 to 3.0% by weight of dry aggregate	1.5 to 3.0% by weight of dry aggregate
Water	Minimum amount necessary to obtain a fluid and homogenous mixture	Minimum amount necessary to obtain a fluid and homogenous mixture

Once the proper consistency is obtained, changes in proportioning of the various components of the mixture shall be held to a minimum.

6. Application Rates: The slurry seal mixture shall be of proper consistency at all times so as to provide the application rate required by the surface condition and shall be in accordance with the following:

Type I: 8.0 to 12.0 lbs per sq yd

Type II: 13.5 to 20 lbs per sq yd

Application rates are affected by the unit weight of the aggregate, the gradation of the aggregate and

the demand of the surface to which the slurry seal is being applied.

7. Equipment: The slurry mixing machine shall be a continuous flow mixing unit and shall be capable of delivering accurately a predetermined proportion of aggregate, water and asphalt emulsion to the mixing chamber and to discharge the thoroughly mixed product on a continuous basis. The equipment shall be capable of pre-wetting the aggregate immediately prior to mixing with the emulsion. The mixing unit of the mixing chamber shall be capable of thoroughly blending all of the components together without violent mixing. The mixing machine shall be equipped with an approved fines feeder that includes an accurate metering device or method to introduce a predetermined proportion of mineral filler into the mixer. The mineral filler shall be fed at the same time and location as the aggregate. The fines feeder shall be required whenever added mineral filler is a part of the aggregate blend. The mixing machine shall be equipped with a water pressure system and fog-type spray bar, adequate for complete fogging of the surface receiving slurry treatment. Attached to the mixer machine shall be a mechanical type squeegee distributor, equipped with flexible material in contact with the surface of the pavement to prevent loss of slurry from the distributor. It shall be maintained so as to prevent loss of slurry on varying grades and crown by adjustments to insure uniform spread. There shall be a steering device and a flexible strike-off. The spreader box shall have an adjustable width. The box shall be kept clean and build-up of asphalt and aggregate on the box or in the corners shall not be permitted. Use of burlap drags or other drags shall be approved by the Engineer. Hand squeegees, shovels, and other equipment shall be provided if necessary to supplement the slurry mixing machine. Power brooms, power blowers, air compressors, and hand brooms suitable for cleaning the surface and cracks of the existing surface shall be implemented to provide a clean surface.
8. Construction Requirements
 - a. Surface Preparation: Immediately prior to applying the slurry, clean the surface of all loose material, mud spots, vegetation, and other objectionable material. Any standard cleaning method used to clean pavements will be acceptable except water flushing. A pickup sweeper must be used unless otherwise approved by the Engineer. Manholes, valve boxes, drop inlets, and other service entrances shall be protected from the slurry seal by a method approved by the Engineer.
 - b. Application: The surface shall be pre-wetted by fogging ahead of the slurry box unless waived by the Engineer. Water used in pre-wetting the surface shall be applied at such a rate that the entire surface is damp with no apparent flowing water in front of the slurry box. The slurry mixture shall be of the desired consistency upon deposit on the surface and no additional elements shall be added. Total time of mixing shall not exceed four (4) minutes. A sufficient amount of slurry shall be carried in all parts of the spreader at all times so that a complete coverage is obtained. Overloading of the spreader shall be avoided. No lumping, balling, or unmixed aggregate shall be permitted. No segregation of the emulsion and aggregate fines from the coarse aggregate shall be permitted. If the coarse aggregate settles to the bottom of the mix, the slurry shall be removed from the pavement. No excessive breaking of emulsion shall be allowed in the spreader box. No streaks, such as those caused by oversized aggregate will be left in the finished pavement.
 - c. Hand Work: Approved squeegees shall be used to spread slurry in areas not accessible to the slurry mixer. Care should be exercised in leaving no unsightly appearance from the hand work.
 - d. Curing: Treated areas shall be allowed to cure for four hours, or until such time as the Engineer permits their opening to traffic.
 - e. Weather Limitation: The slurry seal shall not be applied if either the pavement or air temperature is below 60° F and falling. The mixture shall not be applied if the relative

- humidity exceeds 80%.
- f. Traffic Control: Suitable methods shall be used to protect the slurry from all types of traffic until sufficiently cured to accept traffic. The length of time before traffic is permitted to use the surface depends on the type of emulsified asphalt, mixture characteristics, and weather conditions.
 - g. Lines: Care shall be taken to insure straight lines along curb and shoulders. No runoff on these areas will be permitted. Lines at intersections will be kept straight to provide good appearance.
 - h. Property Owners Notification: The Contractor shall supply and place door tags on the doors of all involved property owners. The door tag language shall be approved by the Engineer.
 - i. Provisions for Public Convenience During Sealing Operation: The Contractor shall provide and maintain sufficient signs, barricades, warning lights, flag persons and watch persons to protect the work and public in a manner satisfactory to the Engineer. Any areas damaged prior to acceptance by the Engineer shall be repaired at the Contractor's expense. "No Parking" signs will be furnished by the Contractor. These signs shall comply with the standards established by the MUTCD with regard to size, color, working height and placement. When "No Parking" signs are posted on the streets with parking meters, the Contractor shall cover the parking meter heads with cloth or paper bags. The Contractor shall take all necessary precautions to protect the public (pedestrian and vehicular) from flying debris. The Contractor shall use warning signs and devices to warn motorists and pedestrians of work ahead.

2206.7 Improved Street Micro-Surfacing

- A. Description: This work shall consist of the application of a polymer modified asphalt emulsion, mineral aggregate, mineral filler, potable water, and other additives, properly proportioned, mixed and spread on a paved surface in accordance with this specification and as directed by the Engineer.
- B. Materials
 - 1. Emulsified Asphalt: The emulsified asphalt shall be a quick wet polymer modified asphalt emulsion conforming to the requirements specified in ASTM D 2397 or AASHTO M 208 for Grade CSS-1h. The cement mixing test shall be waived for this emulsion. The polymer material shall be milled or blended into the asphalt or emulsifier solution prior to the emulsification process. The emulsified asphalt shall have not less than 62% residue after distillation when tested using ASTM D 244. The temperature for this test shall be held below 280° F. Higher temperatures may cause the polymers to break down. In addition, the emulsified asphalt shall have a penetration of between 40 and 90 when tested using ASTM D 2397 at 77° F (25° C) and shall have a minimum softening point of 135° F when tested using ASTM D 36. Each load of emulsified asphalt delivered shall have a certificate of analysis/compliance matching the material used in the mix design.
 - 2. Aggregate for Micro-Surfacing: The aggregate shall be a manufactured crushed stone such as granite, or chat which is a by-product of the milling of lead and zinc ores. The aggregate shall be totally crushed with 100% of the parent aggregate being larger than the largest stone in the gradation to be used. The mineral aggregate used shall conform to one of the following grading requirements when tested in accordance with ASTM C 136 and ASTM C 117. All aggregate shall conform to the quality requirements of ASTM D 1073.

GRADING REQUIREMENT FOR AGGREGATE			
Sieve Size	Amount Passing Sieves, Weight %		
	Type I	Type II	Tolerance
3/8 inch (9.5 mm)	100	100	
No. 4 (4.75 mm)	90 – 100	70 – 90	+/- 5%
No. 8 (2.36 mm)	65 – 90	45 – 70	+/- 5%
No. 16 (1.18 mm)	45 – 70	28 – 50	+/- 5%
No. 30 (600 um)	30 – 50	19 – 34	+/- 5%
No. 50 (300 um)	18 – 30	12 – 25	+/- 4%
No. 100 (150 um)	10 – 21	7 – 18	+/- 3%
No. 200 (75 um)	5 - 15	5 – 15	+/- 2%

The combined aggregate prior to the addition of any chemically active mineral filler shall have a sand equivalent of not less than 65 when tested by ASTM D 2419. The aggregate shall have a weighed average loss not greater than 25% using magnesium sulfate when tested by ASTM C 88. Testing of abrasion resistance shall not exceed 30% when tested by ASTM C 131.

3. Mineral Filler: Mineral filler shall be any recognized brand of non-air entrained Portland cement or hydrated lime. The mineral filler shall be free of lumps and accepted upon visual inspections. The type and amount of mineral filler needed shall be determined by a laboratory mix design and will be considered as part of the aggregate gradation.
4. Water: All water used shall be potable and shall be free of harmful salts or contaminants.
5. Additives: Additives may be added to the emulsion mix or any of the component materials to provide the control of the quick-traffic properties. They must be included as part of the mix design and be compatible with the other components of the mix.
6. Mix Design: The Engineer shall approve all micro-surfacing materials and methods prior to mixing and application. The Contractor shall submit a completed and tested micro-surfacing mix design for the Engineer's approval. The approved test method for micro-surfacing shall be found in ASTM D 6372. The mix design shall be made with the same materials the Contractor will be using on the project. The percentage of each material must be shown on the mix design. Proportions of the mixture shall be as follows unless variations are approved by the Engineer.

	TYPE I	TYPE II
Aggregate for Micro-surfacing	10.0 to 20.0 lbs per sq yd 4.53 to 9.07 kg/m ² (dry basis)	13.5 to 16.5 lbs per sq yd 7.32 to 8.95 kg/m ² (dry basis)
Emulsified Asphalt (Residual Asphalt Content)	7.5 to 13.5% by weight of dry aggregate	7.5 to 13.5% by weight of dry aggregate
Polymer Based Modifier	Minimum of 3% solids based on asphalt weight content	Minimum of 3% solids based on asphalt weight content
Additive	As needed	As needed
Mineral Filler	0.0 to 3.0% by weight of dry aggregate	0.0 to 3.0% by weight of dry aggregate
Water	Minimum amount necessary to obtain a fluid and homogenous mixture	Minimum amount necessary to obtain a fluid and homogenous mixture

Once the proper consistency is obtained, changes in proportioning of the various components of the mixture shall be held to a minimum.

7. Application Rates: The Micro-Surfacing mixture shall be of proper consistency at all times so as to provide the application rate required by the surface condition and shall be in accordance with the following:

Type II: 10.0 to 20.0 lbs per sq yd
Type III: 15.0 to 30.0 lbs per sq yd

Application rates are affected by the unit weight of the aggregate, the gradation of the aggregate, and the demand of the surface to which the micro-surfacing is being applied.

8. Equipment
 - a. Micro-Surfacing Mixing Equipment: The micro-surfacing mixing machine shall be specifically designed and manufactured to lay micro-surfacing. The machine shall be self-propelled, continuous flow mixing unit able to accurately deliver and proportion the aggregate, emulsified asphalt, mineral filler, control setting additive, and water to a revolving multi-blade double-shafted mixer and discharge the mixed product on a continuous flow basis. The machine shall have sufficient storage capacity for aggregate, emulsified asphalt, mineral filler, control additive, and water to maintain an adequate supply to the proportioning controls. On major highway work, the machine may be required to be a self-loading machine capable of loading materials while continuing to lay micro-surfacing. The self-loading machine shall be equipped to allow the operator to have full control of the forward and reverse speed during application of the micro-surfacing material and be equipped with opposite side drivers stationed to assist in alignment. The self-loading device, opposite side drivers stations, and forward and reverse speed controls shall be original equipment manufacturer designed.
 - b. Proportioning Devices: Individual volume or weight controls for proportioning each material, and used in material calibration, shall be provided and properly marked.
 - c. Calibration: Each mixing unit to be used in the performance of the work shall be calibrated prior to construction. Calibration documentation shall include an individual calibration of each material at various settings, which can be related to the machine metering devices. No machine will be allowed to work on the project until a calibration has been completed. Final calibration sheets shall be provided to the Engineer for acceptance.
 - d. Micro-Surfacing Spreading Equipment: The machine shall include a surfacing box with twin-

shafted paddles or spiral augers fixed in a spreader box. A flexible front seal shall be provided to insure no loss of mixture at the road surface contact point. The rear flexible seal shall act as a final strike-off and shall be adjustable in width. The spreader box and rear strike-off shall be so designed and operated that a uniform consistency is achieved to produce a free flow of material to the rear strike-off box. The box shall have suitable means provided to side-shift the box to compensate for variations of pavement geometry. A secondary strike-off shall be provided to improve the surface texture. It shall have the same leveling adjustments as the spreader box.

- e. Auxiliary Equipment: Hand squeegees, shovels, traffic control equipment, and other support and safety equipment shall be provided as necessary to perform the work.
- f. Cleaning Equipment: Power brooms, pickup sweepers, power blowers, air compressors, and hand brooms suitable for cleaning shall be utilized to provide a clean surface.

9. Construction Requirements

- a. Surface Preparation: Immediately prior to applying the micro-surfacing, the surface shall be cleaned of all loose material, silt spots, vegetation, and objectionable material as determined by the Engineer. Any standard cleaning method used to clean pavements will be acceptable except water flushing. Manholes, valve boxes, drop inlets, and other service entrances shall be protected from the micro-surfacing by a method approved by the Engineer.
- b. Application: If the pavement area to be covered is extremely oxidized and raveled or is concrete or brick, a tack coat may be required at the discretion of the Engineer. The tack coat shall conform to Section 2204 and shall be a SS or CSS grade. The tack coat shall be allowed to break sufficiently before the application of micro-surfacing. The surface shall be pre-wetted by fogging ahead of the spreader box unless waived by the Engineer. Water used in pre-wetting the surface shall be applied at such a rate that the entire surface is damp with no apparent flowing water in front of the spreader box. The micro-surfacing mixture shall be of the desired consistency upon deposit on the surface and no additional elements shall be added. A sufficient amount of material shall be carried in all parts of the spreader box at all times so that a complete coverage is obtained. Overloading of the spreader box shall be avoided. No lumping, balling, or unmixed aggregate shall be permitted. No streaks, such as those caused by oversized aggregate shall be left in the finished surface.
- c. Hand Work: Areas which cannot be reached with the mixing machine shall be surfaced using approved hand squeegees to provide a complete and uniform coverage. If necessary, the area to be hand-worked shall be lightly dampened prior to mix placement. The same type of finish as applied by the spreader box shall be required.
- d. Curing: Micro-surfacing shall be allowed to cure for one hour, or until the Engineer permits opening the street to traffic.
- e. Weather Limitation: Micro-surfacing shall not be applied if either the pavement or air temperature is below 60° F and falling. The mixture shall not be applied if the relative humidity exceeds 80%.
- f. Traffic Control: Suitable methods shall be used to protect the micro-surfacing from all types of traffic until sufficiently cured to accept traffic. The length of time before traffic is permitted to use the surface shall be determined by the Engineer.
- g. Lines: Care shall be taken to insure straight lines along curb and shoulders. No runoff on these areas will be permitted. Lines at intersections will be kept straight to provide good appearance.
- h. Property Owners Notification: The Contractor shall supply and place door tags on the doors of all involved property owners. The door tag language shall be approved by the Engineer.
- i. Provisions for Public Convenience During Surfacing Operation: The Contractor shall provide and maintain sufficient signs, barricades, warning lights, flag persons and watch persons to

protect the work and public in a manner satisfactory to the Engineer. Any areas damaged prior to acceptance by the Engineer shall be repaired at the Contractor's expense. "No Parking" signs will be furnished by the Contractor. These signs shall comply with the standards established by the MUTCD with regard to size, color, working height and placement. When "No Parking" signs are posted on the streets with parking meters, the Contractor shall cover the parking meter heads with cloth or paper bags. The Contractor shall take all necessary precautions to protect the public (pedestrian and vehicular) from flying debris. The Contractor shall use warning signs and devices to warn motorists and pedestrians of work ahead.

2206.8 Method of Measurement

- A. Asphaltic Crack Seal will be measured per pound.
- B. Chip seal will be measured by one of the following:
 - 1. Per square yard or tenth part thereof.
 - 2. Actual quantities used:
 - a. Asphaltic concrete patch, per ton or tenth part thereof.
 - b. Bitumen (asphaltic cement or liquid asphalt) per gallon.
 - c. Coated cover aggregate, per ton or tenth part thereof.
- C. Slurry seal will be measured per square yard or tenth part thereof.
- D. Micro-surfacing will be measured per square yard or tenth part thereof.

2206.9 Basis of Payment

- A. Asphaltic Crack Seal will be paid for by one of the following:
 - 1. Contract unit bid price.
 - 2. Contract lump sum bid price.
- B. Chip Seal will be paid for by one of the following:
 - 1. Contract unit bid price.
 - 2. Contract lump sum bid price.
- C. Slurry Seal will be paid for by one of the following:
 - 1. Contract unit bid price.
 - 2. Contract lump sum bid price.
- D. Micro-surfacing will be paid for by one of the following:

1. Contract unit bid price.
2. Contract lump sum bid price.

SECTION 2207 COLD MILLING

2207.1 Scope

This section governs the furnishing of all labor, materials and equipment for the performance of cold milling pavement surfaces as shown on the Plans and in accordance with the Standard Drawings, the specifications and the Special Provisions. This work will consist of the removal of the existing surface, loading, hauling, and stockpiling, if required, of the milled material and the cleaning of the milled surface.

2207.2 Equipment

Milling the surface of pavements shall be completed by the use of a milling machine conforming to the following:

- A. Machine: The cold milling machine shall be self-propelled and able to automatically control grade and slope of the milled surface. Operate the automatic grade and slope control from a travelling stringline a minimum of 30 feet long, attached the milling machine and operating parallel to the direction of travel. Other methods of positive grade control may be used if approved by the Engineer. The machine shall have the means of milling without damaging the remaining pavement (torn, gouged, shoved, broken, etc.). The machine shall be capable of blading the cuttings into a single windrow or depositing them directly into a truck.
- B. Air Pollution: The machine shall be equipped with a dust suppression system including water storage tanks and high pressure spray bars.
- C. Operating Width: It is desirable that the cutting width be greater than 6 feet. In the event the cutting width is less than 6 feet, a system of electronic grade control for consecutive passes will be required.
- D. Cutting Drum: The cutting drum shall be totally enclosed to prevent discharge of any loosened material on adjacent work areas.

2207.3 Construction

A. Methods of Operations for Milling

1. Utilities: Street surfaces adjacent to manholes, water valves and other utility extensions shall be completely removed to the full depth of cut specified for the street unless otherwise specified by the Engineer.
2. Material Disposal: All material from the milling operation shall be removed immediately from the surface of the pavement and properly disposed of by the Contractor at an approved disposal area.
3. Surface Conditions: The drum lacing patterns shall produce a smooth surface finish after milling, with groove depths not to exceed 1/4 inch and groove spacing not to exceed 1 inch unless otherwise approved by the Engineer.

B. Types of Cuts to be made by Milling

1. Leveling: Sufficient passes shall be made such that all irregularities or high spots are eliminated, and that 100% of the surface is milled.
 2. Average Depth: Sufficient passes, or cuts, shall be made in order to remove a specified depth over the entire street section. These depths will be designated in the Plans or Special Provisions.
 3. Curb Cut: Sufficient passes or cuts shall be made to remove the specified depth at the curb for a specified width. These dimensions will be designated in the Plans or Special Provisions.
 4. Bridge Deck Milling: Sufficient passes, or cuts, shall be made in order to remove the material as specified on the Plans or in the Special Provisions.
- C. Cleanup: All loose asphalt and debris shall be removed from the street surface and curb and gutter. Any material and debris that adheres to the curb and gutter shall be removed.
- D. Opening to Traffic: If the milled area will be opened to traffic prior to surfacing, provide a smooth riding surface by either milling or placing a wedge of hot mix asphalt or other approved material of a thickness and design that will remain in place under traffic. The transition between the milled area and transverse joints shall be a minimum of 1 vertical to 24 horizontal. The transition between the milled surface and manholes, utility fixtures or other appurtenances shall be a minimum of 1 vertical to 12 horizontal. Transitions shall be removed prior to surfacing.

2207.4 Method of Measurement

Cold milling will be measured per square yard or tenth part thereof for the specified depth.

2207.5 Basis of Payment

Cold milling will be paid for by one of the following:

- A. Contract unit bid price.
- B. Contract lump sum bid price.

SECTION 2208 PORTLAND CEMENT CONCRETE PAVEMENT

2208.1 Scope

This section governs the furnishing of all labor, materials and equipment for the placement of Portland Cement Concrete Pavement as shown on the Plans and in accordance with the Standard Drawings, the specifications, and the Special Provisions.

2208.2 Referenced Standards

The following standards are referenced directly in this section. The latest version of these standards shall be used. If conflicting standards are referenced, the more stringent standard shall apply.

ASTM

- A 615 Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
A 775 Standard Specification for Epoxy-Coated Steel Reinforcing Bars

- A 1064 Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
- C 31 Standard Practice for Making and Curing Concrete Test Specimens in the Field
- C 39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
- C 143 Standard Test Method for Slump of Hydraulic-Cement Concrete
- C 172 Standard Practice for Sampling Freshly Mixed Concrete
- C 231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
- C 309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- C 1064 Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete

- D 1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
- D 1752 Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
- D 2628 Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
- D 2835 Standard Specification for Lubricant for Installation of Preformed Compression Seals in Concrete Pavements
- D 6690 Standard Specification for Joint and Crack Sealants, Hot-Applied, for Concrete and Asphalt Pavements
- D 7174 Standard Specification for Preformed Closed-Cell Polyolefin Expansion Joint Fillers for Concrete Paving and Structural Construction
- E 965 Test Method for Measuring Surface Macrotexture Depth Using a Sand Volumetric Technique

AASHTO

- M 148 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- M 213 Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
- M 324 Joint Sealants, Hot-Poured, for Concrete and Asphalt Pavements

MCIB Mid-West Concrete Industry Board Concrete Specifications - Concrete Pavement
 The current editions of the "Bulletins" and Approved Sections of the "Standard Concrete Specifications" issued by the Mid-West Concrete Industry Board, Inc. (MCIB) are made a part hereof by reference. However, when the provisions of this Specification differ from the provisions of such "Bulletins" and "Sections" the provisions of this Specification shall govern.

KCMMB Kansas City Metro Materials Board Specifications

Kansas Department of Transportation

Standard Specifications for State Road and Bridge Construction, 2015 Edition

Missouri Highways and Transportation Commission

Missouri Standard Specifications for Highway Construction, 2011 Edition

National Concrete Pavement Technology Center Guide Specifications for Concrete Overlays, September 2015, including latest revisions

2208.3 Materials

- A. Concrete: Concrete shall conform to referenced specifications as called out in the Contract Documents. If no direct reference to concrete specifications is included in the Contract Documents, concrete shall meet KCMMB

specifications.

1. If KCMMB concrete is specified, an approved KCMMB concrete mix shall be required.
2. If MCIB concrete is specified, concrete shall comply with MCIB Section entitled "Concrete Pavement".
3. If KDOT specifications are referenced for concrete, provide material in compliance with the latest version of KDOT specifications. Approval of component materials will be based on submittal of certifications from supplier. Aggregates shall meet the quality requirements specified by KDOT. Engineer reserves the right to perform testing of components to verify compliance.
4. If MoDOT specifications are referenced, provide material in compliance with the latest version of MoDOT specifications. Approval of component materials will be based on submittal of certifications from supplier. Aggregates shall meet the quality requirements specified by MoDOT. Engineer reserves the right to perform testing of components to verify compliance.
5. Proposed concrete mix designs for use on the project shall be submitted to Engineer for approval at least two (2) weeks in advance of anticipated use. Mix design shall be approved prior to use of that mix.
6. Field testing of concrete shall be performed by the Engineer at the frequency required by the referenced specification. Unless otherwise specified, the following tests shall be performed once for every 50 cuyd of concrete placed:
 - a. Sampling of fresh concrete per ASTM C 172
 - b. Slump per ASTM C 143
 - c. Air Content per ASTM C 231
 - d. Temperature per ASTM C 1064
 - e. Cylinders cast per ASTM C 31 and tested per ASTM C 39. Four cylinders shall be cast with one tested at 7 days, 2 tested at 28 days and one held in reserve.
7. For concrete overlays, material and construction specifications shall be governed by the National Concrete Pavement Technology Center Guide Specifications for Concrete Overlays, September 2015, including latest revisions.

B. Reinforcement

1. Bars: Non-epoxy coated bars shall conform to ASTM A 615. Epoxy coated bars shall conform to ASTM A 775.
2. Welded Steel Wire: Welded steel wire fabric shall conform to ASTM A 1064.
3. Supporting Elements: Representative samples of supporting elements shall be submitted and approved by the Engineer prior to their use in the project.
4. Fibers: When specified in the Contract Documents, fibers shall be incorporated into the concrete at the rate recommended by the manufacturer but no less than a minimum of 3 pounds per cubic yard of concrete for macro fibers and 1 pound per cubic yard of concrete for micro fibers. Fibers shall meet the requirements of KDOT Standard Specifications for State Road and Bridge Construction, 2015 Edition, Section 1722.2. Micro fibers are used to control plastic shrinkage cracks in concrete while macro fibers control cracking in hardened concrete and are often used as a substitute for traditional crack

control steel reinforcing bars or mesh. In addition, macro fibers add toughness, and impact and fatigue resistance to hardened concrete.

- C. Isolation Joint Fillers: Isolation joint fillers shall conform to ASTM D 1751, D 1752, or ASTM D 7174.
- D. Joint Sealing Compounds: Joint sealing compounds shall conform to the standards for the type of sealant specified as listed in the following table:

Joint Seals and Sealants	AASHTO	ASTM
Hot-poured, Polymeric Asphalt Based	M 324	D 6690
Preformed Polychloroprene Elastomeric		D 2628
Lubricant for Installation of Preformed Seal	-----	D 2835
Preformed Expansion Joint Filler	M 213	D 1751, D 1752 or D 7174

- E. Curing Membrane: All material to be used or employed in curing Portland Cement Concrete must be approved by the Engineer prior to its use. It shall be of the liquid membrane type and shall conform to ASTM C 309, Type II, Class B or AASHTO M 148, Type 2, white pigmented.

2208.4 Construction

Portland Cement Concrete Pavement shall be constructed to the configuration, and to the lines and grades shown on the Plans.

- A. Grading, Subgrade Preparation and Base Course: All excavation, embankment, subgrade stabilization or aggregate base course required shall be as defined in Sections 2100 "Grading and Site Preparation", 2201 "Subgrade Preparation", 2202 "Subgrade Stabilization", and 2203 "Aggregate Base Course". If areas of the subgrade are below the lines, grades and cross-sections shown on the Plans, they shall be brought to the proper line, grade and cross-section by one of the following:
 1. Additional fill material placed in accordance with applicable sections.
 2. Areas may be filled with additional thickness of Portland Cement Concrete Pavement.
- B. Surface Preparation for Concrete Overlay: Prepare surface for concrete overlay as specified in the National Concrete Pavement Technology Center Guide Specifications for Concrete Overlays, September 2015.
- C. Forms: All forms shall be in good condition, clean, and free from imperfections. Each form shall not vary more than 1/4 inch in horizontal and vertical alignment for each 10 feet of length.
 1. Material & Size: Forms shall be made of metal and shall have a height equal to or greater than the prescribed edge thickness of the pavement slab. Wood forms may be substituted when approved by Engineer and if they are free from warp with sufficient strength for the intended application.
 2. Strength: Forms shall be of such cross-section and strength, and so secured as to resist the pressure of the concrete when struck off, vibrated, and finished, and the impact and vibration of any equipment which they may support.
 3. Installation: Forms shall be set true to line and grade, supported through their length and, joined neatly in such a manner that the joints are free from movement in any direction.

4. Preparation: Forms shall be cleaned and lubricated prior to each use and shall be so designed to permit their removal without damage to the new concrete.
- D. Joints: Generally joints shall be formed at right angles to the true alignment of the pavement and to the depths and configuration specified by the appropriate standard or as modified by the Plans and specifications. For additional guidance on jointing, see American Concrete Paving Association jointing guides. All joints shall be sealed with sealant meeting the requirements of Section 2208.3.D. Unless specified otherwise on the Plans, specifications, Standard Drawings or Special Provisions, use hot-poured joint sealant.
1. Isolation Joints: Isolation joints shall be placed at all locations where shown on the Plans and Standard Drawings or as directed by the Engineer.
 - a. Isolation joints shall extend the entire width of the pavement and from the subgrade to the surface of the pavement. The material will have a suitable tear strip or removable cap provided to allow for the application of the joint sealer to the required depth.
 - b. Under no circumstances shall any concrete be left across the isolation joint at any point.
 - c. Material: Isolation joints shall be formed by a one-piece, one inch thick preformed joint filler cut to the configuration of the correct pavement section.
 - d. Stability: Isolation joints shall be secured in such a manner that they will not be disturbed during the placement, consolidation and finishing of the concrete.
 - e. Dowels: If isolation joints are to be equipped with dowels they shall be of the size and type specified, and shall be firmly supported in place, by means of a dowel basket or other support method approved by the Engineer, which shall remain in place. Each dowel shall be lightly painted or greased with a product approved by the Engineer.
 2. Contraction Joints: Contraction joints shall be placed where indicated and to the depth indicated by the Plans, specifications and Standard Drawings.
 - a. Method: Contraction joints shall be sawed.
 - b. When sawing joints, the Contractor shall begin as soon as the concrete hardens sufficiently to prevent excessive raveling along the saw cut and shall finish before conditions induce uncontrolled cracks, regardless of the time or weather. All sawed joints shall begin with a relief cut that shall be approximately 1/8 inch wide, and a minimum of 1/3 the thickness of the slab unless shown otherwise on the Plans. If the Plans indicate a joint width greater than 1/8" but with no backer rod, the Contractor may saw the initial relief cut to the full width. If a reservoir cut is specified that uses a backer rod, a second stage saw cut which widens the joints to allow the insertion of joint sealing material shall be performed. The second stage saw cut shall not be performed until the concrete is at least 48 hours old and shall be delayed longer when the sawing causes raveling of the concrete. If second stage sawing is performed prior to the completion of the curing period, the Contractor shall maintain the cure by use of materials approved by the Engineer.
 - c. The Contractor shall be responsible for using suitable methods to cut joints straight and in the correct location. The Contractor shall protect joints from damage until completion of the project and shall repair damaged joints to the satisfaction of the Engineer.
 - d. Where not indicated on the Plans or Standard Drawings, joint spacing for concrete overlays shall not exceed 12 times the thickness of the overlay, and shall be constructed such that the larger dimension of any panel does not exceed 125% of the smaller dimension. Joints of adjacent panels shall be aligned. Joints shall intersect pavement free edges at 90 degrees, and shall extend a minimum of 1 foot from the pavement edge. Saw joints shall be one-third the thickness of the slab, or two inches, whichever is greater.

- e. For bonded concrete overlays, joints shall be located above existing joints, shall be sawed full depth plus one-half inch for overlays up to 4 inches in two stages. The first stage provides a relief cut approximately 1/8 inch wide.
 - f. Dowels: If contraction joints are to be equipped with dowels they shall be of the size and type specified and shall be firmly supported in place and accurately aligned parallel to the pavement line and grade with an allowable tolerance of 1/8 inch.
3. Longitudinal and Construction Joints: Longitudinal joints and construction joints shall be placed as shown on the Plans or where the Contractor's construction procedure may require them to be placed with approval of the Engineer. Longitudinal construction joints (joints between construction lanes) shall be keyed or tied joints of the dimensions shown on the Plans or Standard Drawings. Transverse construction joints of the type shown on the Plans or Standard Drawings shall be placed wherever concrete placement is suspended for more than 30 minutes. Unless shown otherwise on the Plans, do not place a construction joint within 5 feet of another transverse expansion, contraction or construction joint.
4. Center Joints: Longitudinal center joints shall be constructed using the methods specified in Section 2208.4.D.2 "Contraction Joints".
5. Tie Bars: Tie bars shall be deformed steel of the dimensions specified by the Plans or Standard Drawings. Tie bars shall be installed at the specified spacing and firmly secured so as not to be disturbed by the construction procedure. Tie bars shall not be placed mechanically or by hand into the plastic concrete during the paving operation unless approved by the Engineer. Tie bars shall not be located within one foot of an intersecting joint.
- E. Placing, Finishing, Curing, and Protection: Concrete shall be furnished in quantities required for immediate use and shall be placed in accordance with the requirements of the applicable specification as stipulated in Section 2208.3.A. Prior to commencing construction, the Contractor shall furnish a concrete delivery plan which includes at a minimum the number of trucks which will be dedicated to the project, the location of the concrete plant, the route and distance from the plant to the job site, and the anticipated rate of concrete usage. It is essential that concrete be delivered in sufficient quantities to prevent stoppage of the paving operation.
1. Concrete Placement: The concrete shall be deposited on the subgrade to the required depth and width of the construction lane in successive batches and in a continuous operation without the use of intermediate forms or bulkheads. The subgrade shall be moistened prior to the placement of concrete. The concrete shall be placed as uniformly as possible in order to minimize the amount of additional spreading necessary. The concrete shall not be permitted to drop freely a distance of greater than 3 feet. While being placed, the concrete shall be vibrated and compacted with suitable tools so that the formation of voids or honeycomb pockets is prevented.
- The concrete shall be well vibrated and tamped against the forms and along all joints. Care shall be taken in the distribution of the concrete to deposit a sufficient volume along the outside form lines so that the curb section can be consolidated and finished simultaneously with the slab.
- No concrete shall be placed around manholes or other structures until they have been brought to the required grade, alignment, and cross slope.
- Concrete shall not be allowed to extrude below the forms.
- Limitations for time of placement and other items not specifically covered by this specification shall be in accordance with the most recent Standard Specifications of the State Department of Transportation

for the state the work is being performed in. The Engineer may extend placement time limitations based on field conditions and concrete consistency and workability.

2. Concrete Finishing Methods: The pavement shall be struck off and consolidated with a mechanical finishing machine. Hand finishing methods may be used for small or irregular areas. Furnish paving and finishing equipment applicable to the type of construction as follows:
 - a. Slip-form Machines: Furnish slip-form machines capable of spreading, consolidating, screeding, and float finishing the freshly placed concrete in one pass to provide a dense and homogeneous pavement with minimal hand finishing.
 - b. Self-Propelled Form-Riding Machines: Furnish mechanical, self-propelled spreading and finishing machines capable of consolidation and finishing the concrete with minimal hand finishing. Do not use machines that displace the fixed side forms.
 - c. Manual Fixed-Form Paving Machines: Furnish spreading and finishing machines capable of consolidating and finishing the concrete with minimal hand finishing.
 - d. Hand Methods: When finishing by hand methods, concrete shall be consolidated by use of vibrating units operating in the concrete. Unless the vibrating apparatus is such that the full width of concrete is consolidated in a single passage, a definite system or pattern shall be used in the operation of the vibrator so the full width of concrete in each linear foot of lane will receive adequate and uniform consolidation. The system and methods of vibrating shall be subject to approval of the Engineer. Vibrating equipment shall, under no circumstances, be used as a tool for moving concrete laterally on the grade.
3. Concrete Finishing
 - a. Do not apply moisture (water, finishing aids, etc.) to the surface of the concrete pavement. The concrete should be provided with proper consistency and workability to place, strike off, consolidate, finish and texture without the addition of moisture. Only in the event of exceptional and unusual circumstances may the Engineer consider allowing a fine, fog mist to be added.
 - b. Floating: All surfaces shall be consolidated and floated after strike-off and prior to final surface finish.
 - c. Straightedging: Following the floating and while the concrete is still plastic, the surface shall be tested for trueness with a 10-foot straightedge placed parallel to the centerline and operated across the entire width of the pavement. The straightedge shall be advanced in successive stages not to exceed half its length and the operation repeated. Surface deviations greater than 1/8 inch shall be corrected and the straightedging repeated. Straightedging may be eliminated if the pavement smoothness is verified using a profilograph as specified in Section 2211.
 - d. Edging: Before final finishing is completed and before the concrete has taken its initial set, the edges of the slab and curb shall be finished to 1/8" radius, or that shown on the Plans or Standard Drawings by the paving equipment, or with hand edging tools.
 - e. Final Surface Finish
 - i. Dragged Surface Treatment: For roadways with a design speed of 45 mph or less to be posted at 45 mph or less, astroturf or burlap shall be dragged longitudinally over the finished surface to produce a tight, uniform, textured surface, and the edges shall be rounded in a workmanlike manner.

For roadways to be posted at 50 mph or more, astroturf or burlap shall be dragged longitudinally over the finished surface to produce a tight, uniform, textured surface, and the edges shall be rounded in a workmanlike manner. The texture achieved by

the astroturf or burlap drag shall be tested by the Contractor in accordance with ASTM E 965, "Test Method for Measuring Surface Macrotexture Depth Using a Sand Volumetric Technique", to ensure the texture is adequate for skid resistance. Test locations will be determined by the Engineer. The results of ASTM E 965 shall show an average texture depth of any lot, as defined below, and shall have a minimum value of 0.032 inch. Any lot showing an average of less than 0.032 inch but equal to or greater than 0.024 inch will be accepted as substantial compliance but the Contractor shall amend their operation to achieve the required 0.032 inch minimum depth. (It is not the intention of this tolerance to allow the Contractor to continuously pave with an average texture depth of less than 0.032 inch). Any lot showing an average texture depth of less than 0.024 inch shall require diamond grinding of the pavement represented by this lot to attain the necessary texture. Any *individual test* showing a texture depth of less than 0.020 inch shall require diamond grinding of the pavement represented by this lot to attain the necessary texture. Limits of any failing individual test shall be determined by running additional tests at 100 foot intervals before and after the failing test location. All testing of the surface texture shall be completed no later than the day following pavement placement.

- ii. Groove Treatment: For roadways to be posted at 50 mph or more, the surface of the traveled lanes shall be grooved in a transverse direction unless specified otherwise in the Plans, Special Provisions, or Specifications. If approved by the Engineer, a suitable longitudinal grooving or a dragged surface treatment as described in Section 2208.4.E.3.e.i may be used in lieu of the transvers grooving. Surface grooving shall be done with a mechanical device such as a wire broom or comb or by hand. The broom or comb shall have a single row of spring steel tines, rectangular in cross section, 1/8 inch to 3/16 inch wide; spaced on 3/4 inch centers of sufficient length, thickness, and resilience to form grooves to a depth of a minimum of 1/8 inch and a maximum of approximately 3/16 inch in the plastic concrete. If grooves are to be installed by hand, the proposed equipment and process to be used shall be approved by the Engineer. This operation shall be done at such time and in such manner that the desired surface texture will be achieved while minimizing displacement of the larger aggregate particles and before the surface permanently sets. Where abutting pavement is to be placed, the grooving should extend as close to the edge as possible without damaging the edge. If abutting pavement is not to be placed, the 6 inch area nearest the edge or 1 foot from the face of the curb is not required to be grooved. For small or irregular areas or during equipment breakdown, grooving may be done by hand methods.

- 4. Curing: As soon as practical after the concrete is finished it shall be cured with an approved curing method. If a liquid curing membrane is used, it shall be white pigmented and applied in accordance to the manufacturer's directions.
 - a. Method of Applying Curing Membrane: A nozzle producing a uniform fan pattern will be used on all spray equipment when applying the liquid curing membrane. The curing compound should be applied immediately after final finishing, and before the loss of all free water on the surface of the concrete. Normally one smooth, even coat shall be applied at a rate of 150 to 200 square feet per gallon, but two coats may be necessary to ensure complete coverage and effective protection. Second coats should be applied at right angles to the first.
 - b. Curing Formed Surfaces: If the forms are removed from finished concrete pavement within a period of 72 hours or if a slip-form paving machine has been used, all exposed surfaces shall be cured. Curing membrane damaged by joint sawing operations shall be repaired by the Contractor as directed by the Engineer.

5. Protection: The Contractor shall, at his own expense, protect the concrete work against damage or defacement of any kind until it has been accepted by the Engineer. All vehicular traffic shall be prohibited from using the new concrete pavement until the following criteria have been met:
 - a. Construction traffic: New concrete pavement may be opened to light construction traffic after a minimum of four (4) days of cure time has elapsed and the joints have been protected from the intrusion of foreign material by an approved method. The Contractor may reduce this length of time by one of these options, performed at the expense of the Contractor:
 - i. Achieve a minimum compressive strength of 70% of the 28 day design strength as determined in accordance with ASTM C 39.
 - ii. Achieve a minimum flexural strength of 350 psi using a third point loading method.
 - b. All traffic: New concrete pavement may be opened to all traffic after a minimum of seven (7) days of cure time has elapsed and the joints have been sealed in accordance with Section 2208.4.D. The Contractor may reduce this length of time by one of these options, performed at the expense of the Contractor:
 - i. Achieve a minimum compressive strength of 100% of the 28 day design strength as determined in accordance with ASTM C 39.
 - ii. Achieve a minimum flexural strength of 450 psi using a third point loading method.

Concrete pavement that is not acceptable to the Engineer because of damage or defacement shall be removed and replaced, or repaired, to the satisfaction of the Engineer, at the expense of the Contractor.

6. Pavement Smoothness: If required by the Contract Documents, pavement smoothness shall adhere to Section 2211. If not required by the Contract Documents, the Engineer shall determine areas to be checked for surface tolerance by the Contractor. The areas identified by the Engineer shall be checked with a 10 foot straightedge placed parallel to the center line at any location within a driving lane. Areas showing high spots of more than 1/4 of an inch in 10 feet shall be marked and ground down with approved grinding equipment to an elevation where the area or spot will not show surface deviations in excess of 1/8 inch when tested with a 10 foot straight edge. Grinding will be performed on the full width of the lane failing to meet the above criteria. The cost of correcting the smoothness and any other associated costs such as traffic control shall be at Contractor's expense.
7. Diamond Grinding: If required by the Contract Documents or if pavement smoothness criteria from Section 2208.4.E or Section 2211 are not achieved, the Contractor shall grind the riding surface to reduce or eliminate the irregularities.
 - a. Use a self-propelled grinding machine with diamond blades mounted on a multi-blade arbor. Avoid using equipment that causes excessive ravels, aggregate fractures, or spalls. Provide uniform texture the full width of the lane.
 - b. Transverse grooving will not be required.
 - c. Use vacuum equipment or other continuous methods to remove grinding slurry and residue. Prevent the grinding slurry from flowing across lanes being used by traffic or into streams, lakes, ponds or other bodies of water, inlets, storm sewer or other drainage system.
 - d. After corrections have been made to the riding surface, test the pavement for smoothness using the same technique used to determine smoothness originally. Furnish and operate the smoothness measurement equipment, and evaluate the results as specified in Section 2211.
 - e. Perform additional grinding as required to attain the required smoothness. Correct all deviations (in excess of 1/2 inch in a length of 25 feet or 1/4 inch in a length of 10 feet) within each section regardless of the profile index value.

8. Temperature Limitation: Concrete work shall be in accordance with the requirements of the state DOT specifications for the state where the work is being performed.
9. Backfill: A minimum of 24 hours shall elapse before forms are removed and 5 days shall elapse or the concrete must have attained 75% of its 28 day compressive strength before pavement is backfilled unless otherwise approved by the Engineer.
10. Backfill shall be accomplished in accordance with Sections 2100 and 2201 entitled "Grading and Site Preparation" and "Subgrade Preparation".
11. The Contractor shall be responsible for the repair of any existing street pavement damaged by the construction to the satisfaction of the Engineer.
12. Joint Sealing and Cleanup: All joints shall be sealed with an approved joint sealer meeting the requirements of Section 2208.3 applied in accordance with this section and the manufacturer's directions within 7 days of the placement of the concrete and prior to the opening of the pavement to traffic. If pavement design does not specifically require the use of joint sealant, prepare the joint as described on the Plans or in the specifications.

The Contractor shall be responsible for the removal of excess dirt, rock, broken concrete, concrete splatters and overspray from the area of the construction.

2208.5 Integral Curb

If required by the Plans, Standard Drawings or Special Provisions, integral curbs shall be placed along the edges of all street pavement, except at such locations as the Engineer may direct.

The integral curb shall be constructed during or immediately following the finishing operation unless otherwise shown on the Plans. Special care shall be taken so that the curb construction does not lag behind the pavement construction and form a "cold joint".

Steel curb forms or integral slip-forming shall be required to form the backs of all curbs except where impractical because of small radii street returns or other special sections.

Concrete shall be consolidated with an approved vibrator.

Curbs shall be finished to the cross-section as shown on the Plans with a mule; or templates supported on the side forms and with a float not less than four feet in length, unless another method is approved by the Engineer.

The finished surface of the curb and gutter shall be checked for no more than 1/4 inch deviation by the use of a 10 foot straightedge and corrected if necessary.

Where grades are flat and while the concrete is still plastic, the flowline of the gutter should be checked by the Contractor to verify positive drainage.

Finishing, edging, curing, protection, jointing, temperature limitations and backfill shall all comply with Section 2208.4. The curb shall have a brush or broom finish.

2208.6 Repairing Defects

Any defect occurring prior to final acceptance of the project or the end of a Contract warranty period shall be repaired by removing and replacing the affected area to the nearest joint, or as directed by the Engineer. After project final acceptance or expiration of the warranty period, repair defects in conformance with the following. Do not begin corrective work until after submitting a plan and receiving the Engineer's approval for repair methods.

Defect Type	Defect Direction	Defect Location	Description	Repair Procedure	Alternate Procedure
Plastic Shrinkage Crack	Any	Anywhere	Only partially penetrates depth	Do nothing	Fill with HMWM2
Uncontrolled Crack	Transverse	Mid-slab	Full-depth	Saw and seal crack	LTR3
Uncontrolled Crack	Transverse	Crosses or ends at transverse joint	Full-depth	Saw and seal the crack; Epoxy uncracked joint	
Uncontrolled Crack	Transverse	Relatively parallel and within 5 ft of joint	Full-depth	Saw and seal the crack; Seal joint	FDR4 to replace crack and joint
Saw cut or Uncontrolled Crack	Transverse	Anywhere	Spalled	Repair spall by PDRS if crack not removed	
Uncontrolled Crack	Longitudinal	Relatively parallel and within 1 ft of joint; May cross or end at longitudinal joint	Full-depth	Saw and seal crack; Epoxy uncracked joint	Cross stitch crack
Uncontrolled Crack	Longitudinal	Relatively parallel and in wheel path 1-4.5 ft (from joint)	Full-depth, hairline or spalled	Remove and replace slab	Cross stitch crack
Uncontrolled Crack	Longitudinal	Relatively parallel and further than 4.5 ft from a long joint or edge	Full-depth	Cross-stitch crack; Seal longitudinal joint	
Saw cut or Uncontrolled Crack	Longitudinal	Anywhere	Spalled	Repair spall by PDRS if crack not removed	
Uncontrolled Crack	Diagonal	Anywhere	Full-depth	FDR4	
Uncontrolled Crack	Multiple per Slab	Anywhere	Two cracks dividing slab into 3 or more pieces	Remove and replace slab	

HMWM = High molecular weight methacrylate poured over surface and sprinkled with sand for skid resistance.

LTR = Load-transfer restoration; 3 dowel bars per wheel path grouted into slots sawed across the crack; Slots must be parallel to each other and the longitudinal joint.

FDR = full-depth repair; 10 ft long by one lane wide. Extend to nearest transverse contraction joint if 10 ft repair would leave a segment of pavement less than 10 ft long.

PDR = partial-depth repair; Saw around spall leaving 2 in between spall and 2 in deep perimeter saw. Chip concrete free, then clean and apply bonding agent to patch area. Place a separating medium along any abutting joint or crack. Fill area with patching mixture.

Cross-stitching: for longitudinal cracks only, drill ¾" holes at 35° angle, alternating from each side of joint on 30-36 inch spacing. Epoxy #5 epoxy coated deformed steel tie-bars into hole.

2208.7 Method of Measurement

Portland Cement Concrete Pavement will be measured per square yard or tenth part thereof for the specified depth.

2208.8 Basis of Payment

Portland Cement Concrete Pavement will be paid for by one of the following:

- A. Contract unit bid price.
- B. Contract lump sum bid price.

SECTION 2209 CURBING

2209.1 Scope

This section governs the furnishing of all labor, materials and equipment for the construction or reconstruction of curbing as shown on the Plans and in accordance with the Standard Drawings, the specifications, and the Special Provisions.

2209.2 Referenced Standards

The following standards are referenced directly in this section. The latest version of these standards shall be used. If conflicting standards are referenced, the more stringent standard shall apply.

ASTM

D 698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))

2209.3 Materials

All Materials shall conform to Section 2208.3. Materials submittals and testing shall conform to Section 2208.

2209.4 Construction

The curbing shall be constructed or reconstructed to the configuration and to the lines and grades shown on the Plans.

- A. Removal of Existing Curbing for Reconstruction: Existing curbing shall be totally removed to the nearest contraction or expansion (isolation) joint or with the approval of the Engineer it may be sawed provided no free section is left that is less than 5 lineal feet in length, and provided the entire curbing section is sawed a minimum of 2 inches below any exposed surface, or sufficiently to prevent disturbance or damage to all adjacent structures or slabs, whichever is greater.

- B. Grading and Subgrade Preparation: All excavation or embankment shall conform to Sections 2100 and 2201 entitled "Grading and Site Preparation" and "Subgrade Preparation".

Compaction shall conform to Section 2201.4.B.

- C. Forms: All forms shall be in good condition, clean, and free from imperfections. Each form shall not vary more than 1/4 inch in horizontal and vertical alignment for each 10 feet in length. Face forms will be used when feasible. Forms shall have a height equal to or greater than the height of the curb face being formed. The forms shall be set true to line and grade and shall be supported to stay in position while depositing and

consolidating the concrete. The forms shall be designed to permit their removal without damage to the concrete. The forms shall be lubricated.

- D. Slip-Form Curb Machine: A slip-form curb machine may be used in lieu of forms. The machine must be equipped with mechanical internal vibrators and be capable of placing curb to the correct cross section, line and grade within the allowable tolerances.
- E. Joints: The joints shall be formed at right angles to the alignment of the curbing and to the depths specified by the appropriate Standard Drawing or as shown on the Plans. Joints should be aligned with concrete pavement joints where feasible.
 - 1. Isolation Joints: Isolation joints shall be placed at all radius points, driveways, curb inlets, or where directed by the Plans or Engineer.
 - a. Material: Isolation joints shall be formed by a one piece, one inch thick preformed joint filler cut to the configuration of the correct curb section, and conforming to Section 2208.3.D.
 - b. Stability: Isolation joints shall be secured in a manner so they will not be disturbed by depositing and consolidating of concrete.
 - c. Edging: The edges of the joints shall be rounded with an edging tool of 1/4 inch radius.
 - 2. Contraction Joints: Curbing shall have contraction joints at intervals of not less than 10 feet or more than 15 feet. They shall extend through the entire curb section from the top of the curb to a depth 2 inches below pavement surface.
 - a. Method: Contraction joints shall be formed or sawed.
 - i. When sawing joints, the contractor shall begin as soon as the concrete hardens sufficiently to prevent excessive raveling along the saw cut and shall finish before conditions induce uncontrolled cracks, regardless of the time or weather. When joint sealing backup material is specified with sawed joints, the first stage, which provides a relief cut shall be approximately 1/8 inch wide, and shall be to Plan depth. The second stage which widens the joints to allow the insertion of joint sealing backup material to Plan depth shall not be performed until the concrete is at least 48 hours old, and shall be delayed longer when the sawing causes raveling of the concrete. If second stage sawing is performed prior to the completion of the curing period, the Contractor shall maintain the cure by use of curing tapes, plastic devices, or other materials approved by the Engineer.
 - ii. When forming joints, templates shall be 1/8" metal cut to the configuration of the curbing section. The templates shall be secured at the proper locations so that they will not be disturbed by the depositing of concrete. The templates shall be removed as soon as the concrete has attained its initial set and finished with a 1/4 inch radius on all exposed edges.
 - b. Joint Sealer: When specified, joint sealants shall conform to Section 2208.3.
- F. Concrete Work: Concrete for curbing shall be placed in accordance with the requirements of Section 2208.4. Isolation and contraction joints shall be constructed as shown on the Plans, Standard Drawings, or where directed by the Engineer.
 - 1. Concrete Placement: Concrete shall be mechanically vibrated and shall not be allowed to extrude below the forms to cause an irregular alignment of the abutting street pavement.
 - 2. Finishing: After placing and initial strike-off the curb shall be tooled to the required radii. If the surface

of the concrete is sufficiently wet that a ridge is formed at the inside of the radius tool, finishing will cease until the excessive moisture has evaporated.

After initial set, the face forms shall be removed and the surface finished to the required dimensions. No water, dryer, or additional mortar shall be applied to the free surface of the concrete.

The finished surface of the concrete shall be broomed perpendicular to the curb with a clean broom to provide an antiskid surface.

In all cases the finished curb shall have a true surface, free from sags, twists, or warps, and shall have a uniform color and appearance.

3. Curing: As soon as practical after the concrete is finished it shall be cured with a liquid curing membrane meeting the requirements of Section 2208.4.E.4, applied according to the manufacturer's directions.

If front and/or back forms are removed from finished curbing within a period of 72 hours of placement these surfaces shall also be cured.

Wet burlap, cotton mat, waterproof paper, polyethylene sheeting or earth backfill is not an acceptable curing method for curbing.

4. Protection: The Contractor shall protect the concrete work against damage or defacement of any kind until it has been accepted by the Engineer. Concrete which is damaged or defaced, shall be removed and replaced, or repaired to the satisfaction of the Engineer, at the expense of the Contractor.
5. Temperature Limitations: Concrete work shall be performed in accordance with requirements of the state DOT specifications for the state where the work is being performed.
6. Backfill: Backfill shall conform to Section 2208.4.E.9. The Contractor shall be responsible for the repair of any pavement disturbed by the construction to the satisfaction of the Engineer.
7. Joint Sealing and Clean-Up: Unless otherwise specified or waived by the Engineer, an approved joint sealer shall be applied in accordance with the manufacturer's directions within 7 days of the placement of the concrete. The Contractor shall be responsible for the removal of excess dirt, rock, broken concrete, concrete splatters and overspray from the area of the construction.
8. Surface Tolerances: Curbing shall have a surface tolerance of 1/4 inch in 10 feet when checked with a ten foot straightedge.
9. Repairing Defects: Defects in the concrete shall be repaired in accordance with Section 2208.6.

2209.5 Method of Measurement

Curbing will be measured per lineal foot or tenth part thereof for the applicable type.

2209.6 Basis of Payment

Curbing will be paid for by one of the following:

- A. Contract unit bid price.
- B. Contract lump sum bid price.

SECTION 2210

This section has been intentionally left blank.

SECTION 2211 SMOOTHNESS

2211.1 Scope

This section governs the furnishing of all labor, materials and equipment for the determination of pavement surface smoothness, evaluation of results, and corrective actions as shown on the Plans and in accordance with the Contract Documents, Standard Drawings, the specifications and the Special Provisions.

2211.2 Referenced Standards

The following standards are referenced directly in this section. The latest version of these standards shall be used. If conflicting standards are referenced, the more stringent standard shall apply.

Kansas Department of Transportation

Standard Specifications for State Road and Bridge Construction, 2015 Edition

Kansas Test Method KT-46 from KDOT Construction Manual, latest revision

Missouri Highways and Transportation Commission

Missouri Standard Specifications for Highway Construction, 2011 Edition

MoDOT Engineering Policy Guide Section 106.3.2.59 TM-59, Determination of the International Roughness Index

2211.3 Equipment

Equipment for determination of pavement smoothness and performance of corrective actions shall be in compliance with the specifications of the Department of Transportation of the state where the work is performed; for MoDOT, Section 502.8 and for KDOT, Sections 503 and 603.

2211.4 Construction

If specified in the Contract Documents, profilographing shall be performed on roadways classified as arterials, major collectors, freeways, expressways and interstates.

- A. Exceptions: Unless otherwise specified in the Contract Documents, profilographing will not be required for local roads or minor collectors. In addition, other exceptions shall be as specified in the state DOT specifications for the state the work is being performed in.
 - 1. Finished pavements on local roads, minor collectors and other areas exempted from profilographing shall be checked with a 10 foot straightedge placed parallel to the center line at any location within a driving lane. Areas showing high spots of more than 1/4 of an inch in 10 feet shall be marked and ground down with approved grinding equipment to an elevation where the area or spot will not show surface deviations in excess of 1/8 inch when tested with a 10 foot straight edge. Grinding will be

performed on the full width of the lane failing to meet the smoothness criteria. The cost of correcting the smoothness and associated traffic control shall be at Contractor's expense.

- B. Profilographing: Profilograph testing and evaluation shall be performed in accordance with the State Department of Transportation specifications and test methods for the state where the work is being performed; for MoDOT, Section 502.8 and for KDOT, Sections 503 and 603. Within two days after the paving, furnish the Engineer with the profilogram and its evaluation.
- C. Corrective Actions: Corrective actions shall be performed at the Contractor's expense and in accordance with the State Department of Transportation specifications for the state where the work is being performed; for MoDOT, Section 502.8 and for KDOT, Sections 503 and 603.
- D. Final Report: The Contractor shall submit a final report to the Engineer with final profilograph results verifying compliance with the specified pavement smoothness requirements.
- E. Pay Adjustments: No pay adjustments (incentive or disincentive) shall be made to the smoothness or pavement items based on the results of the profilograph testing.

2211.5 Method of Measurement

Smoothness will be measured as a lump sum unit.

2211.6 Basis of Payment

Smoothness will be paid for by Contract lump sum bid price.

END OF SECTION

SECTION 2300 - INCIDENTAL CONSTRUCTION

CITY OF LEE'S SUMMIT, MISSOURI STANDARD SPECIFICATIONS

The City of Lee's Summit hereby adopts Section 2300 of the Kansas City Metropolitan Chapter of APWA Construction and Material Specifications, current edition. The following additions, deletions and/or revisions are adopted as a part of Section 2300 for use within Lee's Summit. Text in bold italics indicates revisions or additions to the APWA standard.

2301.3 Materials

2301.3.A Concrete:

Concrete shall be a currently approved KCMMB 4k mix.

2301.3 Materials

ADD the following:

F. ADA Detectable Warning Surfaces: The material used to provide contrast shall be an integral part of the walking surface. The material for detectable surface shall be:

1. Grouted-in-Place Clay Pavers

- a. Paving brick shall be 2 1/4" x 3 5/8" x 7 5/8" and shall meet the requirements of ASTM C902 for Class SX, Type 1 brick and ASTM C1272.***
- b. The bricks shall be placed in a Soldier Course pattern on type A and Type M ramps, or in the Herringbone or Soldier Course pattern on Type B ramps.***
- c. The bricks shall be saw cut only and any brick shall not be less than 25% of a full brick.***
- d. Type M mortar shall be used for the setting bed and grouted joints in accordance with ASTM C270, Table 1 (Masonry Cement Type only).***

2. Cast-in-Place Tiles: Acceptable products include ceramic composites, composites, reinforced concrete, or materials of strength and durability similar to that of the concrete walking surface. Proposed materials shall be approved by the City prior to installation.

3. Color for all surfaces options shall be 'brick red'. Any color variation to meet contrast requirements must be approved by the City.

4. Surface applied retrofit tiles shall not be allowed.

2302 Asphalt Sidewalks, Driveways, and Bicycle/Pedestrian Paths

ADD the following statement to Paragraph 2302.1

Scope: *Asphalt shall not be allowed for sidewalks, driveways and bicycle/pedestrian paths within the public right-of-way.*

Section 2304 Concrete Paver Stones (for Median Treatment)

2304.3 Material: ADD the following 1.3.A Concrete:

Stamped and colored concrete shall be used for medians and edge treatments along arterial streets. Interlocking paver stones will not be allowed for such use along arterial streets.

2305 Maintenance of Traffic: Delete APWA section in its entirety (replace with LS Section 3000 – Traffic Control, Marking and Signing)

2306 Pavement Markings: Delete APWA section in its entirety (replace with LS Section 3000 – Traffic Control, Marking and Signing).

DIVISION II
CONSTRUCTION AND MATERIAL SPECIFICATIONS SEWERS
SECTION 2300 – INCIDENTAL CONSTRUCTION

APPROVED AND ADOPTED THIS 15th DAY OF FEBRUARY, 2017

KANSAS CITY METROPOLITAN CHAPTER
OF THE AMERICAN PUBLIC WORKS ASSOCIATION

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2301 STANDARD SIDEWALKS, SIDEWALK RAMPS, DRIVEWAYS, AND BICYCLE /PEDESTRIAN PATHS

2301.1 Scope

This section governs the furnishing of all labor, materials and equipment for the construction or reconstruction of sidewalks, sidewalk ramps driveways, and bicycle/pedestrian paths as shown on the Plans and in accordance with the Standard Drawings, the specifications and the Special Provisions.

2301.2 Referenced Standards

The following standards are referenced directly in this section. The latest version of these standards shall be used. If conflicting standards are referenced, the more stringent standard shall apply.

ADAAG – ADA Accessibility Guidelines

Section 4.7 – Curb Ramps

PROWAG - Public Rights-of-Way Accessibility Guidelines

ASTM

A 615	Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
A 775	Standard Specification for Epoxy-Coated Steel Reinforcing Bars
A 1064	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
C 31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
C 39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
C 143	Standard Test Method for Slump of Hydraulic-Cement Concrete
C 172	Standard Practice for Sampling Freshly Mixed Concrete
C 231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
C 309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
C 920	Standard Specification for Elastomeric Joint Sealants
C 1064	Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
D 1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
D 1752	Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
D 2805	Standard Test Method for Hiding Power or Paints by Reflectometry
D 7174	Standard Specification for Preformed Closed-Cell Polyolefin Expansion Joint Fillers for Concrete Paving and Structural Construction

AASHTO

M 148	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
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MCIB	Mid-West Concrete Industry Board Concrete Specifications - Concrete Pavement. The current editions of the "Bulletins" and Approved Sections of the "Standard Concrete Specifications" issued by the Mid-West Concrete Industry Board, Inc. (MCIB) are made a part hereof by reference. However, when the provisions of this Specification differ from the provisions of such "Bulletins" and "Sections" the provisions of this Specification shall govern. Reference December 2000 Specifications if most recent version does not contain specified mix designs.
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KCMMB Kansas City Metro Materials Board Specifications

Kansas Department of Transportation

Standard Specifications for State Road and Bridge Construction, 2015 Edition

Missouri Highways and Transportation Commission

Missouri Standard Specifications for Highway Construction, 2011 Edition

2301.3 Materials

- A.** Concrete: Concrete shall conform to referenced specifications as called out in the Contract Documents. If no direct reference to concrete specifications is included in the Contract Documents, concrete shall meet KCMMB specifications.
1. If KCMMB concrete is specified, an approved KCMMB concrete mix shall be required.
 2. If MCIB concrete is specified, concrete shall comply with MCIB Section entitled "Concrete Pavement".
 3. If KDOT specifications are referenced for concrete, provide material in compliance with the latest version of KDOT specifications. Approval of component materials will be based on submittal of certifications from supplier. Aggregates shall meet the quality requirements specified by KDOT. Engineer reserves the right to perform testing of components to verify compliance.
 4. If MoDOT specifications are referenced, provide material in compliance with the latest version of MoDOT specifications. Approval of component materials will be based on submittal of certifications from supplier. Aggregates shall meet the quality requirements specified by MoDOT. Engineer reserves the right to perform testing of components to verify compliance.
 5. Proposed concrete mix designs for use on the project shall be submitted to Engineer for approval at least two (2) weeks in advance of anticipated use. Mix design shall be approved prior to use of that mix.
 6. Field testing of concrete shall be at the Contractor's expense and performed by an ACI certified materials testing firm acceptable to the Owner. Unless otherwise specified, the following tests shall be performed once for every 50 cu yd of concrete placed:
 - a. Sampling of fresh concrete per ASTM C 172
 - b. Slump per ASTM C 143
 - c. Air Content per ASTM C 231
 - d. Temperature per ASTM C 1064
 - e. Cylinders cast per ASTM C 31 and tested per ASTM C 39. Four cylinders shall be cast with one tested at 7 days, 2 tested at 28 days and one held in reserve.
- B.** Reinforcement: Reinforcement is not required unless shown on the Plans, Standard Drawings or in the Special Provisions. If specified to be used, reinforcement shall meet the following requirements:
1. Bars: Non-epoxy coated bars shall conform to ASTM A 615. Epoxy coated bars shall conform to ASTM A 775.

2. Welded Steel Wire: Welded steel wire fabric shall conform to ASTM A 1064.
 3. Supporting Elements: Representative samples of supporting elements shall be submitted and approved by the Engineer prior to their use in the project.
 4. Fibers: When specified in the Contract Documents, fibers shall be incorporated into the concrete at the rate recommended by the manufacturer but no less than a minimum of 3 pounds per cubic yard of concrete for macro fibers and 1 pound per cubic yard of concrete for micro fibers. Fibers shall meet the requirements of KDOT Standard Specifications for State Road and Bridge Construction, 2015 Edition, Section 1722.2. Micro fibers are used to control plastic shrinkage cracks in concrete while macro fibers control cracking in hardened concrete and are often used as a substitute for traditional crack control steel reinforcing bars or mesh. In addition, macro fibers add toughness, and impact and fatigue resistance to hardened concrete.
- C. Isolation Joint: Isolation joints shall be formed by a one piece, 1/2-inch thick non-extruding preformed joint filler cut to the configuration of the abutting section. The filler material shall be full depth, and shall conform to ASTM D 1751, D 1752, or D 7174. ASTM D 1752 material shall be used against curved surfaces, around utility boxes or poles, or against other irregular surfaces, and may be used for all other applications.
- D. Joint sealer shall meet the requirements of Section 2208.3 or may be an approved one-component, moisture-curing, non-priming, gun-grade, elastomeric polyurethane joint sealant that meets the requirements of ASTM C 920, Type S, Grade NS, Class 25, Use NT and M.
- E. Curing Membrane: All material to be used or employed in curing Portland Cement Concrete must be approved by the Engineer prior to its use. It shall be of the liquid membrane type and shall conform to ASTM C 309, Type II, Class A or B or AASHTO M 148, Type 2, white pigmented.

2301.4 Construction

The sidewalks, sidewalk ramps, driveways or bicycle/pedestrian paths shall be constructed or reconstructed to the configuration, and to the lines and grades shown on the Plans. Generally sidewalks, sidewalk ramps, driveways, and bicycle/pedestrian paths should be constructed after the curbing. Sidewalk ramp construction shall comply fully with all requirements for sidewalks in this section and shall comply with the requirements of ADAAG Section 4.7 and the most current federal guidelines governing sidewalk ramps (i.e. PROWAG).

- A. Removal: Existing sidewalks, sidewalk ramps, driveways, or bicycle/pedestrian paths shall be totally removed to the nearest contraction or isolation joint, unless otherwise specified by the Engineer. The section shall be sawed full depth.
- B. Grading, Subgrade Preparation and Base Course: All excavation, embankment, subgrade stabilization or aggregate base course required shall be as defined in Sections 2100 "Grading and Site Preparation", 2201 "Subgrade Preparation", 2202 "Subgrade Stabilization", and 2203 "Aggregate Base Course", except as follows:
1. Unless otherwise specified on the Plans, Standard Drawings or Special Provisions, the subgrade shall be compacted until no further consolidation of the material occurs using compaction methods approved by the Engineer. The Engineer will visually determine the acceptance of the subgrade. Satisfactory moisture content shall be achieved to provide sufficient compaction of material as approved by the Engineer.

If during reconstruction operations additional fill material is needed beneath sidewalks or driveways it shall be untreated compacted aggregate conforming to Section 2203.3.A, placed in conformance with Section 2203.4.A.

- C. Forms: All forms shall be in good condition, clean, and free from imperfections. Each form shall not vary more than 1/4 inch in horizontal or vertical alignment for each 10 feet in length.
 - 1. Material and Size: Forms shall be made of metal unless otherwise approved by the Engineer and shall have a height equal to or greater than the depth of the sidewalk, driveway, or bicycle/pedestrian path section. Wood forms may be substituted when approved by Engineer and if they are free from warp with sufficient strength for the intended application.
 - 2. Strength: Forms shall be of such cross-section and strength, and so secured as to resist the pressure of the concrete when struck off, vibrated, and finished, and the impact and vibration of any equipment which they may support.
 - 3. Installation: The forms shall be set true to line and grade, supported through their length and joined neatly in such a manner that the joints are free from movement in any direction.
 - 4. Preparation: Forms shall be cleaned and lubricated prior to each use and shall be so designed to permit their removal without damage to the new concrete.
- D. Slip-form Machine: A slip-form machine may be used in lieu of forms. The machine must be equipped with mechanical internal vibrators and be capable of placing concrete to the correct cross section, line and grade within the allowable tolerances.
- E. Grades and Slopes: The grade and slope along the length of the walk shall conform to the most current version of PROWAG. Unless shown otherwise on the Plans or directed by the Engineer, the cross slope shall be toward the street. The sidewalk cross slope shall be carried through driveways.
- F. Joints: Unless directed by the Engineer the joints shall be formed at right angles to the alignment of the sidewalk, driveway, or bicycle/pedestrian path and to the configuration specified by the Plans or Standard Drawings.
 - 1. Joint Patterns
 - a. Sidewalk surfaces shall be marked with a transverse joint spaced at a distance equal to the width of the sidewalk. Sidewalks greater than 6 feet in width shall be divided by longitudinal joints spaced not less than 30 inches nor more than 60 inches with transverse joints spaced to form a square pattern. Edger tool marks shall remain showing unless the sidewalk is slip-formed and subsequently sawed. Curb joints should align with sidewalk joints where they abut.
 - b. Concrete driveways and bicycle/pedestrian paths shall have a maximum slab dimension no greater than 10 feet, although widths no more than 24 times the slab thickness will be permitted to match existing joint patterns.
 - 2. Isolation joints: Isolation joints shall be placed at locations shown on the Plans and Standard Drawings or as directed by the Engineer.
 - a. General: The preformed isolation joint material shall be left 1/2-inch below the surface, or a suitable tear strip will be provided to allow for the application of the joint sealer.

- b. Stability: Isolation joints shall be secured in a manner so they will not be disturbed by depositing and consolidating the concrete.
 - c. Edging: The newly poured edges of these joints shall be rounded with an edging tool of ¼ inch radius.
 - d. Spacing: Isolation joints shall be placed at spacing indicated on the Plans or Standard Drawings. Spacing should not exceed 100' from center to center.
 - 3. Contraction joints: Contraction joints shall be 1-inch deep by 1/8-inch wide with 1/4-inch radii rounded edges.
 - a. Edging: Edger marks shall remain showing unless the sidewalk, driveway or bicycle/pedestrian path is slip formed and subsequently sawed.
 - b. Slip forming: Contraction joints may be sawed 1/8-inch wide by 1/3rd the thickness of the slab.
 - c. Joint Sealer: Joint sealer is not required, unless otherwise specified in the Plans, Standard Drawings or Special Provisions.
- G. Concrete Work: Concrete shall be furnished in quantities required for immediate use and shall be placed in accordance with the requirements of the applicable specification as stipulated in Section 2208.3.A.
- 1. Concrete Placement: Deposit and consolidate concrete as close to the final position as possible, beginning at one corner of the forms. Perform necessary hand spreading with shovels or come-alongs, not with rakes or vibrators. All concrete shall be well vibrated unless approved otherwise by the Engineer. Do not walk in the fresh concrete with boots or shoes coated with earth or foreign substances. When concrete is placed on a sloped surface, begin concrete placement at the lowest area.
- Limitations for time of placement and other items not specifically covered by this specification shall be in accordance with the most recent Standard Specifications of the State Department of Transportation for the state the work is being performed in. The Engineer may extend placement time limitations based on field conditions and concrete consistency and workability.
- 2. Finishing
 - a. Strike off the concrete with a vibratory screed or a hand strike-off method when adequate consolidation is attained. Immediately after strike-off, the concrete may be bull-floated to remove any high or low spots. Minimize the use of the bull-float.
 - b. Do not finish concrete with water standing on the surface. All edges of the slab shall be carefully finished with a 1/4-inch radius edger.
 - c. After finishing, the surface of the concrete shall be broomed with a fine clean broom to provide an antiskid surface, and the edges and joints retooled unless slip-formed.
 - d. In all cases the finished sidewalk, driveway, or bicycle/pedestrian path shall have a true surface, free from sags, twists, or warps, and shall have a uniform color and appearance.
 - 3. Curing: As soon as practical after the concrete is finished it shall be cured with an approved liquid curing membrane applied according to manufacturer's directions.
 - a. If forms are removed within a period of 72 hours of placement those formed surfaces shall also be cured.
 - b. Wet burlap, cotton mats, waterproof paper, polyethylene sheeting or earth backfill shall not be acceptable as curing methods.

4. Protection: The Contractor shall protect the concrete work against damage or defacement of any kind until it has been accepted by the Engineer. Concrete which is damaged or defaced shall be removed and replaced or repaired to the satisfaction of the Engineer, at the expense of the Contractor.
5. Temperature Limitations: Concrete shall be placed in accordance with requirements of the state DOT specifications for the state where the work is being performed.
- H. Backfill: A minimum of 24 hours shall elapse before forms are removed and 5 days shall elapse or the concrete must have attained 75% of its 28 day compressive strength before pavement is backfilled unless otherwise approved by the Engineer.
- I. Backfill shall be accomplished in accordance with Sections 2100 and 2201 entitled "Grading and Site Preparation" and "Subgrade Preparation".
- J. The Contractor shall be responsible for the repair of any street pavement damaged by the construction to the satisfaction of the Engineer.
- K. Joint Sealing and Clean-Up: All isolation joints shall be sealed with an approved joint sealer meeting the requirements of Section 2301.3.D applied in accordance with Section 2208.4 and the manufacturer's directions within 7 days of the placement of the concrete and prior to the opening of the pavement to traffic.
- L. The Contractor shall be responsible for the removal of excess dirt, rock, broken concrete, splatters and overspray from the construction area within 10 days unless otherwise directed by the Engineer.
- M. Surface Tolerances: Sidewalks, driveways, and bicycle/pedestrian paths shall have a surface tolerance of 1/4 inch in 10 feet when checked with a 10 foot straightedge. Vertical deflections at sidewalk joints shall not exceed 1/4-inch.
- N. Detectable Warnings: Detectable warnings are required standardized surface features built in or applied to walking surfaces on sidewalks or ramps to warn visually impaired people of hazards on a circulation path. Those hazards include, but are not limited to interfaces between sidewalks and areas where moving vehicles may be present. Detectable warnings shall be in accordance with PROWAG Section R305.

2301.5 Method of Measurement

- A. Sidewalks: Sidewalks will be measured per square foot or tenth part thereof.
- B. Sidewalk Ramps: Sidewalk ramps including detectable warning will be measured by one of the following:
 1. Per square foot or tenth part thereof. Street curbing adjoining sidewalk ramps will be measured in accordance with Section 2209.5 and paid for separately.
 2. Per each.
- C. Driveways: Driveways will be measured per square foot or tenth part thereof.
- D. Bicycle/Pedestrian Paths: Bicycle/Pedestrian paths will be measured per square foot or tenth part thereof.

2301.6 Basis of Payment

All items in this section will be paid for by the Contract unit bid price.

SECTION 2302 ASPHALT SIDEWALKS, DRIVEWAYS, AND BICYCLE/PEDESTRIAN PATHS

2302.1 Scope

This section governs the furnishing of all labor, materials and equipment for the construction or reconstruction of asphalt sidewalks, driveways, and bicycle/pedestrian paths as shown on the Plans and in accordance with the Standard Drawings, the specifications and the Special Provisions.

2302.2 Asphalt Sidewalks

Asphalt shall not be used in the construction of any approved permanent sidewalk. Asphalt may be used as material for temporary sidewalks if approved in advance by the Engineer.

2302.3 Asphalt Driveways

Asphalt driveways may be constructed with prior approval of the Engineer in accordance with the provisions of Section 2205 "Asphalt Paving" and Section 2209 "Curbing" as applicable.

2302.4 Asphalt Bicycle/Pedestrian Paths

Asphalt bicycle/pedestrian paths shall be constructed in accordance with the provisions of Section 2205 "Asphalt Paving" and in accordance with the applicable provisions of Section 2302.3.

2302.5 Method of Measurement

A. Asphalt Sidewalks: Asphalt Sidewalks will be measured by one of the following:

1. Per ton or tenth part thereof.
2. Per square foot or tenth part thereof.

B. Asphalt Driveways: Asphalt Driveways will be measured by one of the following:

1. Per ton or tenth part thereof.
2. Per square foot or tenth part thereof.

C. Asphalt Bicycle Pedestrian Paths: Asphalt Bicycle/Pedestrian paths will be measured by one of the following:

1. Per ton or tenth part thereof.
2. Per square foot or tenth part thereof.

2302.6 Basis of Payment

All items in this section will be paid for at the Contract unit bid price.

SECTION 2303 ROCK BLANKET

2303.1 Scope

This section governs the furnishing of all labor, materials and equipment for the construction of a protecting blanket of rock or broken concrete on slopes, channel bank or stream banks as shown on the Plans and in accordance with the Standard Drawings, the specifications and the Special Provisions.

2303.2 Materials

The material for rock blanket shall be durable stone or broken concrete containing a combined total of not more than ten percent (10%) of earth, sand, shale, and non-durable rock. It is preferable that the material contain a large percentage of pieces as large as the thickness of the blanket will permit, with enough smaller pieces of various sizes to fill the larger voids. Acceptance of quality and size of material may be made by the Engineer using visual inspection at the job site. If broken concrete is used, all reinforcing shall be removed prior to placement.

Rock Blanket shall be specified by class as shown in the following tables:

Class	Percent Heavier Than									
	1 Ton	1/2 Ton	1/4 Ton	250 lbs	200 lbs	180 lbs	75 lbs	60 lbs	10 lbs	5 lbs
1 Ton	50+	95+								
1/2 Ton	0	50+	95+							
1/4 Ton		0	50+				90+			
Facing					0		50+			90+
Light 24			0		50+					90+
Light18				0		5-15		50-70	85-100	

2303.3 Construction

A trench at the toe of the slope shall be excavated to the elevation as shown on the Plans or to a minimum of 2-feet when not shown. The slopes shall conform to the proper cross section and be compacted to a uniform density as required for adjacent material. The rock or broken concrete shall be placed on the slope, to the prescribed thickness, elevation and extent, and shall be manipulated so that the flat sides are in contact, thereby eliminating large voids. The outside of the blanket shall present an appearance free from segregation and with a proportionate amount of the larger pieces showing.

2303.4 Method of Measurement

Rock blanket will be measured by one of the following:

- A. Per square yard or tenth part thereof.
- B. Per ton or tenth part thereof.

2303.5 Basis of Payment

Rock blanket will be paid for by the Contract unit bid price.

SECTION 2304 CONCRETE PAVER STONES (FOR MEDIAN TREATMENT)

2304.1 Scope

This section governs the furnishing of all labor, equipment and tools and for the performance of all work necessary to install concrete paver stones as shown on the Plans and in accordance with the Standard Drawings, the specifications and the Special Provisions.

2304.2 Referenced Standards

The following standards are referenced directly in this section. The latest version of these standards shall be used. If conflicting standards are referenced, the more stringent standard shall apply.

ASTM

C 67	Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
C 140	Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
C 418	Standard Test Method for Abrasion Resistance of Concrete by Sandblasting
C 936	Standard Specification for Solid Concrete Interlocking Paving Units

MCIB	Mid-West Concrete Industry Board Concrete Specifications - Concrete Pavement The current editions of the "Bulletins" and Approved Sections of the "Standard Concrete Specifications" issued by the Mid-West Concrete Industry Board, Inc. (MCIB) are made a part hereof by reference. However, when the provisions of this Specification differ from the provisions of such "Bulletins" and "Sections" the provisions of this Specification shall govern. Reference December 2000 Specifications if most recent version does not contain specified mix designs.
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KCMMB	Kansas City Metro Materials Board Specifications
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2304.3 Materials

A. Interlocking Concrete Paver Stones (ASTM C 936)

1. Paver stones shall be cobblestone style consisting of full stones, 4-5/8" x 7" x 2-3/8"; two thirds stones, 4-5/8" x 4-5/8" x 2 3/8"; and one third stones, 4-5/8" x 2-5/16" x 2-3/8". The mix of stones sizes shall be approximately 28% full size, 57% two thirds size and 15% one third size.
2. Cementitious Materials: Materials shall conform to the ASTM, AASHTO and other referenced specifications as required by mix design specifications (MCIB or KCMMB).
3. Aggregates: Aggregates shall conform to the ASTM, AASHTO and other referenced specifications as required by mix design specifications (MCIB or KCMMB).
4. Other Constituents: Air-entraining agents, coloring pigments, integral water repellents, finely ground silica, etc. shall conform to ASTM standards where applicable, or shall be previously established as suitable for use in concrete.
5. Physical Requirements: The Contractor shall provide a certification showing compliance with the following requirements. The Engineer reserves the right to sample and test materials as deemed necessary.

- a. Compressive Strength: At the time of delivery to the work site, the average compressive strength shall be not less than 8,000 psi with no individual unit strength less than 7,200 psi, with testing procedures in accordance with ASTM C 140.
 - b. Absorption: The average absorption shall not be greater than 5% with no individual unit absorption greater than 7%.
 - c. Durability: The manufacturer shall satisfy the Engineer either by proven field performance or the laboratory freeze–thaw test that the paving units have adequate durability.
 - i. Proven Field Performance: Satisfactory field performance is indicated when units similar in composition, and made with the same manufacturing processes as those to be supplied to the Contractor, do not exhibit objectionable deterioration after at least three years. The units used as the basis for proven field performance shall have been exposed to the same environmental factors as is contemplated for the units supplied to the Contractor.
 - ii. Freeze–Thaw Test: When tested in accordance with Section 8 of ASTM C 67, specimens shall have no breakage and not greater than 1.0% loss in dry weight of any individual unit when subjected to 50 freeze–thaw cycles. This test shall be conducted not more than 12 months prior to delivery of units.
 - d. Abrasion Resistance: When tested by sandblasting in accordance with ASTM C 418, specimens shall not have greater volume loss than 0.3 cubic inches per square inch. The average thickness loss shall not exceed 1/8-inch.
 - e. Permissible Variations in Dimensions: Length or width of units shall not differ by more than 1/16-inch from approved samples. Heights of units shall not differ by more than 1/8-inch from the specified standard.
 - f. Visual Inspection: All units shall be sound and free of defects that would interfere with the proper placing of unit or impair the strength or permanence of the construction. Minor cracks incidental to the usual methods of manufacturer, or minor chipping resulting from customary methods of handling in shipment and delivery, shall not be deemed grounds for rejection.
6. Sampling and Testing: The Engineer or his authorized representative shall be accorded proper facilities to inspect and sample the units at the place of manufacture from the lot ready for delivery. Sampling and testing of units shall be in accordance with ASTM C 140 except as required.
 7. Rejection: In case the shipment fails to conform to the specified requirements, the manufacturer may sort it, and new test units shall be selected at random by the Engineer from the retained lot and tested at the expense of the manufacturer. In case the second set of test units fails to conform to specified requirements, the entire lot shall be rejected.
 8. Expense of Tests: The expense of inspection and testing shall be borne by the Engineer except as specified otherwise above.
- B. Base Course Concrete: Base course concrete shall conform to the requirements of MCIB Mix No. WA610–1–4 or an approved KCMMB 4K mix.
 - C. Sand for Laying Course: The sand for the laying course shall be well graded, clean, washed, sharp sand with 100% passing a 3/8" sieve size and a maximum of 3% passing a No. 200 sieve size. This is commonly known as manufactured concrete sand, limestone screening, or similar. Mason Sand will not be permitted.

2304.4 Construction

- A. Product Handling: Paver stones shall be delivered and unloaded at jobsite on pallets and bound in such a

manner that no damage occurs to the product during handling, hauling and unloading.

- B. Edge Restraint: All edges of the installed paver stone shall be restrained by the concrete curb, concrete sidewalk, or another suitable method for preventing the movement of the edge stones.
- C. Concrete Base Course: A concrete base course shall be constructed in accordance with the requirements of Section 2301. The base course shall be shaped to the grade and cross section as shown on the plans with an allowable tolerance of 1/4-inch. The base course shall be 4-inches thick, and should be graded to allow a 1-inch thick sand course between the base and the paving stones, unless shown otherwise on the Plans.

Payment for concrete base course shall be subsidiary to other bid items. The finished base course must be approved by the Engineer before the placement of the sand laying course. The uncompacted sand laying course shall be spread evenly over the area to be paved and then screened to a level that will produce 1-inch thickness when the paver stones have been placed and vibrated. Once screened and leveled to the desired elevation, the sand laying course shall not be disturbed in any way.

- D. Placing Paver Stones: The paver stones shall be installed in rows perpendicular to the major axis of the median being paved. Within each row the stone sizes shall be randomly mixed so that joints between stones are not normally aligned with joints between stones in adjacent rows. No joints shall be aligned for more than three consecutive rows. The paver stones shall be laid in such a manner that the desired pattern is maintained and the joints between the stones are as tight as possible. For maximum interlock it is recommended that joints between stones do not exceed 1/8 inch. String lines should be used to hold all pattern lines true.

The gaps at the edge of the paver surface shall be filled with standard edge stones or with stones cut to fit. Cutting shall be accomplished to leave a clean edge to the traffic surface using a double-headed breaker or a masonry saw. However, when cutting precision designed areas, a masonry saw is recommended. Whenever possible, no cuts should result with a paver less than 1/3 of original dimension.

Paver stones shall be vibrated to their final level in the sand laying course by two or three passes of a vibrating compactor capable of 3,000 to 5,000 pounds compaction force with the surface clean and joints open. After vibration, clean concrete sand containing at least 30% of 1/8-inch particles shall be spread over the paver stone surface, allowed to dry, and vibrated into the joints with additional passes of the plate vibrator so as to completely fill the joints.

Surplus material shall then be swept from the surface. Upon completion of work covered in this Section, the Contractor shall clean up all work areas by removing all debris, surplus material and equipment from the site.

After final vibrating, the surface shall be true to grade and shall not vary by more than 1/4-inch when tested with a 10 foot straight edge at any location on the surface.

2304.5 Method of Measurement

Concrete Paver Stones will be measured by the square foot or tenth part thereof.

2304.6 Basis of Payment

Concrete Paver Stones will be paid for by the Contract unit bid price.

SECTION 2305 MAINTENANCE OF TRAFFIC

2305.1 Scope

This section governs the furnishing of all labor, equipment and tools and for the performance of all work necessary to provide Maintenance of Traffic as specified herein, as shown on the Plans and in accordance with the Standard Drawings, the specifications and the Special Provisions.

2305.2 Referenced Standards

The following standards are referenced directly in this section. The latest version of these standards shall be used. If conflicting standards are referenced, the more stringent standard shall apply.

ATSSA

Quality Standards for Work Zone Traffic Control Devices

Manual of Uniform Traffic Control Devices, Part VI (MUTCD)

2305.3 General

The Contractor is required to maintain access for pedestrians and vehicles to all properties served by the streets and sidewalks impacted by the construction.

2305.4 Traffic Maintenance and Warning Devices

- A. The Contractor will be responsible for arranging for installation of the necessary traffic control devices (with the exception of the barricades and other channelizing devices) a minimum of 48 hours prior to beginning the project so that inspection can be conducted by the Engineer.

Traffic maintenance devices including barricades, flashing lights, flaggers and other traffic control devices shall be in conformance with "Part VI of the Manual on Uniform Traffic Control Devices" latest edition.

- B. Device Maintenance: The Contractor's representative will make daily inspections of the traffic control devices installed and maintain records of any maintenance required and the date on which it was completed. These records will be maintained for the duration of the project and be incorporated as part of the final records. It shall be the Contractor's responsibility to maintain all traffic control devices in proper working condition and placement at all times. The Contractor shall promptly correct any deficiencies in traffic control.
- C. Traffic Control Plan Revisions: Engineer reserves the right to make adjustments or revisions in traffic handling requirements that may become necessary after construction has started. These changes will be determined on the basis of periodic inspections throughout the duration of the project. Notice of such change will be transmitted to the Contractor and it will be his responsibility to make the necessary changes as soon as practicable after receipt of the notification.

2305.5 Pedestrian Traffic Control

- A. Devices: All traffic control along pedestrian routes (sidewalks) shall meet the requirements of sections of the latest version of the MUTCD. Particular attention should be paid to 6D.01 and 6D.02 for pedestrian safety.
- B. Pedestrian Route Closures: Pedestrian routes shall not be closed unless approved by the Engineer. If a pedestrian route must be temporarily closed, an alternate accessible route must be maintained.

- C. Pedestrian Access: Accessible pedestrian access to all buildings served by the sidewalk must be maintained at all times during the project.
- D. Pedestrian Routes Protection: Existing pedestrian routes and alternate accessible routes shall be protected from construction activities at all times. This protection may include, but is not limited to, railings, fences, barricades, and covered walkways.

2305.6 Flashers and Other Traffic Control Devices

All traffic control devices shall be maintained in acceptable condition as defined by the latest ATSSA "Quality Standards for Work Zone Traffic Control Devices." Devices in unacceptable or marginal condition as determined above shall be removed from the job site and replaced with devices in acceptable condition.

2305.7 Method of Measurement

Maintenance of Traffic will be measured as specified by the Contract Documents. Measurements shall be per each device per day listed as identified in the Plans and as adjusted by the Engineer during construction. The device must be set for at least one-half of a calendar day for it to be measured for payment. Relocation of devices required by project phasing shown on the Plans or proposed by the Contractor shall be subsidiary to the line item.

2305.8 Basis of Payment

Maintenance of Traffic will be paid for by one of the following:

- A. Contract unit bid price.
- B. Contract lump sum bid price.

SECTION 2306 PAVEMENT MARKINGS

2306.1 Scope

This section governs the furnishing of labor, equipment, and materials and for the performance of work necessary to furnish and install white and yellow permanent or temporary retro-reflectORIZED pavement marking materials as shown on the Plans and in accordance with the Standard Drawings, the specifications and the Special Provisions.

2306.2 Referenced Standards

The following standards are referenced directly in this section. The latest version of these standards shall be used.

ASTM

C 321	Standard Test Method for Bond Strength of Chemical-Resistant Mortars
C 501	Standard Test Method for Relative Resistance to Wear of Unglazed Ceramic Tile by the Tile Abraser
D 36	Standard Test Method for Softening Point of Bitumen (Ring and Ball Apparatus)
D 92	Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester
D 93	Standard Test Methods for Flash Point by Pensky Martens Closed Tester
D 256	Standard Test Method Methods for Determining the Izod Pendulum Impact Resistance of Plastic
D 476	Standard Specification for Titanium Dioxide Pigments, Type II Rutile

D 562	Standard Test Method for Consistency of Paints Using Stormer Viscosimeter
D 570	Standard Test Method for Water Absorption of Plastics
D 638	Standard Test Method for Tensile Properties of Plastics
D 711	Standard Test Method for No-Pick-Up Time of Traffic Paint
D 768	Standard Specification for Yellow Iron Oxide
D 868	Standard Test Method for Evaluating Degree of Bleeding of Traffic Paint
D 1152	Standard Specification for Methanol (Methyl Alcohol)
D 1155	Standard Test Method for Roundness of Glass Spheres
D 1199	Standard Specification for Calcium Carbonate Pigments
D 1210	Standard Test Method for Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage
D 1214	Standard Test Method for Sieve Analysis of Glass Spheres
D 1475	Standard test Method for Density of Paint, Varnish, Lacquer, and Related Products
D 2240	Standard Test Method for Rubber Property-Durometer Hardness
D 2243	Standard Test Method for Freeze-Thaw Resistance of Waterborne Coatings
D 2369	Standard Test Method for Volatile Content of Coatings
D 2805	Standard Test Method for Hiding Power of Paints by Reflectometry
D 3723	Standard Test Method for Pigment Content of Water Emulsion by Low Temperature Ashing
D 3960	Standard Practice for Determining Volatile Organic Content (VOC) of Paints and Related Coatings
D 4060	Standard Test Method for Abrasion Resistance of Organic Coatings by Taber Abraser
D 4061	Standard Test Method for Retroreflectance of Horizontal Coating
D 4366	Standard Test Methods for Hardness of Organic Coatings by Pendulum Damping Tests
D 4796	Standard Test Method for Bond Strength of Thermoplastic Traffic Marking Material
D 5420	Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact)
E 70	Standard Test Method for pH of Aqueous Solutions With the Glass Electrode
E 303	Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester
E 308	Standard Practice for Computing the Colors of Objects by Using the CIE System
E 660	Standard Practice for Accelerated Polishing of Aggregates or Pavement Surfaces Using a Small-Wheel, Circular Track Polishing Machine
E 1347	Standard Test Method for Color and Color-Difference Measurement by Tristimulus (Filter) Colorimetry
E 1349	Standard Test Method for Reflectance Factor and Color by Spectrophotometry Using Bidirectional Geometry

AASHTO

M 247	Standard Specification for Glass Beads Used in Pavement Markings
M 249	Standard Specification for White and Yellow Reflective Thermoplastic Striping Material (Solid Form)
T 250	Standard Method of Test for Thermoplastic Traffic Line Material

Manual of Uniform Traffic Control Devices, latest Edition (MUTCD)

ACI

Federal Test Method Standard No. 141d, Method 4252 – Paint, Varnish, Lacquer and Related Materials; Methods of Inspection, Sampling and Testing

Federal Test Method Standard No. 141d, Method 6242 – Paint, Varnish, Lacquer and Related Materials; Methods of Inspection, Sampling and Testing

Federal Standard 595, Colors used in Government Procurement

Federal Specification TT-P-115a – Paint, Traffic (Highway, White and Yellow)

Federal Specification TT-P-1952B – Paint, Traffic and Airfield Marking, Water Emulsion Base

“Standard Color Chips for Highway Signs” (US Bureau of Public Roads, Washington D.C.)

2306.3 General

The permanent pavement markings shall be installed immediately after the roadway surface is complete unless prior approval is received by the Engineer. The installation of the yellow markings (as required) is the first priority. If the permanent markings cannot be installed and thus the roadway would be unmarked overnight, temporary removable markings shall be installed and remain until the permanent markings can be installed. The contractor shall make every possible effort to remove the temporary pavement markings and install permanent pavement markings within 48 hours. Only under extreme circumstances and with the approval of the Engineer, will the duration of the temporary pavement markings be extended. Under no circumstance should the temporary pavement markings be in place for more than 2 weeks. If permanent markings cannot be installed within the specified time then semi-permanent markings shall be installed following the guidelines as set forth in the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD) Part VI, Sections F6 and G6. The temporary removable markings shall be removed prior to installation of the permanent markings. In situations where markings conflict with the traffic routing, such as a lane closure or a lane diversion, conflicting markings shall be removed prior to application of the next set of markings.

2306.4 Striping Applicability Chart

These charts provide guidance for the selection of striping materials:

Marking Material	Roadway Surface	Application	Durability
Thermoplastic	New asphalt	Permanent	High
Aggressive bond thermoplastic	Aged asphalt	Permanent	High
Preformed thermoplastic	Asphalt, concrete	Permanent	High
Cold plastic	Asphalt, concrete	Permanent	Moderate
Paint	All surfaces	Permanent, temporary	Low
Epoxy	All surfaces	Permanent	High
Temporary Tape (Type I)	All surfaces	Temporary	Low
Temporary Tape (Type II)	All surfaces	Temporary	Low
Line masking tape	All surfaces	Temporary	Low

Roadway Surface	Permanent Marking	Temporary Marking
New asphalt	Thermoplastic	Temporary Tape (I or II)
Old asphalt	Aggressive bond thermoplastic	Temporary Tape (I or II)
Slurry or microsurface	Thermoplastic	Temporary Tape (I or II)
Milled concrete or asphalt	Not applicable	Paint
Asphalt to be milled	Not applicable	Paint
Base asphalt	Not applicable	Paint, Temporary Tape (Type II)
New or old concrete	Aggressive bond thermoplastic, Epoxy	Paint
Concrete	Inlaid cold plastic	Paint
Diamond ground concrete	Epoxy	Paint

Note: Old asphalt is asphalt which is more than 6 months old, or which has been open to traffic.

2306.5 Symbol Applicability Charts

These charts provide guidance for the selection of text and non-text symbol materials:

Roadway Surface	Text Symbols	Temporary Text Symbols
New asphalt	Pre-formed thermoplastic	Temporary Tape (I or II)
Old asphalt	Pre-formed thermoplastic	Temporary Tape (I or II), paint
Slurry or microsurface	Pre-formed thermoplastic	Temporary Tape (I or II), paint
Milled concrete or asphalt	Not applicable	Paint
Asphalt to be milled	Not applicable	Paint
Base asphalt	Not applicable	Paint
New or old concrete	Inlaid cold plastic	Temporary Tape (I or II)
Concrete	Inlaid cold plastic	Temporary Tape (I or II)
Diamond ground concrete	Inlaid cold plastic	Temporary Tape (I or II)

2306.6 Prequalification

- A. If the Owner has an established prequalification program, manufacturers interested in prequalifying material under this specification shall submit to the Owner:
 1. A sample of the material. Sample quantities are determined by the Owner. The submittal of a material sample may be waived by the Owner at their discretion.
 2. Certifications by qualified testing laboratories that the material meets all required tests.
 3. A list of existing installations.
- B. The Owner may test submitted samples or materials as used for compliance with all requirements of this specification.
- C. Products will remain on the prequalified list as long as the results of verification testing and/or field performance are satisfactory. Any changes in formulation should be reported to the Owner for review and evaluation to determine if requalification is necessary.
- D. No material shall be used unless the material has been prequalified or approved by the Engineer.
- E. A list of qualified materials by manufacturer may be maintained by the Owner.

2306.7 Materials

- A. Pre-Mix Glass Spheres: Pre-mix glass spheres shall be uncoated and conform to AASHTO M 247 Type 1. The glass spheres used in the formulation shall be lustrous, free from film, scratches, and pits. The glass spheres shall also meet the following requirements:
 1. Roundness: The roundness of the spheres shall be a minimum of 70% when tested in accordance with ASTM D 1155.
 2. Gradation: The gradation when tested in accordance with the method provided in ASTM D 1214 (by use of U.S. Standard Sieves) shall be:

Size of Sieve	Mass % Passing
No. 18	80 – 100
No. 50	20 – 50
No. 80	0 – 10

- Refractive Index: When tested by a liquid immersion method at 77° F, the refractive index of the spheres shall be a minimum of 1.50.

B. Drop-On Glass Spheres: The spheres shall be manufactured from glass of a composition designed to be highly resistant to traffic wear and to the effects of weathering. The particles shall be spherical in shape, containing not more than thirty percent (30%) of irregularly shaped particles. They shall be essentially free of sharp angular particles, and particles showing milkiness or surface scoring or scratching. They shall meet the requirements of AASHTO M 247 Type 1.

- Gradation: The gradation when tested in accordance with the method provided in ASTM D 1214 (by use of U.S. Standard Sieves) shall be:

Size of Sieve	% Passing (by Weight)
No. 20	100
No. 30	80 – 100
No. 50	18 – 35
No. 80	0 – 10
No. 100	0 – 2

- Refractive Index: When tested by a liquid immersion method at 77° F, the refractive index of the spheres shall be within the range of 1.50 to 1.60.
- Moisture Proof Requirements: The spheres shall show no tendency to absorb moisture in storage and shall remain free of clusters and hard lumps. The spheres shall flow freely from dispensing equipment at any time when surface and atmospheric conditions are satisfactory for application.

C. Thermoplastic Pavement Markings: This specification covers a white and yellow thermoplastic reflectorized pavement marking material of a type that is applied to asphalt road surfaces in a molten state by mechanical means to receive a surface application of glass spheres, and which upon cooling to normal pavement temperature, produces an adherent reflectorized stripe of specified thickness and width and is capable of resisting deformation.

- Characteristics: The material shall not exude fumes that are toxic, obnoxious or injurious to person or property, when it is heated to the temperature range specified by the manufacturer for application. It shall remain stable when held for 4 hours at this temperature, or when subject to three reheatings after cooling to ambient temperature.

The temperature-viscosity characteristics of the plastic material shall remain constant throughout repeated reheatings, and shall show like characteristics from batch to batch. There shall be no obvious change in color of the material either as a result of repeated reheatings or from batch to batch.

The thermoplastic material shall easily extrude from the equipment to produce a cross-section of line 90 to 125 mil thick, which shall be continuous and uniform in shape, and have clear and sharp dimensions.

2. Serviceability: The compound shall resist deterioration by contact with sodium chloride, calcium chloride or other chemicals used to prevent roadway ice, or because of the oil content of pavement materials or from oil droppings or other effects of traffic. The markings shall remain intact under normal traffic conditions at temperatures below 140° F.
3. Specific Gravity: The material's specific gravity shall not be less than 1.8 nor exceed 2.3 referred to water at 77° F when determined by a water displacement method at 77° F.
4. Set Time: When applied at the specified temperature and thickness, the material shall set to bear traffic in not more than 2 minutes when the air temperature is 50° F and not more than 10 minutes when the air temperature is 90° F.
5. Composition: The thermoplastic pavement marking material shall be homogeneously composed of pigment, filler, resin binder and glass reflectorizing spheres. The solid resin shall be a "maleic-modified glycerol ester resin" (alkyd binder) comprising at least one-third of the binder compositions and be no less than eight percent (8%) by weight of the entire material formulation. The alkyd binder shall consist of a mixture of synthetic resins (at least one of which is solid at room temperature), and high boiling point plasticizers. The material shall not contain any petroleum derived ingredients. Yellow pigment shall be heat stabilized encapsulated lead chromate. The thermoplastic pavement marking material shall contain the following ingredients:

INGREDIENT (Percent by Weight)	WHITE	YELLOW
Binder	18.0 min.	18.0 min.
Titanium Dioxide	10.0 min.	-----
Glass Spheres	20.0 – 50.0	20.0 – 50.0
Lead Chromate	-----	2.0 – 4.5
Inert Fillers	42.0 max.	50.0 max.

The material shall be thoroughly mixed and furnished in a free flowing granular form. The material shall meet the requirements of this specification for a period of one year. The material shall readily melt in a uniform mixture. The material shall be free from all skins, dirt, and foreign objects. It shall be of such composition that it will not bleed, stain or discolor when applied to bituminous pavement. The manufacturer shall replace material not meeting the above requirements.

6. Color: The color of the thermoplastic material after heating for 4 hours ± 5 minutes at 425 ± 3° F shall conform to the following when tested by Federal Test Method Standard 141 Method 4252:

White	Federal Color Chip No. 17875 (Fed. Std. No. 595)
Yellow	Federal Color Chip No. 13538 (Fed. Std. No. 595)

7. Reflectance: The daylight luminous reflectance of the white material shall be not less than 75% when tested according to ASTM E 1347. The yellow shall have a minimum brightness of 45% relative to magnesium oxide, and shall be within the green and red tolerance of the "Standard Color Chips for Highway Signs (January 1939)" obtainable from the United States Bureau of Public Roads, Washington, D.C. (TT-P-115a).
8. Softening Point: After heating the thermoplastic material for 4 hours + 5 minutes at 425 ± 3° F and testing in accordance with ASTM D 36, the material shall have a softening point 215 ± 15° F.

9. Flowability: After heating the thermoplastic material for 4 hours \pm 5 minutes at $425 \pm 3^\circ$ F and testing for flowability, the white thermoplastic shall have a maximum percent residue of 18% and the yellow thermoplastic shall have a maximum residue of 21%.

After heating the thermoplastic material for 8.5 hours \pm 5 minutes at $425 \pm 3^\circ$ F and testing for flowability, the thermoplastic shall have a maximum percent residue of 28%.
10. Indentation Resistance: Hardness shall be measured by a Shore Durometer, Type A2, as described in ASTM D 2240, except that the Durometer and the panel shall be at 77° F, and a 4.4 lb load applied. After 15 seconds, the reading shall be not less than 55.
11. Abrasion Resistance: The material shall not show a maximum loss of 0.02 ounces subjected to 200 revolutions on a Taber Abraser at 77° F, using H-22 calibrate wheels, weighted to 17.6 ounces. The wearing surface should be kept wet with distilled water throughout the test. The panel for this test shall be prepared by forming a representative lot of material at a thickness of 125 mil on a 4-inch square panel (thickness $0.050 + 0.001$ inch) on which a suitable primer has been previously applied.
12. Low Temperature Impact Resistance: The materials shall not fracture when subjected to an impact of 64 inch pounds at -4° F, for at least 3 hours. The panel is then placed in an instrument also maintained at -4° F, consisting of a 10.5 pound freely falling weight controlled to drop vertically for 6-inches onto the surface of the panel, which it strikes with a hemispherical indenter having a radius of 0.28-inches.
13. Water Absorption: Materials shall have a maximum of 0.5 percent by weight of retained water when tested by ASTM D 570, procedure (A).
14. Yellowness Index: The white thermoplastic material shall not exceed a yellowness index of 0.15.
15. Flash Point: The thermoplastic material shall have a flash point not less than 475° F when tested in accordance with ASTM D 92.
16. Cracking Resistance: After heating the thermoplastic material for 4 hours + 5 minutes at $425 \pm 3^\circ$ F; applying to concrete blocks, and cooling $15 \pm 3^\circ$ F, the material shall show no cracks. Properly applied, the material shall show less than six stress cracks per ten lineal feet of markings independent of pavement fracturing and faulting, for at least six months.

D. Aggressive Bond Thermoplastic Pavement Markings: This specification covers a white and yellow adhesive thermoplastic reflectorized pavement marking material that is applied to road surfaces, including Portland Cement Concrete (PCC) and aged asphalt without need of a primer/sealer. The material is applied to the road surface in a molten state by mechanical means with surface application of glass beads. Upon cooling to normal pavement temperature, it produces an adherent reflectorized stripe of specified thickness and width with limited thermal/seasonal deformation. In order to qualify as a non-sealer thermoplastic that can be applied to concrete surfaces without a sealer, the material must meet or exceed the requirements listed below.

1. Characteristics: The thermoplastic material shall be homogeneously composed of pigments, resins, polymers (adhesive constituent), glass reflectorizing spheres and other fillers. The thermoplastic material shall be available in a variety of surface delineation colors from the same manufacturer. The manufacturer shall have the option of formulating the material according to their own specifications.

However, certain physical and chemical requirements specified must be satisfied in order to qualify as a non-primed striping application for PCC and aged asphalt surfaces.

The material shall not exude fumes which are toxic or injurious to persons or properties upon heating to application temperature.

2. Specific Gravity: The specific gravity of the white and yellow thermoplastic pavement marking material shall not exceed 2.15.
3. Composition: The pigment, intermix reflectorizing spheres, and fillers shall be uniformly dispersed in the resin and polymer upon heating to application temperature. The material shall be free of dirt and foreign matter and must meet or exceed the compositional requirements (percentage by weight) indicated below. The total resin/binder content must be 22% min. – 26% max. (weight) of total product ingredients.

Test Component	White	Yellow (Lead Chromate)	Yellow (Heavy Metal Free)
Glass Beads	30% min.	30% min.	30% min.
Pigment – TiO ₂	10% min.	N/A	N/A
Yellow (PbCrO ₃)	N/A	2% min.	Federal Color
Resin/Binder Content	22% min.	22% min.	22% min.
Inert Fillers	42.0 max.	50.0 max.	At manufacturer's discretion

4. Color: The thermoplastic material after heating for four hours \pm 5 min. at $425 \pm 3^\circ$ F and cooled to $77 \pm 3^\circ$ F shall meet the following:

White	Daylight reflectance at $45^\circ - 0^\circ - 80\%$ min.
Yellow	Daylight reflectance at $45^\circ - 0^\circ - 45\%$ min.

Yellow color shall match Federal Test Standard Number 5958 – Color 13538 and lie within the following ranges:

X	0.485 – 0.510
Y	0.445 – 0.470

The chromaticities and luminance factors of ordinary colors of retroreflecting material shall be determined under an angle of illumination of 45 degrees; direction of view perpendicular to surface; and illumination CIE standard illuminant D65.

5. Bond Strength: After heating the thermoplastic material for four hours \pm 5 minutes at $425 \pm 3^\circ$ F, the bond strength to Portland Cement Concrete (PCC) shall equal or exceed 275 psi (ASTM Standard Test Method for Bond Strength of Thermoplastic Traffic Marking Materials – D 4796 or ASTM C 321). Failures of type described in Section 6.1 of ASTM D 4796 bond test, must be repeated to obtain a quantifiable number. Failure of types 6.2, 6.3, and 6.4 of ASTM D 4796 bond test, must exceed the specified thermoplastic – cement brick separation.
6. Low Temperatures Cracking (Stress) Resistance for Extended Period: The material shall be tested according to AASHTO T 250 Section 7 with Section 7.2.3, modified for an extended cold temperature of $15 \pm 3^\circ$ F exposure period of 72 hours. Any cracking shall constitute failure of the material to qualify as a non-sealer aggressive bonding material for PCC road surfaces.

7. Impact Resistance (Gardner Falling Weight): The test specimens should be formed according to the following procedure:

Heat approximately 14.1 ounces of material in an open pint can for 4 hours at $425 \pm 3^\circ \text{F}$. Preheat specimen draw down blade, 2-inches x 4-inches with a 1/8-inch die opening for approximately one hour at $425 \pm 3^\circ \text{F}$. The blade is usually placed in the oven containing the sample material during the last hour of sample heating.

After heating the sample for four hours, remove the sample and the draw down blade from the oven. Place the 125-mil blade onto a PCC block. Quickly pour the sample $425 \pm 3^\circ \text{F}$ into the opening of the draw down screed and draw down the sample for the entire length of the concrete block. Allow the drawn down test sample to condition in the open in the standard laboratory atmosphere, $73.4 \pm 3^\circ \text{F}$ and $50 \pm 5\%$ relative humidity.

Perform the testing procedure according to ASTM D 5420 Section 11. Record and report the type of failure as (a) crack or cracks on the surface, (b) cracks that penetrate the entire thickness, (c) brittle shatter (the test specimen in several pieces after impact), or (d) ductile failure (the specimen is penetrated by a blunt tear).

Both the yellow and white non-sealer materials shall have minimum impact resistance of 80 inch pounds with no visible surface cracks.

8. Impact Resistance (Notched Izod): After heating the material for four hours ± 5 minutes at $425 \pm 3^\circ \text{F}$ and forming test specimens according to AASHTO T 250 Section 8, both the yellow and white samples shall be a minimum notched impact resistance of 11.0 ± 0.3 inch pounds. The specimens shall be tested both at room temperature $73.4 \pm 3^\circ \text{F}$ and low temperature of $15 \pm 3^\circ \text{F}$ in accordance with ASTM D 256 test method A.
9. Oil and Grease Resistance: The thermoplastic material shall show no signs of deterioration or solubility after motor oil is rubbed vigorously into a sample for 2 minutes and allowed to penetrate for 5 minutes.
10. Set Time: When applied at a temperature range of $412.5 \pm 12.5^\circ \text{F}$ and thickness of 90 to 125 mil the material shall set to bear traffic in not more than 2-minutes when the air temperature is $50 \pm 3^\circ \text{F}$ and not more than ten minutes when the air temperature is $90 \pm 3^\circ \text{F}$.
11. Flash Point: The thermoplastic material shall have a flash point of not less than 500°F when tested in accordance with ASTM D 92.
12. Storage Life: The material shall maintain the requirements of this specification for a minimum period of one year. The thermoplastic material must melt uniformly with no evidence of skins or unmelted particles for this one year time period. Any material failing to do so shall be replaced by the manufacturer at their expense.
13. Packaging and Marking: The thermoplastic material shall be packaged in suitable containers to which it will not adhere during shipment and storage. The container of thermoplastic material shall weigh approximately 50 lbs. Each container shall designate user information, manufacturer's name and address, batch number and date of manufacture. Each batch manufactured shall have its own separate number. The label shall carry appropriate user warnings and instructions.
14. NTPEP Test Program: The material must have been applied, without surface primer, on two NTPEP

Decks (PCC) and evaluated for a period of at least one year. A minimum of 90% of the original pavement striping must be intact on the PCC decks after a one-year review period. The percent retention is calculated based on the measured test area square footage (neglecting mil thickness wear down) minus the road surface areas that are exposed due to cracking and chipping away of thermoplastic from the concrete surface caused by product bond failure to the substrate.

- E. Preformed Thermoplastic Pavement Markings: This specification is for the furnishing of retroreflective preformed thermoplastic pavement marking materials that can be adhered to asphalt, concrete and Portland cement concrete pavements by means of heat fusion. The applied markings shall be very durable, oil and grease impervious and provide immediate and continuing retroreflectivity.

1. Characteristics: The preformed marking material shall consist of a resilient white and yellow polymer thermoplastic with uniformly distributed glass beads throughout its entire cross section.

Preformed words and symbols shall conform to the applicable shapes and sizes as prescribed in the latest revision of the Manual on Uniform Traffic Control Devices (MUTCD).

The preformed markings shall be fusible to asphalt concrete and Portland cement concrete pavements by means of the normal heat of a propane type of torch. Adhesives, primers or sealers shall not be used prior to the preformed marking application on asphalt concrete and Portland cement concrete pavements.

The preformed markings shall conform to pavement contours, breaks and faults through the action of traffic at normal pavement temperatures. The markings shall have resealing characteristics and be capable of fusing to itself and previously applied worn hydrocarbon and/or alkyd thermoplastic pavement markings.

The preformed markings shall be capable of application on new, dense and open graded asphalt concrete wearing courses during the paving operation in accordance with the manufacturer's instructions. After application, the markings shall be immediately ready for traffic. The preformed markings shall be suitable for use for one year after the date of receipt when stored in accordance with the manufacturer's recommendations.

The preformed thermoplastic markings shall not be brittle and must be sufficiently cohesive and flexible at temperatures exceeding 50 degrees F for one person to carry without the danger of fracturing the material prior to application.

2. Composition: The retroreflective pliant polymer thermoplastic pavement markings shall consist of a homogeneous mixture of high quality polymeric thermoplastic binders, pigments, fillers and glass beads. The thermoplastic material must conform to AASHTO designation M 249 with the exception of the relevant differences due to the material being supplied in a preformed state.
3. Glass Beads: The markings shall contain 30% glass spheres which shall conform to AASHTO M 247 Type 1, except that glass spheres shall have a minimum of 70% true spheres on each sieve and 80% true spheres overall.

The glass beads must be homogeneously blended throughout the material with a securely bonded protruding exposed layer of beads that provide immediate and continuous retroreflectivity; no additional glass beads shall be dropped on the material during application. Curved arrows must be available without protruding glass beads if reversibility is needed.

4. Retroreflectivity: The preformed marking shall upon application exhibit uniform adequate nighttime retroreflectivity when tested in accordance with ASTM E 1710. At 86 degree 30 feet incidence angle and 1 degree 30-feet divergence angle, the markings shall have average minimum intensities of 350 millicandelas for white and 175 millicandelas for yellow as measured with a Mirolux or LTL-2000 retroreflectometer. Follow manufacturer's instructions for use.

Using a Taber Abraser with an H-18 wheel and a 4.4 ounce load, the sample shall be inspected at 200 cycles, under a microscope, to observe the extent and type of bead failure. No more than 15% of the beads shall be lost due to popout and the predominant mode of failure shall be "wear down" of the beads.

5. Color Characteristics: The thermoplastic material without glass beads shall meet the following:

White	Daylight reflectance at 45° / 0° of 80% min.
Yellow	Daylight reflectance at 45° / 0° of 45% min.

The daylight reflectance shall not change significantly when the preformed thermoplastic is properly applied to the roadway surface.

For highway use, the white markings shall contain a minimum of 8% by weight of Titanium Dioxide pigment to ensure a color similar to Federal Highway White, Color No. 17886 Standard 595. Yellow color shall reasonably match color chip Number 13538 of Federal Standard 595 and be lead free.

6. Skid Resistance: The surface of the preformed thermoplastic markings shall provide a minimum skid resistance value of 45 BPN when tested according to ASTM E 303.
7. Thickness: The width of the supplied material shall have a minimum average thickness of 90 mils.
8. Flexibility: The preformed thermoplastic marking material shall have flexibility at 50° F such that no cracking occurs in the test sample when a 1-inch by 6-inches sample is bent through an arc of 900 at a uniform rate in 10 seconds (9 seconds per degree) over a one inch mandrel. The sample must be conditioned prior to testing at 50 ± 2° F for a minimum of four hours. At least two specimens tested must meet the flexibility requirements at 50° F for a passing result.
9. Environmental Resistance: The applied markings shall be resistant to deterioration due to exposure to sunlight, water, oil, diesel fuels, gasoline, pavement oil content, salt, and adverse weather conditions.
10. Effective Performance Life: When properly applied, in accordance with the manufacturer's instructions, the pavement markings shall be neat and durable. The markings shall remain retroreflective and show no fading, lifting, shrinkage, tearing, roll back or other signs of poor adhesion.

F. Cold Plastic Pavement Markings: This specification covers a white and yellow pre-formed cold plastic reflectorized pavement marking material of a type that is applied to a road surface by an inlaid, pre-coated pressure sensitive adhesive that produces an adherent reflectorized stripe of specified thickness and width and is capable of resisting deformation.

1. Characteristics: The material shall be manufactured without the use of lead-chromate pigments or other, similar, lead-containing chemicals.

Glass beads shall be incorporated to provide immediate and continuing retroreflection. Ceramic skid particles shall be bonded to the top layer to provide a skid-resistant surface.

Preformed word and symbol markings shall conform to the applicable shapes and sizes as outlined in the Manual on Uniform Traffic Control Devices (MUTCD).

The preformed markings shall be capable of being adhered to pavements by an inlaid, pre-coated pressure sensitive adhesive. A surface preparation adhesive may be used to precondition the inlay pavement surface.

The preformed marking film shall mold itself to pavement contours by the action of traffic. Following proper inlay application and tamping, the markings shall be immediately ready for traffic.

2. **Composition:** The retroreflective pavement marking film shall consist of a mixture of high-quality polymeric materials, pigments and glass beads distributed throughout its base cross-sectional area. A reflective layer of glass beads and a layer of skid-resistant ceramic particles shall be bonded to the top urethane wearing surface. The urethane wear surface shall have a nominal thickness of 5 mil (0.005 inches). The film shall have a pre-coated, shear-resistant, pressure sensitive adhesive.
3. **Color:** The daytime color of the white film shall provide a minimum initial luminance factor, Y, of 80 and shall conform to the following chromaticity requirements:

WHITE		YELLOW	
X Values	Y Values	X Values	Y Values
0.290	0.315	0.474	0.455
0.310	0.295	0.491	0.435
0.330	0.360	0.512	0.486
0.350	0.340	0.536	0.463

The daytime color of the yellow film shall provide an initial luminance factor, Y, in a range of 36 to 59 and shall conform to the above chromaticity requirements:

Measurements shall be made in accordance with ASTM E 1349, using illuminant "C" and 0/45 (45/0) geometry. Calculations shall be in accordance with ASTM E 308 for the 2-degree observer.

4. **Reflectance:** The white and yellow films shall have the following initial minimum reflectance values as measured in accordance with the testing procedures of ASTM D 4061. The photometric quantity to be measured shall be coefficient of retroreflected luminance (RL) and shall be expressed as millicandelas per square foot per foot-candle (mcd-ft⁻²-fc⁻¹).

	WHITE			YELLOW		
Entrance Angle	86.0°	86.0°	86.5°	86.0°	86.0°	86.5°
Observation Angle	0.2°	0.5°	1.0°	0.2°	0.5°	1.0°
Retroreflected Luminance R _L (mcd-ft ⁻² -fc ⁻¹)	700	500	400	410	250	175

5. **Skid Resistance:** The surface of the retroreflective films shall provide an initial minimum skid resistance value of 55 BPN as measured by the British Portable Skid Tester in accordance with ASTM E 303.

The surface of the retroreflective film shall retain an average skid resistance value of 45 BPN, when tested in accordance with ASTM E 303, for a period of one year when installed in non-snow removal areas. The 45 BPN minimum value shall be an average of several readings taken in both the wheel

track and non-wheel track areas.

6. Tensile Strength and Elongation: The film shall have a minimum tensile strength of 150 lbs. per square inch of cross-section when measured in the direction of the length of the roll and tested in accordance to ASTM D 638, except that a sample 6 inch x 1 inch shall be tested at a temperature between 70° F and 80° F using a jaw speed of 10 to 12 inches per minute. The sample shall have a maximum elongation of 50% at break when tested by this method.
 7. Reflectivity Retention: The glass beads must be strongly bonded and not be easily removed by traffic wear. Using a Taber Abraser with an H-18 wheel and a 4.4 ounce load, the sample shall be inspected at 200 cycles, under a microscope, to observe the extent and type of bead failure. No more than 15% of the beads shall be lost due to popout and the predominant mode of failure shall be "wear down" of the beads.
 8. Glass Beads: The size, quality and refractive index of the glass beads shall be such that the performance requirements for the markings shall be met. The bead adhesion shall be such that beads are not easily removed when the material surface is scratched. The film shall have glass bead retention qualities such that when a 2-inches by 6-inches sample is bent over a 1/2-inch diameter mandrel, with the 2-inch dimension perpendicular to the mandrel axis, microscopic examination of the area on the mandrel shall show no more than 10% of the beads with entrapment by the binder of less than 40%.
 9. Thickness: The film, without adhesive, shall have a minimum thickness of 60 mil.
- G. Lead-Free, Water-Borne Emulsion Based White and Yellow Traffic Paint: The pavement marking paint shall be rapid dry. The traffic paint shall provide optimum adhesion for glass spheres when both binder and glass spheres are applied in the recommended quantities.
1. Drying Time: When applied at a wet film thickness of 15 mils with a top dressing of 6–10 pounds of glass spheres per gallon of paint and when the pavement temperature is between 50° F and 120° F and the relative humidity doesn't exceed 80%, the binder shall dry to a no-tracking condition in a minimum of 20 seconds and a maximum of 60 seconds.
- These dry times shall not be exceeded when the paint is applied with specialized equipment so as to have the pigmented binder at a temperature of 150° F to 170° F at the spray gun.
- The no-tracking condition shall be determined by passing over the applied line in a simulated passing maneuver with a passenger car traveling 35 MPH. There shall be no visual deposition of the paint to the pavement surface when viewed from a distance of 50 feet. Furthermore, the pigmented binder, without glass spheres, shall dry to no-tracking condition in 180 seconds or less when tested in accordance with ASTM D 711.
2. Directional Reflectance: The daylight directional reflectance of white pigmented binder (without glass spheres) shall be not less than 85% relative to magnesium oxide when tested in accordance with Federal Test Method Standard No. 141d, Method 6242. If yellow, after drying shall suitably match color 13538 of Federal Standard 595.
 3. The paint for the pavement markings shall contain no lead and/or chromium and shall have volatile organic content conforming to the latest Environmental Protection Agency regulations.
 4. In addition, the paint and/or components shall conform to the American Society for Testing Materials

(ASTM) as follows:

D 93	Standard Test Methods for Flash Point by Pensky Martens Closed Tester
D 476	Standard Specification for Titanium Dioxide Pigments, Type II Rutile
D 562	Standard Test Method for Consistency of Paints Using Stormer Viscosimeter
D 711	Standard Test Method for No-Pick-Up Time of Traffic Paint
D 768	Standard Specification for Yellow Iron Oxide
D 868	Standard Test Method for Evaluating Degree of Bleeding of Traffic Paint
D 1152	Standard Specification for Methanol (Methyl Alcohol)
D 1199	Standard Specification for Calcium Carbonate Pigments
D 1210	Standard Test Method for Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage
D 1475	Standard test Method for Density of Paint, Varnish, Lacquer, and Related Products
D 2243	Standard Test Method for Freeze-Thaw Resistance of Waterborne Coatings
D 2369	Standard Test Method for Volatile Content of Coatings
D 2805	Standard Test Method for Hiding Power of Paints by Reflectometry
D 3723	Standard Test Method for Pigment Content of Water Emulsion by Low Temperature Ashing
D 3960	Standard Practice for Determining Volatile Organic Content (VOC) of Paints and Related Coatings
D 4060	Standard Test Method for Abrasion Resistance of Organic Coatings by Taber Abraser
D 4366	Standard Test Methods for Hardness of Organic Coatings by Pendulum Damping Tests
E 70	Standard Test Method for pH of Aqueous Solutions With the Glass Electrode
E 1347	Standard Test Method for Color and Color-Difference Measurement by Tristimulus (Filter) Colorimetry

The paint shall show no cracking, flaking, blistering, appreciable loss of adhesion, softening, coagulation, discoloration, and have a minimum bleeding ratio of 0.97 when tested in accordance with Federal Specification TT-P-1952B.

The paint shall be capable of dilution with water at all levels without curdling or precipitation such that the wet paint can be readily cleaned up with water only.

The minimum contrast ratio shall be 0.96 when drawing down with a 0.005 bird film applicator on a 2A Leneta Chart or equal and air-dried for 24 hours.

Contrast Ratio = Black/White.

- H. Temporary Tape: This specification covers pavement marking tape of two colors, white and yellow, and of two types, Type I and Type II.

Type I Regular (This type is not required to be easily removable intact)

Type II Removable (This type is to be readily removable intact, either manually or with a roll-up device after having been in place through the construction season)

1. General: This material shall be a pavement striping tape designed to provide reflective delineation under both dry and moderate rainfall conditions. The tape shall consist of glass spheres tightly embedded to a binder; on a conformable backing pre-coated with a pressure sensitive adhesive. The striping material shall be thin, flexible, formable, and following application shall remain conformed to the texture of the pavement surface. The tape shall be furnished in the color and type designated on the Plans or in the Contract Documents. The markings shall be pre-coated with a pressure sensitive

adhesive and shall be capable of being adhered to asphalt concrete or Portland cement concrete in accordance with manufacturer's instructions without the use of heat, solvents or other additional adhesive means, and shall be immediately ready for traffic after application. The adhesive shall not require a liner or release paper. The striping material shall have a uniform appearance, free from cracks and the edges shall be true, straight and unbroken. The material shall be weather resistant and show no appreciable fading, lifting or shrinkage when applied in accordance with the manufacturer's recommendations.

2. Color and Daylight Reflectance: The daylight reflectance (ASTM E 1347) of white shall be not less than 70%. The color of yellow shall be within the red and green tolerance limits of the Highway Yellow Color Tolerance Chart issued by the U.S. Department of Transportation.
 3. Dimensions: The width and length shall be as shown on the Plans or in the Contract Documents. The material shall be available in rolls and there shall be no more than three splices per 50 yards of length.
 4. Packaging: The material shall be packaged in accordance with accepted commercial standards and when stored under normal conditions, shall be suitable for use for a period of at least one year after purchase.
 5. Adhesion: The material shall adhere to asphalt and concrete surfaces when applied according to manufacturer's recommendations at surface temperatures above 50° F and shall be immediately ready for traffic following application.
 6. Removability: Type II tape shall be removable from asphalt and Portland cement concrete intact or in large pieces, either manually or with a roll-up device, at temperatures above 40° F without use of heat, solvents, grinding or blasting.
 7. Reflection: The white and yellow material shall be retroreflective, reflecting white or yellow respectively and shall be readily visible at night when viewed with automobile headlamps using high beams from a distance of at least 300 feet.
 8. Durability: Type II material shall maintain adhesion, show no alligating, show no signs of pulling apart, and shall suffer no more than a 25% loss of beads, sand and grit when subjected to 30,000 revolutions on a small-wheel circular track as described in ASTM E 660, with the following variations or exceptions:
 - a. Two opposite wheels mounted with Goodyear 3.40-5 NHS Industrial Rib tires shall be used with a total load of 51.5 pounds on each tire. Tire air pressure shall be maintained at 25 pounds. The wheels shall be mounted perpendicular to the specimens and toed out 20 to produce a slight abrading action.
 - b. Specimens shall be applied to 6-inch diameter dense graded bituminous concrete surface which has been compacted at 3,000 psi for two minutes. After application, the specimens shall be allowed to cure at least 16 hours before beginning the test.
- I. Epoxy: This specification is for the application of epoxy resin and glass beads as reflective pavement markings on Portland cement concrete or bituminous pavements. The epoxy resin material shall be toxic heavy metal free, two-component, 100% solids, and shall be formulated and tested to perform as a pavement marking material with glass spheres applied to the surface. The two components are an epoxy resin and an amine curing agent. The Contractor shall provide complete manufacturer's specifications and material safety data sheets to the Engineer for all material furnished.

1. Characteristics: The material shall not exude toxic fumes when heated to application temperature. The material which, when mixed in the proper ratio and applied at 0.14 mil wet film thickness at 74.8° F with the proper saturation of glass beads, has a no-tracking time of less than 40 minutes for slow curing material and less than 10 minutes for rapid curing material. The material shall be capable of fully curing under a constant surface temperature of 32° F or above.
2. Properties of Cured Material
 - a. Color: Provide white which complies with Federal Standard 595 17875. Provide yellow which matches the standard shade within the red and green tolerance limits when compared with the Highway Yellow Color Tolerance chart available from the U.S. Department of Transportation, Washington, D.C. (Federal Standard 595, 13538).
 - b. Abrasion Resistance: 0.0028 ounces maximum loss when tested at 30 ± 1.5 mils and a 72 hour cure and with a CS-17 wheel under a load of 2.2 lbs. for 1000 cycles.
 - c. Hardness: Shore D hardness of 75 minimum.
 - d. Adhesion to Concrete: When catalyzed, has such a high degree of adhesion to the specified concrete surface that there is a 100% concrete failure. Apply the material at a film thickness of 15 ± 1.5 mils to concrete with a minimum compressive strength of 4,061 psi. Allow the material to cure for 72 hours at 77° F before the test is performed.
 - e. Yellowness Index: White only. Value after 72 hours in QUV – 30 maximum when tested at 15 ± 1.0 mils and a 72 hour cure.
 - f. Field Evaluation: Field test materials at AASHTO NTPEP regional test facilities, which include both hot and cold weather conditions and are a minimum of six months in duration.
3. Glass Beads For Drop-On Application (double drop system)
 - a. For the first drop, furnish large beads, which are compatible with the epoxy system, and comply with AASHTO M 247 except with the following gradation (FP-96, Type 4):

Sieve Size	Percent Passing
No. 10	100
No. 12	95 – 100
No. 14	80 – 95
No. 16	10 – 40
No. 18	0 – 5
No. 20	0 – 2
 - b. For the second drop, furnish regular beads which are specifically manufactured to be compatible with the epoxy system, and which comply with the requirements of AASHTO M 247, Type 1.
 - c. Both types of beads are to be coated with a moisture resistant coating and an adhesion promoting coating which is compatible with the epoxy system.
4. Test Methods
 - a. Adhesion to Concrete - KDOT Standard Specifications Section 2214.2.a(2)(d) Bond Strength
 - b. Hardness ASTM D 2240
 - c. Abrasion Resistance ASTM C 501

2306.8 Method of Installation

The proposed permanent markings shall be laid out by the Contractor as shown on the Plans in advance of the marking installation. Markings shall not be applied until the layout and conditions of the surface have been approved by the Engineer. If a paint line is used for layout purposes (in lieu of a chalk line or string line) the paint line shall not be wider than 1/2-inch in width. If wider, the paint shall be removed following the application of the final permanent marking. New markings shall match existing markings as applicable in areas abutting existing road surfaces. The surface shall be dry and all dust, debris, oil, grease, dirt, temporary markings and other foreign matter shall be removed from the road surface prior to the application of the permanent marking material.

The Contractor shall be responsible for keeping traffic off freshly applied markings until they have set sufficiently to bear traffic. Traffic control is the responsibility of the Contractor and shall conform to the MUTCD. Failure to comply with traffic control guidelines will result in the pavement marking Contractor being directed to stop operations and leave the site until proper and approved traffic control has arrived and is put in place.

Temporary pavement markings shall be installed the same day that the existing pavement markings are damaged, removed or covered up prior to lane opening.

Temporary pavement markings shall be installed using the same cycle length as the permanent markings and be at least 2-feet long. Double yellow markings shall be used for temporary centerline and single white markings shall be used for temporary lane lines on four lane roadways. Single yellow markings shall be used for temporary centerline on two lane roadways as directed by the Engineer.

Half-cycle lengths with a minimum of 2-foot stripe and 10-foot gap should be used on roadways with severe curvature.

- A. Glass Spheres: The drop on glass beads shall be applied at a rate of eight to ten pounds per 100 square feet.
- B. Thermoplastic Pavement Markings: Thermoplastic material shall readily apply to the pavement at temperatures of 400° F to 425° F from approved equipment to produce an extruded line that shall be continuous and uniform in shape having clear and sharp dimensions. Application temperatures shall not exceed 450° F.

Thermoplastic may be used for cross walks and stop bars as specified under the conditions described herein. The thermoplastic markings shall be applied to the pavement surface in a molten state by mechanical means with surface application of glass spheres, and upon cooling to normal pavement temperature, produce an adherent retro-reflectORIZED stripe of specified thickness and width and capable of resisting deformation.

- 1. Equipment: The equipment used to install the thermoplastic shall be as follows:
 - a. A self-propelled machine is required in order to fulfill the timing needs of the marking installation for longitudinal lines.
 - b. If thermoplastic is used for transverse lines, i.e., crosswalks and stop lines, a push cart shall be used according to the following requirements:
 - i. Only one pass with the thermoplastic pavement marking equipment shall be allowed in order to provide the required line width according to the Plans.
 - ii. Multiple passes of narrower lines with overlaps to provide the required width shall not be allowed unless otherwise approved by the Engineer after review of a test strip installation.
 - iii. If approved, the Contractor shall be required to heat the seam with a torch and feather the overlapped material with a putty knife. Liquid thermoplastic shall not be used for word or symbol markings.
 - c. Constructed to provide mixing and agitation of the materials. Conveying parts between the main material reservoir and the shaping die shall be constructed as to prevent accumulation and clogging.

- d. Constructed so that mixing and conveying parts up to and including the shaping die will maintain the materials at a temperature between 400° F and 450° F. To assure that the material does not fall below the minimum temperature, the shaping die shall be heated by means of a gas-fired infrared heater or a heated, oil-jacketed system.
- e. Constructed as to insure continuous uniformity in the dimensions of the stripe. The applicator shall provide a means for cleanly cutting off square stripe ends and shall provide a method of applying "skip" lines. The equipment shall be constructed to be able to provide for varying die widths and to produce varying widths of traffic markings. The use of pans, aprons, or similar appliances with die overruns will not be permitted.
- f. All conditions apply as stated above for material temperatures, line definition and workmanship when a hand pushcart is used for cross walks. The Engineer will verify measurement.
- g. Equipment with a special kettle for melting and heating the material shall be provided. The kettle shall be equipped with a thermostat so that heating can be done by controlled heat transfer liquid rather than by direct flame so as to provide positive temperature control and prevent overheating of the material.
- h. Constructed for a nominal application of 90 – 125 mil thickness.
- i. The heater and applicator shall be so equipped and arranged as to meet the requirements of the National Board of Fire Underwriters of the National Fire Protection Association, of the state, and of the local authorities.
- j. Equipped with an automatic glass bead dispenser attached to the striping machine in such a manner that the beads are dispensed almost instantaneously upon the installed line. The glass bead dispenser shall be equipped with an automatic cut-off control synchronized with the cut-off of the thermoplastic material.
- k. The equipment shall be arranged as to permit preheating of the pavement immediately prior to application of the thermoplastic material, if preheating is recommended by the thermoplastic manufacturer.
- l. The applicator shall be capable of containing a minimum of 1000 pounds of molten material (not applicable for hand-liner use).
- m. The applicator shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc.
- n. The Contractor's striping machine shall be equipped with electrical foot counters. The counters shall individually tabulate the length of line applied by each gun whether solid or dashed. The Contractor shall determine the accuracy of the foot counters and establish an adjustment factor as required to determine the pay item quantities. The foot counters shall be periodically checked to assure accurate measurements. No thermoplastic shall be applied without the accurate operation of the foot counters. The Contractor shall provide the Engineer with a certified document on these calibrations.

2. Application Over Existing Markings

- a. Existing thermoplastic markings on asphalt road surfaces may be overlaid with thermoplastic material providing that the existing markings (thermoplastic) are less than 30 mils thick, and are securely bonded to the substrate. If the thermoplastic is greater than 30 mils, or not securely bonded to the substrate, then it shall be ground to 30 mils, or removed completely if not securely bonded to the road.
- b. Existing solvent based paint on asphalt road surfaces may be overlaid with thermoplastic provided that more than 75% of the road surface is exposed, and there is no more than a single coat of paint on the remaining unexposed area. If more than one layer of paint exists, the paint is not securely anchored to the substrate, or there is less than 75% of the road surface exposed, then the paint must be thoroughly removed.

- c. All existing polyester, epoxy, or other type pavement marking paints on asphalt or concrete road surfaces must be completely removed from all road surfaces prior to the installation of thermoplastic material.
 - 3. Application Temperatures: To insure optimum adhesion, the pavement and ambient air temperature shall be 50° F and rising. The thermoplastic material shall be applied in a melted state at a temperature of 400° F to 425° F. The temperature of the material within the shaping dies shall be maintained at the manufacturer's recommendations for application temperatures, but in no case shall the temperature fall below 400° F or exceed 450° F.

The material shall not break down or deteriorate if held at the plastic temperature for a period of four (4) hours or by reason of three (3) reheatings to the plastic temperature (400° F to 425° F).

Where manufacturer's application temperatures differ from those as specified, the manufacturer's temperatures shall apply upon approval of the Engineer.
 - 4. Line Quality: The finished lines shall have well defined edges and be free of waviness. Pavement marking lines shall be straight or of uniform curvature and shall conform with the tangents, curves, and transitions as specified in the pavement marking standards and/or as directed by the Engineer.
 - 5. Line Thickness: The minimum thickness of the lines as viewed from a lateral cross section shall be not less than 90 mil near the edges, or less than 125 mil at the center. Drop-on glass beads shall not be included in the measurement, or if so, then appropriate allowances shall be made for the added mil thickness. A device for gauging the installed material thickness shall be furnished to the Engineer as requested for use on the project. The gauge shall be easy to read and shall readily indicate excessive variations.
 - 6. Clean Up: The Contractor shall be responsible for removing all pavement markings material spilled upon the roadway surface or adjoining area. The Contractor shall use methods acceptable to the Engineer for removing the spilled material.
 - 7. Line Repair: Any pavement marking which is crossed by a vehicle and tracked shall be replaced and any subsequent marking made by the vehicle shall be removed by methods acceptable to the Engineer at no additional cost to the Owner.
- C. Preformed Thermoplastic Pavement Markings: The markings shall be applied in accordance with the manufacturer's recommendations on clean and dry surfaces.
- 1. Asphalt: The materials shall be applied using the propane torch method recommended by the manufacturer. The material must be able to be applied at ambient and road temperatures down to 32° F without any preheating of the pavement to a specific temperature. The pavement shall be clean, dry and free of debris and oil or grease residue.
 - a. At temperatures below 50° F, the preformed thermoplastic pavement markings shall be kept as warm as possible to maintain flexibility.
 - b. Remove pavement surface moisture by holding a propane torch approximately 6 inches above the section of asphalt using a continuous circular motion.
 - c. Heat the pavement with the torch upon placing the material to a temperature of 200° F for 90 mil, and up to 300° F for 125 mil materials.
 - d. Immediately after the road surface has been properly preheated, position the material with exposed bead side up and heat.

- e. Position the torch approximately 12-inches over the marking so the flame is extended and heat is evenly applied moving the torch in a circular motion across the marking. When the correct temperature of the marking has been reached, it will turn slightly darker or pale yellow if the material is white. Over heated or burned material shall be removed.
 - f. After the entire material section has been heated and bonded to the pavement, re-heat the perimeter of the marking and the road surface to bond the edges.
 - g. If installing reversible arrows, which do not contain a top coating of glass beads, the glass spheres shall be hand applied on the molten material.
 - h. Feather the leading edge of the pavement marking with a putty knife or bevel with the torch. Leading edges are any edge that would be susceptible to snow plow blades approaching from the direction of normal travel.
 - i. After cooling, use a putty knife to attempt to remove a portion of the material. The material shall not pry off without asphalt embedded to the underside.
2. Concrete: New concrete surfaces must be sandblasted to entirely remove curing compound. The same application procedure shall be used as described for asphalt pavements. However, a compatible primer sealer may be applied before application to assure proper adhesion.
 3. Chip Seal Surfaces: The same application procedure shall be used as described for asphalt pavements. However, loose aggregate should be removed where the preformed thermoplastic pavement marking is to be applied.
- D. Cold Plastic Pavement Markings: The Contractor shall furnish and install white and yellow permanent retro-reflectORIZED cold preformed plastic pavement marking material at the location shown on the Plans, in conformance with the material specifications included herein.

The cold plastic markings shall consist of a homogeneous, extruded, prefabricated material of specified thickness and width which shall contain reflective glass spheres uniformly distributed throughout the cross-section, and shall be applied only to concrete pavement surfaces by means of an approved inlaid grinding process with pre-coated adhesive and pressure.

1. Contractor's personnel: It is important that the Contractor's personnel be completely knowledgeable of all application requirements and procedures prior to product application. It is the responsibility of the Contractor to contact the supplier of the cold plastic material if questions regarding application procedures or conditions arise.
2. Procedure: This procedure explains how to apply tape to concrete surfaces only. Apply the tape according to manufacturer's instruction in conjunction with an approved inlaid grinding method.
3. Road conditions: It is recommended that the tape be installed as soon as practical following tape manufacturer instructions.
 - a. Cold plastic pavement markings shall be inlaid by an approved grooving process into concrete pavement surfaces. Cold plastic will not be allowed on asphalt pavement surfaces whether inlaid into hot asphalt or existing asphalt surfaces. Grooving the pavement surface allows preformed pavement marking tape to better adhere by creating a fresh surface. Grooving also produces a lower profile marking by embedding the tape into the pavement surface, which helps protect the tape from snowplow damage.
 - b. The cutting head shall consist of diamond tipped cutting blades "gang stacked" 0.25 inches to 0.50 inches wide. The spacers between each blade must be such that there is less than a 10 mil raise in the finished groove between the blades. Water-cooling the blades may be

- necessary for long line grooving.
 - c. The groove width shall be equal to the tape width plus 1 inch \pm 1/8 inch. The depth of the groove shall be 75% of the tape thickness \pm 15%. For series 420, 60 mil tapes, the groove shall be 45 mils \pm 10 mils or 0.05 inch \pm 0.01 inch. The bottom of the groove should have a smooth, flat surface. If a coarse tooth pattern is present, increase the number of blades and decrease the thickness of the spacers between the blades on the cutting head. If water-cooling is used, flush the groove immediately after grooving to clean the surface.
 - d. Clean the surface of the road and the groove using a broom and/or high-pressure air blower. If either of these methods fail to clean the road surface, then high-pressure water wash shall be used. Road surface, including the surface of the groove must be dry and all dust, dirt, debris, oil, grease and foreign material removed before applying tape. If using water-cooling to groove, the groove must be completely dry prior to tape application.
 - 4. Tape Application: If there is a crack in the pavement, or if the tape is to be applied over a bridge expansion joint, manhole or utility box, lay the tape over the crack joint or fitting, then cut the tape 1-inch away from the crack or joint on each side. Apply the required surface preparation adhesive and allow to dry completely (5–10 minutes at 70° F, but not over 30 minutes).
 - 5. Tamping: Tamp the tape thoroughly with a tamping cart with a minimum 200 pound load, three times back and forth (six passes) over each part of the tape. Start in the center of the marking and work out to the edges removing any trapped air.
 - 6. Do not twist or turn the tamper cart on the tape.
 - 7. Make six passes (three passes back and forth) over each part of the tape (tamping is very important).
 - 8. Make sure all edges are firmly adhered.
 - 9. Application Conditions
 - a. Air temperature 60° F and rising.
 - b. Surface temperature 70° F and rising.
 - c. Overnight air temperature 40° F the night before tape application.
 - d. Pavement surface must be clean and dry. No rainfall should occur within 24 hours prior to application.
 - e. Butt splices must be used; do not overlap tape ends.
 - f. Traffic must be kept off of pavement surfaces coated with a surface preparation adhesive prior to tape application (follow manufacturer's instruction regarding the use of surface preparation adhesive).
 - 10. Surface moisture: Cold preformed plastic tapes will not adhere if moisture is present. Therefore, road surfaces must be dry and above the minimum required temperature for application of all tapes. If rainfall occurs within 24 hours prior to application, a surface moisture test (plastic wrap or roofing paper method as approved by the Engineer) must be performed and approval obtained from the Engineer. The groove must be visibly dry for a minimum of two hours prior to application. A moisture test shall be completed after the two-hour drying time to ensure no presence of moisture.
- E. Pavement Marking Paint: The Contractor shall furnish and install white and yellow retro-reflectORIZED pavement marking paint material at the location shown on the Plans, in conformance with the material specifications included herein.

1. The wet thickness and dry thickness of the pavement marking paint shall not be less than 15 mils and 12 mils, respectively without glass beads.
 2. Glass beads shall be applied uniformly over the entire length of line at the rate of 6 to 10 lbs. per gallon of paint.
 3. The gun tip shall be oriented perpendicular to the centerline to ensure that the beginning and ends of all lines are perpendicular to the centerline and not skewed.
 4. The equipment shall be maintained such that the needle can be fully closed when shut as to ensure square cut lines at the beginning and ends.
- F. Epoxy Pavement Marking: The Contractor shall furnish and install white and yellow epoxy markings at the location shown on the Plans, in conformance with the material specifications included herein.
1. Equipment
 - a. Use equipment that is capable of spraying both yellow and white epoxy in the manufacturer's recommended proportions. Provide equipment that can place stripes on the left and right sides, and place two lines simultaneously with either line in a solid or intermittent pattern in yellow or white. All guns must be in full view of operators at all times. If words, symbols, crosswalks, cross-hatching and stop bars are to be of epoxy resin material, equip the truck with a hand spray wand for such application. Mount the equipment on a truck of sufficient size and stability, and with an adequate power source, to produce lines of uniform dimension and prevent application failure. Provide equipment with metering devices to register the accumulated volume dispensed for each material, each day. Additionally, provide individual pressure gauges, clearly visible to the operator, for each pump used.
 - b. Provide equipment with two glass bead dispensers (double drop system) that uniformly distributes the glass beads to the surface of the epoxy pavement marking at a rate of at least 25 pounds per gallon. Glass beads may be applied by a pressure gun or controlled free fall.
 2. Contractor's Personnel: Assure that at least one employee on the project when pavement markings are being applied holds an American Traffic Safety Services Association (ATSSA) pavement marking certification.
 3. Surface Preparation
 - a. On existing pavements, remove the existing pavement markings in accordance with these specifications. Remove the existing markings and prepare the surface according to the manufacturer's recommendations (for the type of markings being installed).
 - b. On new Portland cement concrete pavement (PCCP), use shot blasting to remove curing compounds and laitance from the surfaces to which the pavement marking will be applied. Prepare the surfaces of new concrete bridge decks the same as new PCCP.
 - c. On all pavements, thoroughly remove all dirt, grit, grease, grime, vegetable matter, residue of prior pavement marking application (including such adhesives or primers that may have been used in their application), and any other foreign matter from the roadway surface prior to the application of epoxy pavement markings.
 4. Alignment: All layout required in the construction of the pavement marking is the responsibility of the Contractor. Lay out the pavement marking as detailed on the Plans. When the Plans do not provide details, submit a layout plan (conforming to the requirements of the Manual on Uniform Traffic Control

Devices (MUTCD)) for the pavement markings to the Engineer for approval. Normally locate longitudinal pavement marking stripes 2-inches from existing longitudinal joints. Provide adequate guide marks (approximately 2-inches by 6-inches at approximately 30 to 50 ft. intervals) for the application of the pavement markings.

5. Pavement Marking Application

- a. When no traffic is present, and for edge lines under any condition of traffic, a slower curing epoxy material (40 minutes) may be used. When the application is taking place under traffic, use a fast setting (10 minutes) epoxy material for center lines and skip lines.
- b. Apply the epoxy material closely behind the cleaning procedure.
- c. Provide the Engineer with a copy of the manufacturer's application instructions. Apply the epoxy pavement markings in accordance with the manufacturer's recommendations. In the absence of manufacturer's recommendations, apply the markings when the ambient and pavement surface temperatures are 50° F and rising. Cease pavement marking operations when the ambient or the pavement surface temperature drops to 50° F.
- d. Before mixing the components of the pavement marking material, heat the individual components to the temperature ranges recommended by the manufacturer of the material. Avoid exceeding the maximum recommended temperature at any time.
- e. Apply the epoxy pavement marking material at a thickness of 20 mils \pm 0.2 mils on asphalt and PCCP. Immediately apply the glass beads to the epoxy pavement marking at the rate of 25 pounds per gallon of epoxy, equally divided between the large and regular bead gradations. Apply the large beads on the first drop and the regular beads on the second.

2306.9 Method of Removal

Temporary pavement markings on milled surfaces scheduled to be overlaid do not have to be removed prior to performing the overlay. Permanent pavement markings installed on new asphalt surfaces shall be removed without structurally damaging the pavement or scarring the surface. The method of pavement marking tape removal shall be by a high pressure water blast method, a low-pressure water and sand blast method, a steel shot blast method, or burning method. Grinding or black paint covering shall not be allowed on new pavement surfaces.

2306.10 Performance Measures

The Contractor shall remove and replace, at the Contractor's expense, any finished markings that have the following deficiencies:

- Drag marks, gashes, gouges, pitting, foreign covering, discoloration, or areas that have failed to solidify
- Improper adhesion, length, width, or thickness
- Glass bead inadequacy
- Ragged appearance with areas that do not present sharply defined edges
- Deviation from the specified layout by an unreasonable amount based on Engineer's judgment

Drippings between markings shall be removed when instructed by the Engineer and shall not result in visible deterioration of the pavement.

2306.11 Method of Measurement

Pavement Markings will be measured by one of the following:

- A. Per linear foot of line. Skip lines are paid based upon length of marked section, 1-foot of a dual line is paid for at two unit feet bid.
- B. Per each symbol.

2306.12 Basis of Payment

Pavement Markings will be paid for by one of the following:

- A. Contract unit bid price.
- B. Contract lump sum bid price.

SECTION 2307 FENCING

2307.1 Scope

This section governs the furnishing all labor, materials, and equipment for the for the installation and removal of fencing as shown on the Plans and in accordance with the Standard Drawings, the specifications and the Special Provisions.

2307.2 Referenced Standards

The following standards are referenced directly in this section. The latest version of these standards shall be used. If conflicting standards are referenced, the more stringent standard shall apply.

MCIB Mid-West Concrete Industry Board Concrete Specifications - Concrete Pavement
The current editions of the "Bulletins" and Approved Sections of the "Standard Concrete Specifications" issued by the Mid-West Concrete Industry Board, Inc. (MCIB) are made a part hereof by reference. However, when the provisions of this Specification differ from the provisions of such "Bulletins" and "Sections" the provisions of this Specification shall govern.

KCMMB Kansas City Metro Materials Board Specifications

Kansas Department of Transportation

Standard Specifications for State Road and Bridge Construction, 2015 Edition

Section 828 – Fencing

Section 1620 – Material for Fencing

Missouri Highways and Transportation Commission

Missouri Standard Specifications for Highway Construction, 2011 Edition

Section 1043 Fence Materials

Section 607 Chain Link Fence

2307.3 Materials

- A. All materials used for the installation of a permanent chain link fence shall be new material conforming to:
 - 1. Missouri Projects: Section 1043 of the Missouri Standard Specification for highway construction except concrete for posts shall be MCIB Mix No. A543-1-4-0.479, approved KCMMB 4K mix, or approved

equal.

2. Kansas Projects: Section 1620 of the Kansas Standard Specifications for State Road and Bridge Construction except concrete for posts shall be MCIB Mix No. A543-1-4-0.479, approved KCMMB 4K mix, or approved equal.
- B. All material used for the installation of permanent decorative fence shall be new material as specified or as shown on the Plans or that match the existing fence.

2307.4 Construction

- A. Removal: Existing fence shall be removed as specified or as shown on the Plans or as directed by the Engineer. Removed fencing may be used for temporary fencing only with the Engineer's approval. Fences interfering with construction, and located within public right-of-way or as may be allowed for in permits or agreements, may be removed by the Contractor only if the opening is provided with a temporary gate that will be maintained in a closed position except to permit passage of equipment and vehicles unless otherwise specified. Fences within temporary construction easements may be removed by the Contractor provided that temporary fencing is installed in such a manner as to serve the purpose of the fencing removed. The Contractor shall locate and record all fence corners prior to removal. All fencing removed shall be restored by the Contractor to a condition equal to or better than that existing prior to construction unless otherwise specified. The Contractor is liable for loss and costs associated with stray animals caused by the removal or improper construction of temporary or permanent fencing.
- B. Chain-Link Fence: Chain-Link Fence shall be installed at the locations shown on the Plans or as directed by the Engineer in accordance the applicable KDOT or MoDOT specifications for the state where the work is being performed. However, the bottom of the fabric shall be not more than 1 ½ inches above the finished ground line unless shown otherwise on the Plans. All residential fence shall have a top rail and all edges of fence fabric shall be knuckled.
- C. Decorative Fence: Decorative fence shall be installed at the locations shown on the Plans or as directed by the Engineer in accordance with the manufacturer's instructions and recognized industry standards or as directed by the Engineer.

2307.5 Method of Measurement

- A. Fence shall be measured along the slope of the fence to the nearest linear foot. Vehicle gates shall not be included in this measurement.
- B. Gates: Gates shall be measured per each for the size and type specified.
- C. Temporary Fence: Temporary fence will be measured by one of the following:
1. No measurement made.
 2. Per foot measured along the slope to the nearest linear foot.
- D. Fence Removal: Fence removal will be measured by one of the following:
1. No measurement made.

2. Per linear foot to nearest foot.

2307.6 Basis of Payment

All items in this section will be paid for at the respective Contract unit bid price. There will be no separate payment for pedestrian gates; they are subsidiary to the fencing pay item.

SECTION 2308 STEEL BEAM GUARDRAIL

2308.1 Scope

This section governs the furnishing all labor, materials, and equipment for the for the installation of Steel Beam Guardrail as shown on the Plans and in accordance with the Standard Drawings, the specifications and the Special Provisions.

2308.2 Referenced Standards

ASTM

- A 36 Standard Specification for Carbon Structural Steel
- A 123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- A 153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

AASHTO

- M 180 Standard Specification for Corrugated Sheet Steel Beams for Highway Guardrail

2308.3 Materials

- A. Steel Posts: All posts, terminal post connectors, and steel blocks for guardrail shall be formed from a structural steel meeting the requirements of ASTM A 36, and shall be galvanized in accordance with ASTM A 123.
- B. Guardrail and Hardware: All guardrail and hardware shall conform to the requirements of AASHTO M 180 Class A, Type 1. Hardware shall be galvanized in accordance with ASTM A 153. Guardrail shall be galvanized with a minimum of 1.80 ounces of Zinc per sqft. All Zinc shall be "Prime Western" grade or better.

2308.4 Construction

- A. Setting Posts: Posts shall be set to the depth and spaced at the intervals shown on the Plans or Standard Drawings. They shall be set vertical and true to line and grade. Steel posts may be driven by a power hammer or may be set in dug or bored holes of a size sufficient to permit thorough compacting of the backfill around the post. The backfill material shall be dry sand, placed in layers not exceeding 12 inches in thickness to a depth of 12 inches below the finished grade. After erecting and adjusting the rail to true line and grade, the sand backfill shall be compacted by flooding. The final 12 inches of backfill consisting of suitable earth material shall then be compacted in six inch lifts. Any "mushrooming" of the top of a post shall be removed and damaged spelter coating on posts shall be repaired by the zinc alloy stick method while the surface is heated to approximately 600° F. Other methods of repairing the spelter coating shall receive prior approval of the Engineer.
- B. Erecting Guardrail: Bolt holes shall be shop punched. Field punching, reaming and drilling will not be permitted. Guardrail beams shall be spliced, only at posts by lapping in the direction of traffic, using the required number of splice bolts. Beams for twisted turned down terminal sections may be either field or shop twisted. Sufficient twist shall be introduced such that the beam shall retain the required shape in a relaxed condition. Beams to be

erected on a radius of 150 feet or less shall be shop-curved as shown on the Plans. Each end of every installation of guardrail shall have an end, bridge anchor, or terminal section of the design and type shown on the Plans or Standard Drawings. They shall be of the same material and shall be galvanized in accordance with the requirements for the guardrail beam. Galvanized rail shall be handled in a manner to avoid damage to the galvanized coating. Any sections of rail, end sections or terminal sections on which the spelter coating has been bruised or broken shall be rejected, or may with the prior approval of the Engineer, be repaired by the method prescribed for repairing damaged spelter coating of steel posts.

2308.5 Method of Measurement

Steel beam guardrail will be measured from center of terminal post to center of terminal post per linear foot and quarter part thereof.

2308.6 Basis of Payment

Payment will be made at the Contract unit or lump sum bid price. There will be no separate payment for terminal end sections except when specified in the Contract Documents.

END OF SECTION

SECTION 2400 – SEEDING AND SODDING

CITY OF LEE’S SUMMIT, MISSOURI STANDARD SPECIFICATIONS

The City of Lee’s Summit hereby adopts Section 2400 of the Kansas City Metropolitan Chapter of APWA Construction and Material Specifications, current edition.

**DIVISION II
CONSTRUCTION AND MATERIAL SPECIFICATIONS
SECTION 2400 SEEDING, SODDING AND OVERSEEDING**

APPROVED AND ADOPTED THIS 15th DAY OF FEBRUARY 2017

**KANSAS CITY METROPOLITAN CHAPTER
OF THE AMERICAN PUBLIC WORKS ASSOCIATION**

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SECTION 2400 GENERAL

2400.1 Scope

This section governs all general specifications necessary for installation of seeding, sodding, native grasses, hydroseeding and overseeding in accordance with the Standard Drawings, the specifications and Special Provisions.

The Contractor shall furnish all plants and materials and perform all operations in connection with the preparation, fertilizing, placing, watering, weeding, firming and establishment, of sodded and seeded areas (both temporary and permanent applications). All areas of established yards shall be restored by sodding unless otherwise approved by the Owner. The Contractor shall sod and/or seed disturbed areas where shown on the Plans or by field inspection, as required by the Storm Water Pollution Prevention Plan and pursuant to all permits, applicable federal and state laws. The Contractor shall be responsible for establishment of grass.

2400.2 Referenced Standards

APWA
2150 Erosion Control

Kansas Department of Transportation
Standard Specifications for State Road and Bridge Construction, 2015 Edition
KDOT Division 2100, and Division 900

Missouri Highways and Transportation Commission
Missouri Standard Specifications for Highway Construction, 2011 Edition
MODOT Section 800

Federal and State Department of Agriculture Regulations

Applicable State Weed Laws, Missouri Revised Statutes Chapter 263, and Kansas Statutes Annotated, Chapter 2, Article 13.

American Sod Producers Association (A.S.P.A.) "Specifications for Turfgrass Sod", and "Specifications for Topsoil Material and Application"

2400.3 Definitions

- A. Rough Grading is to mean the work necessary to prepare the subgrade for topsoil application and shall be compatible with the surrounding landscape while making a smooth transition to existing undisturbed conditions.
- B. Subgrade is to mean that level of earth below the topsoil layer.
- C. Compacted backfill is to mean a compaction of 90 percent standard proctor density for that material.
- D. Tolerance is to mean that amount above or below a given line.
- E. Certified Sod: State Certified Sod shall be turfgrass sod, grown from certified high quality seed that has

been inspected by the State Certification Agency.

- F. Certified Seed: A grass or legume seed named variety that has been reviewed and accepted and meets all state and federal requirements, rules and regulations. The seed shall be grown and processed in the United States or Canada and comply with the requirements of the corresponding State Seed Law. Certified Seed shall be packaged and labeled with an inspection certificate from the State Certification Agency stating genetic identity, purity, and freedom from noxious weeds as well as excessive amounts of other crop and weedy plants at time of harvest. Cleaning and conditioning of seed must result in a product that meets or exceeds minimum standards.
- G. Establishment Period: A period when planting work has been performed and initially accepted, and there is a Contract requirement to care for the planted areas in some way until the period ends.
- H. Fertilizer: The grade of fertilizer will be identified according to the percent nitrogen (N), percent of available phosphoric acid (P205), and percent water soluble potassium (K20), in that order, and approval will be based on that identification.
- I. Native Plant (existing): A variety of plant species occurring in its natural habitat without direct or indirect human actions.
- J. Noxious Weed: All weed designated by the State Weed Board as injurious to public health, agriculture, recreation, wildlife, or all public or private property. The United States Department of Agriculture (USDA) for the corresponding state will be the authority in determination of noxious weed species.
- K. Pure Live Seed (PLS): The amount of living seed in the total quantity of seed when non-viable seed or non-seed material is excluded. The following formula shall be used to determine the amount of commercial seed required to provide each kind of seed for the specified quantities of pure live seeds:

$$\text{Pounds of Commercial Seed Required} = \frac{10,000 \times \text{Pure Live Seed (lbs per acre)}}{\text{Purity (Percent)} \times \text{Germination (percent)}}$$
- L. Riparian: Related to the bank, shore, or water-influenced areas of a watercourse or water body.
- M. Sensitive Areas: Defined areas such as wetlands, natural water and riparian resources, special environmental zones, or where certain activities are restricted such as the use of chemicals.
- N. Specified Weeds: All noxious weeds as defined above, and all plant species identified in the Special Provisions or on the Plans as a species to be removed.
- O. Weed: A plant that is undesirable where it is growing.

2400.4 Submittals

Prior to delivery to the job site, Contractor shall submit to the Owner for approval the source and supplier of all grass seed, sod, fertilizer and mulch materials, along with the type of equipment to be used on this project and any tests completed. Manufacturer's bulletins, leaflets and other descriptive data which contain cuts, dimensions, and specifications will be acceptable for cataloged materials. Such bulletins, leaflets and other descriptive data shall be clearly marked to show which item is to be used and which paragraph of the contract specification it is to satisfy.

2400.5 Protection and Repair

The seeded/sodded area shall be kept free of traffic until accepted. If at any time before acceptance of the completed contract, any portion of the seeded surface becomes gullied or otherwise damaged, or the seeding has been damaged or destroyed, the affected portion shall be repaired to re-establish the specified condition prior to the acceptance of the work.

2400.6 Acceptance of Seeding and Sodding

- A. Acceptance: Acceptance by the Owner will occur when areas seeded and/or sodded are determined to be established turf areas ready for mowing. Grass areas in excess of one (1) square foot that are dead or in poor condition regarding color and quality shall be replaced at the Contractor's expense prior to the initiation of the Maintenance Period.
- B. Sod Watering: Throughout the Maintenance Period, the Contractor shall be responsible for watering the installed sod until it is established and ready for mowing. In the absence of rainfall, watering shall be performed daily during the first week and shall be sufficient to maintain moist soil to a depth of at least 4 inches. Soil on sod pads shall be kept moist at all times. Watering may be done during the heat of the day to help prevent wilting. After the second week, the Contractor shall water the sod as required to maintain adequate moisture in the upper 4 inches of topsoil necessary for the promotion of deep root growth until final acceptance as established turf areas ready for mowing.
- C. Seed Watering: The Contractor shall be responsible for watering seeded areas, keeping all areas moist throughout the germination period, following the substantial germination of the seed, and during the occurrence of a dry or drought period. Continued watering will be required until final acceptance as established turf areas ready for mowing.
- D. Acceptance Notification: After acceptance of the seeded or sodded area by the Owner, the Contractor shall by door hangers or other approved methods, notify all affected property owners that the maintenance of the grassed areas is now their responsibility.

2400.7 Clean-up

During the progress of this work and upon completion, thoroughly clean the project area, remove and properly dispose of all resultant dirt, debris and other waste materials.

2400.8 Guarantee

The Contractor shall guarantee all work and materials for a period of one full growing season (Spring to Fall) after the date of final acceptance of the project. During the guarantee period, all turf which dies or exhibits weed growth or undesirable grasses, free of eroded areas, bare spots, diseases and insects, shall be replaced with like material at the expense of the Contractor. Contractor to replace as originally specified areas which have failed to survive, as often as required, to establish the seeded/sodded lawn area until accepted, at no additional compensation. Contractor to repair and replace to original condition all damages to property resultant from the sodding operation and all damages as a result from the remedying of these defects, without additional compensation.

SECTION 2401 SEEDING

2401.1 Scope

This section governs furnishing all labor, materials and equipment necessary for complete installation of seeding in

accordance with the Standard Drawings, the specifications and Special Provisions. The Contractor shall furnish all plants and materials and perform all operations in connection with the preparation, fertilizing, placing, watering, firming and establishment, of seeding areas, complete and in strict accordance with these specifications and applicable Plans, and subject to the terms and conditions of the Contract. The Contractor shall seed disturbed areas where shown on the Plans or by field inspection and as required by the Storm Water Pollution Prevention Plan. The Contractor shall be responsible for establishment of grass.

2401.2 Materials

A. Seed: Seed shall be labeled in accordance with U.S. Department of Agriculture Rules and Regulations under Federal Seed Act. All seed shall be furnished in sealed standard containers unless exception is granted in writing by the Owner. Seed shall be free from noxious weeds and recleaned "Grade A" recent crop seed treated with appropriate fungicide at time of mixing. Seed which has become wet, moldy, or otherwise damaged in transit or in storage will not be acceptable. Seed mix to be used will be identified prior to sowing. The minimum percentage by weight of pure live seed in each lot of seed shall be as follows:

1. Seeding – Mix #1 (Turf Areas)

Festuca arundinacea, Fineleaf Tall Fescue. Varieties- Hounddog V. Rebel Jr., Rebel III, Rebel 3D, Barlexas, Millennium, Southern Choice, Tar Heel, Wolf Pack, Bonsai 2000, Shortstop II Coyote, or other pre-approved substitutes 62.5%

Poa pratensis, Kentucky Bluegrass. Varieties- Baran, Nassau, Ram I, Nublu, Rugby II, Award, Blacksburg, Challenger, Eagleton, Limousine, Livingston, Midnight, Nuglade, Preakness, Princeton 105, Quantum Leap, 1757 or other approved substitutes 25.0%

Lolium multiflorum – annual ryegrass 12.5%

2. Seeding – Mix #2 (Low Use Areas)

Fescue ovina, Sheeps Fescue. Varieties- Azay, Big Horn, or other pre-approved substitutes 15.0%

Fescuca rubra subsp. Commutata, Chewings Fescue, Varieties-James town II, Victory, Tiffany, or other approved substitutes 20.0%

Fescuca longifolia, Hard Fescue. Varieties- Spartan, Tournament, Warwick, Discovery, Waldina, Aurora, 4 AG Attila, Reliant II, Scaldis, or other pre-approved substitutes 35.0%

Fescuca ruba subsp. Ruba, Creeping Red Fescue. Varieties- Shademaster II, Jasper, Cindy, Pennlawn, or other pre-approved substitutes 30.0%

3. Seeding Rate: Seed mixture shall be sown at the minimum rate of 10 pounds per 1000 square feet for new seeding. See Section 2406.3.E.1 for overseeding rates.

B. Inorganic Fertilizer: Inorganic fertilizer shall be composed of a formula 12-12-12, 13-13-13 or other approved substitute, and shall conform to the applicable State fertilizer laws. Fertilizer shall be of a type that can be uniformly distributed by the application equipment. Fertilizer may be furnished in a dry (granulated) or liquid form. When applied dry, the fertilizer shall be a granular, non-burning chemically combined product composed of not less than 50% organic slow acting, guaranteed analysis professional fertilizer. Granular or

pellet form shall be uniform in composition, dry and free flowing and shall be delivered to the site in the original unopened containers each bearing the manufacturer's guaranteed analysis. Any fertilizer which becomes caked or otherwise damaged, making it unsuitable for use, will not be accepted. When applied in a liquid form, fertilizer may be chemically combined or may be furnished as separate ingredients.

- C. Mulch: Mulch shall be the vegetative type, or wood cellulose fiber type, whichever is specified in the Special Provisions, or as approved by the Owner.
 - 1. Vegetative Type: The vegetative type shall be the cereal straw from stalks of oats, rye, wheat or barley and shall be free of prohibited and noxious weed seeds.
 - 2. Wood Cellulose Fiber Mulch: Wood cellulose fiber shall contain no germination or growth inhibiting ingredients, and shall be dyed an appropriate color to aid in visual metering in its application. It shall be easily and evenly dispersed and suspended when agitated in water, and when sprayed uniformly on the soil surface, shall form a blotter-like cover, which readily absorbs the water and allows infiltration to the underlying soil. The mulch material shall be supplied in packages of not more than 100 pounds gross weight, and shall be marked by the manufacturer to show the air dry weight content (air dry weight shall contain no more than 10 percent moisture).
- D. Water: Water, hose and other watering equipment required for the work shall be furnished by the Contractor.
- E. Other Materials: Other materials not specifically described but required for a complete and proper planting installation, shall be as selected by the Contractor subject to the approval by the Owner.
- F. Equipment: The seeding operation shall be accomplished with equipment suitable for preparing the seed bed, sowing the seed, fertilizing, spreading the vegetative type mulch, or spreading the wood cellulose fiber mulch in accordance with the applicable requirements of the following sub-section entitled "Construction".
- G. Top Soil: The Contractor shall make every reasonable effort to stockpile existing top soil prior to excavation and reuse it in the same general locations. No payment will be made for topsoil furnishing and placement necessary due to excessive hauling off of existing top soil on the project site.
- H. Qualifications of Workman: Provide at least one person, who shall be present at all times during the execution of this work, who is thoroughly familiar with all materials and installation procedures included in the Sodding and Seeding operations as specified herein.
- I. Delivery Containers: Deliver all items to the site in their original containers with all labels intact and legible at time of Owner inspection.
- J. Protection: Use all means necessary to protect all materials before, during and after installation, and to protect the installed work and materials of all other trades.
- K. Replacements: In the event of damage or rejection, immediately make all repairs and replacements to the approval of the Owner and at no additional cost to the Owner.
- L. Weather Conditions: All sodding and seeding shall be performed during favorable weather conditions and only during normal and acceptable planting seasons when satisfactory growing conditions exist. The planting operations shall not be performed during times of extreme drought, when ground is frozen or during times of other unfavorable climatic conditions unless otherwise approved by Owner. The Contractor assumes full and complete responsibility for all such plantings and operations.

- M. Planting Dates: Recommended dates for all seeding and planting shall be March 15 through October 15 unless otherwise approved by the Owner.
- N. Pre-planting Inspection: Prior to the work of this section, the Contractor shall carefully inspect the installed work of all other trades and verify that all such work is complete to the point where installation may properly commence.
- O. Discrepancies: Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

2401.3 Construction

- A. All equipment used in the project and all workmanship shall meet the approval of the Owner.
- B. All areas to be seeded shall be tilled or disked to a depth of 3-4 inches and raked or smoothed to remove debris, clods, surface stone, 2-inches diameter or larger and weeds. Grades on the areas to be sodded or seeded shall be maintained in true, even and compacted conditions to prevent the formations of depressions. Areas overseeded, to be seeded that have washed or eroded shall be brought to grade and compacted thoroughly by the Contractor prior to placing the seeding or overseeding. No grading shall be done when the soils are in a muddy or frozen condition.
- C. Steel Edging: The finish sub-grade of areas to be planted shall be 2" below top of steel edging, if present, for grass sod and flush with top of steel edging for seeding.
- D. Other Edges: The finished sub-grade next to curbs, sidewalk and drive approaches shall allow for the seed to be placed level with the improvement. The sub-grade shall be finished level with the improvement for seeding.
- E. Fertilizer Application: For areas to be seeded, fertilizer shall be applied when area receives final grading and tillage.
- F. Application of Fertilizer: The Contractor has the option to obtain soil tests from a recognized testing laboratory, approved by Owner, to determine soil pH, nitrogen, phosphorus and potassium requirements and organic matter content. A pH of 5.8 to 7.0 and phosphorus and potassium levels of medium or higher range for the particular test used is required. Soils falling below these test levels must be supplemented with the appropriate materials to meet such test levels. If the above soil test is not performed a 13-13-13 fertilizer shall be applied at the rate of 400 pounds per acre.
- G. Acceptance of Plant Bed: Acceptance of the plant bed for seeding shall be obtained from the Owner for each section of area as indicated on the Plans. The Contractor shall be responsible for maintaining the accepted areas until the effective date for planting.
- H. Sowing shall be accomplished by use of an approved mechanical seeder or drill (hand spreader can be used in small areas), making sure that successive seed strips overlap to provide uniform coverage. Seed should be drilled to a depth of 1/2 inch.
 - 1. Seed mixed in proportions shown in Section 2405.2 may be broadcast by approved sowing equipment. The seed shall be uniformly distributed over the designated areas. The seed shall be covered to an average depth of 1/2 inch by means of a brush harrow, spike-tooth harrow, chain

harrow, cultipacker or other approved device.

2. Areas to be seeded shall be fertilized at rates specified in Section 2401.3.F. The seedbed shall be free of any irregularities in the surface, and shall be corrected in order to prevent formation of water pockets. All seeded areas are to be completely covered with hydromulch or with straw anchored to the soil a minimum depth of 3 inches by a disc harrow set nearly straight, to properly maintain soil moisture and to provide shade for the newly germinated chutes.
 3. Promptly after mulching, wet the seedbed thoroughly, keeping all areas moist throughout the germination period. Protect all turf areas by erecting temporary fences, barriers, signs, etc. as necessary to prevent trampling and disturbance.
 4. When delays in operations carry the work beyond the most favorable planting season for the grasses designated, or when conditions are such, by reason of drought, high winds, excessive moisture, or other factors that satisfactory results are not likely to be obtained, the seeding operation shall be stopped and work shall be resumed only when conditions are favorable again or when approved alternative or corrective measures and procedures have been put into effect. If inspection during seeding operations or after indicate there are areas which have been skipped, the sowing of additional seed on these areas will be required.
 5. The seeded areas will be inspected for acceptable grass coverage and will be acceptable when grasses designated are growing and are in good condition and no area more than ½ of one percent of the total areas shall be bare, of which no single area shall be more than one foot square in area. Any bare area larger than this will not be acceptable and shall be reseeded.
- I. Compaction: Immediately following the completion of seeding operations, the entire area shall be compacted by means of a roller weighing at least 60 but not more than 90 pounds per linear foot of roller.
- J. Maintenance Period: The Contractor shall be responsible for maintaining the installed grass seed and sod until all areas are complete and accepted by the Owner.
- K. Mulching: Mulching shall be done within 24 hours following the seeding operation except in the case of wood cellulose fiber type mulch.
1. Vegetative Type Mulch: After compacting the surface, mulch shall be uniformly spread at the rate of 1.5 tons per acre by means of a mechanical spreader or other approved means. As soon as the mulch is spread it shall be anchored to the soil a minimum depth of 3 inches by use of a heavy disc harrow, set nearly straight, or a similar approved tool. Discs of the anchoring tool shall be set approximately 9 inches apart. Anchoring shall be accomplished by not more than two passes of the tool.
 2. Wood Cellulose Fiber Type: Wood cellulose fiber mulch shall be added to the hydraulic seeder after the proportionate amounts of seed, fertilizer and water, and other approved materials are added. These ingredients shall be mixed to form a slurry which shall be applied at the rate of 1,000 pounds per acre. The mulch shall make a uniform coverage of the soil surface that will be satisfactory to the Owner.

SECTION 2402 SODDING

2402.1 Scope

This section governs the furnishing all labor, materials and equipment necessary for complete installation of sodding, in accordance with the Standard Drawings, the specifications and Special Provisions.

2402.2 Materials

- A. Sod: All grass sod shall be State Certified, nursery grown native mixture of Hounddog, Rebel, Pride, Cochise, Coyote or other substitute, as may be approved. Sod shall be a Tall Turf type Fescue with 10 percent Bluegrass that is free of objectionable grassy and broadleaf weeds. Sod shall be considered free of such weeds if less than 5 such plants are present per 100 square feet of area. Sod will not be acceptable if it contains any of the following weeds: Common burmudagrass,(wiregrass), quackgrass, johnsongrass, poison ivy, nutsedge, mumblewill, Canada thistle, bindweed, wild garlic, ground ivy, perennial sorral and brome grass, or as defined by current weed laws.
1. Pad Size: The sod shall be cut to supplier's standard width and length but not less than 12 x 24 inches and not more than 24 x 72 inches or bigger sizes that are approved by the Owner. There shall not be broken pads, torn or uneven ends.
 2. Strength: Root development shall be such that standard size pieces will support their own weight and retain their shape when suspended vertically from a firm grasp on the uppermost 10% of area.
 3. Mowing Height: Before harvesting sod, it shall be mowed uniformly at a height of 2 - 2½ inches. The sod shall be stripped or harvested by machine at a uniform thickness of 1½ inches ± ¼ inch. Measurement of thickness shall exclude top growth and thatch.
- B. Fertilizer: Fertilizer shall be inorganic 12-12-12 or 13-13-13 grade, uniform in composition, free flowing and suitable for application with approved equipment, delivered to the site in convenient containers, each fully labeled, conforming to applicable state fertilizer laws, bearing the name, trade name, or trademark and warranty of the producer.
- C. Top Soil: The Contractor shall make every reasonable effort to stockpile existing top soil prior to excavation and reuse it in the same general locations. No payment will be made for topsoil furnishing and placement necessary due to excessive hauling off of existing top soil on the project site.
- D. Qualifications of Workman: Provide at least one person, who shall be present at all times during the execution of this work, who is thoroughly familiar with all materials and installation procedures included in the Sodding and Seeding operations as specified herein.
- E. Delivery Containers: Deliver all items to the site in their original containers with all labels intact and legible at time of Owner inspection.
- F. Protection: Use all means necessary to protect all materials before, during and after installation, and to protect the installed work and materials of all other trades.
- G. Replacements: In the event of damage or rejection, immediately make all repairs and replacements to the approval of the Owner and at no additional cost to the Owner.
- H. Weather Conditions: All sodding and seeding shall be performed during favorable weather conditions and only during normal and acceptable planting seasons when satisfactory growing conditions exist. The planting operations shall not be performed during times of extreme drought, when ground is frozen or during times of other unfavorable climatic conditions unless otherwise approved by Owner. The Contractor

assumes full and complete responsibility for all such plantings and operations.

- I. Planting Dates: Recommended dates for all seeding and planting shall be March 15 through October 15 unless otherwise approved by the Owner.
- J. Pre-planting Inspection: Prior to the work of this section, the Contractor shall carefully inspect the installed work of all other trades and verify that all such work is complete to the point where installation may properly commence.
- K. Discrepancies: Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

2402.3 Construction

- A. Sod shall not be harvested or delivered when excessively wet or dry. Sod shall be harvested, delivered and installed within a period of 36 hours. Protect sod from sun, wind, dehydration, and rain prior to installation that cannot be placed immediately on delivery. Sod showing visible signs of heating or dehydration will be rejected.
- B. Areas to be sodded shall be fertilized at the rates specified in Section 2401.3.F. The sod-bed shall be free of any irregularities in the surface resulting from fertilizing or other operations and shall be corrected in order to prevent the formation of water pockets. Freshly graded areas, which have set long enough to become dry and crusted over, shall be tilled as specified above, prior to placing the sod.
- C. The first row of sod should, if possible, be laid in a straight line with subsequent rows placed parallel and tightly against one another. Lateral joints shall be staggered as in brick laying to promote more uniform growth and strength. Care shall be exercised to ensure that the sod is not stretched or overlapped and that all joints are butted tight in order to prevent voids which would otherwise cause air drying of the roots. Where new sod meets existing grassed areas, a straight, vertical edge shall be cut to allow smooth match. Sod shall be watered and firmed in accordance with Section 2400.6.B. If it is necessary to walk excessively on newly laid sod or soil, walking boards should be laid for this purpose.
- D. Sod shall be laid with staggered joints and at right angles to direction of slope. Sod shall be secured by tamping or rolling. On slopes 4:1 or steeper and in drainage channels, all sod shall be anchored at minimum two-foot intervals to prevent movement under rainfall conditions.
- E. The Contractor shall be responsible for having adequate water available at the site prior to and during the installation of the sod and the areas to be seeded. The sod shall be watered immediately after installation to prevent drying during progress of the work. As sodding is completed on any one section, the entire area shall be thoroughly irrigated to a one inch depth below the new sod pad. After a short drying period, the sod shall be rolled with a roller weighing not less than 60 or more than 90 pounds per linear foot to firm the sod pad and smooth minor surface irregularities. Subsequent watering should maintain sod and soil moisture to a depth of at least four inches, supplement rainfall, to promote growth, promote proper rooting to insure sod survival, and to prevent dormancy.
- F. Apply second application of fertilizer at the rate of 300 pounds per acre two weeks after laying sod and prior to final acceptance.
- G. The sodded areas will be inspected for the acceptable grass coverage and will be acceptable when grasses designated are growing and are in good conditions, and no area more than ½ of one percent of the total

area shall be bare or dead, of which no single area shall be more than one foot square in area. Any bare or dead area larger than this will not be acceptable, and shall be resodded.

- H. Maintenance Period – The Contractor shall be responsible for maintaining the installed grass seed and sod until all areas are complete and accepted by the Owner.
- I. Maintenance of sodded areas shall include watering, weeding, mowing to a 2½ inch height after growth has exceeded 3 inches and prior to a 4 inch growth, replacement and installation of sod as originally specified for sodded areas failing to survive, and repair of rutting, should that occur. Clippings from mowing which mat on the grass are to be removed.

SECTION 2403 NATIVE GRASSES

2403.1 Scope

This section governs the furnishing all labor, materials and equipment necessary for complete installation of native grasses, in accordance with the Standard Drawings, the specifications and Special Provisions.

2403.2 Materials

Furnished and installed per Section 2403.3. Annual plants which sprout rapidly and survive for only one growing season are suitable only for establishing temporary vegetative cover. See Temporary Seeding, Section 2153.5.

- A. The seed mix will be as follows:
 Short-grass Mix
 Seeding Rate: 6.42 lb/Acre (40.3 Seeds/ft²)

GRASSES:					
SCIENTIFIC NAME	COMMON NAME	% of Mix	Seeds/ft ²	Rate/Acre	
<i>Bouteloua curtipendula</i>	Sideoats Grama	18.69%	2.6	1.200	PLS lb
<i>Elymus canadensis</i>	Canada Wild Rye	9.35%	1.1	0.600	PLS lb
<i>Koeleria cristata</i>	June Grass	1.56%	7.3	0.100	PLS lb
<i>Schizachyrium scoparium</i>	Little Bluestem	34.27%	12.1	2.200	PLS lb
<i>Sporobolus aspera</i>	Rough Dropseed	6.23%	4.4	0.400	PLS lb
<i>Sporobolus cryptandrus</i>	Sand Dropseed	0.31%	2.6	0.020	PLS lb
<i>Sporobolus heterolepis</i>	Prairie Dropseed	0.16%	0.1	0.010	PLS lb

WILDFLOWERS:					
SCIENTIFIC NAME	COMMON NAME	% of Mix	Seeds/ft ²	Rate/Acre	
Aster laevis	Smooth Blue Aster	0.31%	0.4	0.020	PLS lb
Astragalus canadensis	Canada Milk Vetch	1.56%	0.6	0.100	PLS lb
Chamaecrista fasciculata	Partridge Pea	6.23%	0.4	0.400	PLS lb
Dalea candidum	White Prairie Clover	0.93%	0.4	0.060	PLS lb
Dalea purpurea	Purple Prairie Clover	6.23%	2.6	0.400	PLS lb
Desmanthus illinoensis	Illinois Bundle Flower	7.79%	0.8	0.500	PLS lb
Desmodium canadense	Showy Tick Trefoil	0.93%	0.1	0.060	PLS lb
Lespedeza capitata	Round-headed Bush Clover	0.31%	0.1	0.020	PLS lb
Ratibida pinnata	Yellow Coneflower	3.12%	3.1	0.200	PLS lb
Rudbeckia hirta	Black-eyed Susan	2.02%	1.5	0.130	PLS lb

2403.3 Construction

- A. Prior to planting the topsoil in the disturbed area shall be tilled to 6 inches and compacted to approximately 80% density.
- B. Native grass seed shall be installed using a rangeland type grain drill seeder per the rates stated. Depths of seeding plants should be ½ inch.
- C. Spread and crimp 2,000 lbs. per acre of clean straw or hay within seven days of seeding.
- D. Contractor shall provide a minimum of one watering after planting to establish the cover crop.
- E. Cover crop shall provide 70% cover within 21 days of seeding.
- F. Contractor shall guarantee that seeded areas will have 80% cover within two full growing seasons.
- G. Contractor shall allow one application of selective herbicides in the spring to control weeds.
- H. Care must be taken to comply with manufacturers labels.

SECTION 2404 HYDROSEEDING

2404.1 Scope

This section governs furnishing all labor, materials and equipment necessary for complete installation of

hydroseeding, in accordance with the Standard Drawings, the specifications and Special Provisions. Seed and fertilizer, mixed in proportions previously specified, may be broadcast in a hydromulch with water which forms an emulsion and covers the prepared designated areas in a uniform manner.

2404.2 Materials

Areas to be hydroseeded shall be fertilized at rates specified in Section 2401.3.F. The seed-bed shall be free of any irregularities in the surface, and shall be corrected to prevent formation of water pockets. Hydromulch used shall be a wood fiber mulch with tackifier, such as Conwit 2000, or approved equivalent. Hydromulch shall be applied at the rate of 1500 lbs. per acre.

2404.3 Construction

- A. Seed and fertilizer, mixed in proportions previously specified, may be broadcast in a hydromulch with water which forms an emulsion and covers the prepared designated areas in a uniform manner.
- B. Areas to be hydroseeded shall be fertilized at rates specified in Section 2406.3. The seed-bed shall be free of any irregularities in the surface, and shall be corrected to prevent formation of water pockets.
- C. Hydromulch used shall be a wood fiber mulch with tackifier, such as Conwit 2000, or approved equivalent. Hydromulch shall be applied at the rate of 1500 lbs. per acre.
- D. Hydroseeder filling tank should be $\frac{1}{2}$ full of water before adding seed, fertilizer and hydromulch components. Begin agitation while adding remaining water so that a uniform mixture is obtained. Seed, fertilizer and hydromulch components shall not be added to water more than four (4) hours prior to application.
- E. Discharge hydromulch slurry mix on prepared soil for uniform distribution.
- F. Keep all areas seeded moist throughout germination period. Protect all turf areas by erecting temporary fences, barriers, signs, etc. as necessary to prevent trampling and disturbance.
- G. The seeded areas will be inspected for acceptable grass coverage and will be acceptable when grasses designated are growing and are in good condition and no area more than $\frac{1}{2}$ of one percent of the total areas shall be bare, of which no single area shall be more than one foot square in area. Any bare area larger than this will not be acceptable and shall be reseeded.
- H. Contractor shall provide a minimum of one watering after planting to establish the cover crop.
- I. Cover crop shall provide 70% cover within 21 days of seeding.
- J. Contractor shall guarantee that seeded areas will have 80% cover within two full growing seasons.
- K. Contractor shall allow one application of selective herbicides in the spring to control weeds.
- L. Care must be taken to comply with manufacturers labels.

SECTION 2405 OVERSEEDING

2405.1 Scope

This section governs the furnishing all labor, materials and equipment necessary for complete installation of overseeding in accordance with the Standard Drawings, the specifications and Special Provisions. Overseeding is the planting of grass seed directly into the existing turf, without tearing up the turf, or the soil.

2405.2 Materials

All designated existing turf areas being overseeded shall use seed previously specified at the rate of 160 pounds per acre in a uniform manner. Areas to be overseeded shall be fertilized at rates previously specified.

2405.3 Construction

- A. The seed-bed shall be free of any irregularities in the surface, and shall be corrected in order to prevent formation of water pockets.
- B. Seed shall be applied with a seed drill. The seed drill shall verticut the soil to a minimum depth of ½ inch at not more than 1½ inch spacing between furrows.
- C. Areas that have washed or eroded shall be brought to grade and compacted prior to overseeding.
- D. The seeded areas shall be inspected for acceptable grass coverage and will be acceptable when grasses designated are growing and are in good condition. Not more than ½ of one percent of the designated turf area shall be bare, of which no single area shall be more than one foot square in area. Any area left unseeded larger than this will not be acceptable, and be reseeded.

SECTION 2406 MEASUREMENTS AND PAYMENTS

2406.1 General

There will be no measurement or separate payment for any items of work not specifically identified and listed in the Contract Documents and all costs will be included in the Contract unit prices for other items listed in the Contract Documents.

2406.2 Methods of Measurement

The quantities of accepted work shall be measured or determined as follows:

- A. Seeding
 - 1. Seeding will be measured per acre or hundredth part thereof. Seeding will be measured complete, in-place, to the nearest acre. No measurement will be made in areas that are not grassed, such as street paving, driveways, parking areas, gardens, and sidewalks. Areas that are disturbed which lie outside the Contractor's seeding limits, as defined by the Plans or Contract Documents, will not be measured for payment, but shall be restored to a condition equal to or better than that existing prior to construction.
 - 2. Sanitary Sewer Project Construction: Seeding will be measured horizontally in linear feet along the centerline of sewer, regardless of the width of disturbed areas or type of seed used. Seeding will be measured only when centerline of sewer lies in grassed areas to be seeded as shown on the Plans. When centerline of sewer lies in areas that are not grassed, such as street paving, driveways,

parking areas, gardens, etc., no measurement will be made. Areas that are disturbed which lie outside the Contractor's normal trenching operation areas will not be measured for payment, but shall be restored to a condition equal to or better than that existing prior to construction. Each area measured will be measured either as seeding or sodding, but not as both. When sewer ends in grassed area, measurement will be made only to centerline of manhole.

3. Horizontal in linear feet along the back of curb (edge of pavement) regardless of the width of disturbed areas or type of seed used. Measurement will be made on each side of the roadway. No measurement will be made through or along intersecting roadways, drive approaches or similar structures.
4. No measurement in field, per Contract unit quantity only.

B. Sodding

1. Sodding will be measured per square yard or tenth part thereof. Sodding will be measured complete, in-place, to the nearest acre. No measurement will be made in areas that are not grassed, such as street paving, driveways, parking areas, gardens, and sidewalks. Areas that are disturbed which lie outside the Contractor's seeding limits, as defined by the Plans or Contract Documents, will not be measured for payment, but shall be restored to a condition equal to or better than that existing prior to construction.
2. Sanitary Sewer Project Construction: Sodding will be measured horizontally in linear feet along the centerline of sewer. Regardless of width of disturbed areas or type sod used. Sodding will be measured only when centerline of sewer lies in grassed areas to be seeded as shown on the Plans. When centerline of sewer lies in areas that are not grassed (such as street paving, driveways, parking areas, gardens, etc.) no measurement will be made. Areas that are disturbed which lie outside the Contractor's normal trenching operation areas will not be measured for payment, but shall be restored to a condition equal to or better than that existing prior to construction. Each area measured will be measured as either seeding or sodding, but not as both. When sewer ends in grassed area, measurement will be made only to centerline of manhole.
3. Horizontal in linear feet along the back of curb (edge of pavement) regardless of the width of disturbed areas or type of sod used. Measurement will be made on each side of the roadway. No measurement will be made through or along intersecting roadways, drive approaches or similar structures.
4. No measurement in field, per Contract unit quantity only.

2404.3 Basis of Payment

Payment for seeding and sodding will be paid for at the Contract Unit Prices as listed in the Unit Prices Bid Form. Such payment and price shall constitute full compensation for all labor, materials, tools and equipment necessary to complete the item.

The following items are considered subsidiary to the "Seeding" and "Sodding" pay items and no additional payment will be provided: Soil Preparation, Scalping of Existing Vegetation, Top Soil, Fertilizer, Mulch, Watering, Seed, Compaction, Maintenance, Protection and Repair, and Clean-up.

END OF SECTION

STORM SEWERS

SECTION 2600 - STORM SEWERS

CITY OF LEE'S SUMMIT, MISSOURI STANDARD SPECIFICATIONS

The City of Lee's Summit, Missouri's hereby adopts Section 2600 of the Kansas City Metropolitan Chapter of APWA Construction and Material Specifications, current edition. The following additions, deletions and/or revisions are adopted as a part of Section 2600 for use within Lee's Summit, Missouri.

2602.2 Materials

Delete Paragraph B and replace with the following:

Corrugated metal pipe shall not be used in the construction of public infrastructure. Storm drainage systems to remain privately owned and maintained may use corrugated Aluminized Steel Pipe

2602.2 Materials:

ADD the following

G. Polypropylene Pipe

- 1. Double wall polypropylene pipe shall have a smooth interior and annular exterior corrugations and conform to ASTM F2881 and AASHTO M330. Triple wall polypropylene pipe shall have smooth interior and exterior surfaces with inner corrugations and conform to ASTM F 2764. The pipe shall not be perforated unless otherwise specified.***
- 2. Pipe shall be joined with a gasketed integral bell and spigot joint meeting the requirements of ASTM F2881 for double wall pipe or ASTM F2764 for triple wall pipe.***
- 3. Coupling bands shall cover at least two full corrugations on each section of pipe and shall prevent the infiltration of soil into the pipe.***

2602.3 Construction:

2602.3.B.5.d Structure Connections – Laying and Jointing

REVISE to read as follows:

Pipes connected to structures shall be cut parallel with the inside face of the structure for structures having plane walls and parallel with the spring line of the pipe for structures having curved walls. Projection of the pipe beyond the inside face shall not exceed ***3 inches*** (measured at the springline for structures having curved walls). ***When installed, all gaps and openings intended to be closed, shall be sealed with grout, concrete or other approved material.***

2604.2 Materials (for storm sewer structures):

2604.2.A – Concrete Mixes

STORM SEWERS

REVISE to read as follows:

“Concrete for structures and structural components shall be KCMMB 4k or 5k mix; or MCIB 4,500 psi or 5,000 psi mix. Nominal aggregate shall be 1-inch or larger. Concrete used for soil stabilization, pipe cradles, filling, leveling courses and other similar purposes may use smaller nominal aggregate sizes of 1/2-inch, 3/4-inch.”

2604.2 F – Manhole Castings and Metal Castings:

ADD the following

3. Metal Castings shall be selected from the current City of Lee’s Summit Public Works Approved Products List.

2604.3 Construction (for storm sewer structures):

2604.3.A.2 Finishing:

ADD the following

c. If an adjustment is required for the top slab which is less than or equal to 6 inches, the adjustment shall be made with non-shrink grout with a coating of cement on both faces, if the adjustment is greater than 6 inches, the adjustment shall be made with dowelled concrete. Dowels shall be bars embedded 6 inches into the walls. All reinforcement shall be the same size and spacing as the wall steel.

ADD the following:

2604.3.D. Cast-in-Place Box Culvert Support Slab:

Cast in place box culverts shall have a 3 inch thick grade slab cast under the bottom slab. The grade slab shall be at least as wide as the structure and shall stop short of the toe walls. Commercial grade concrete may be used with minimum 2500 psi compressive strength. The slab should be set with proper grade control to match the elevations required for the culvert.

**DIVISION II
CONSTRUCTION AND MATERIAL SPECIFICATIONS
SECTION 2600 STORM SEWERS**

APPROVED AND ADOPTED THIS 15th DAY OF FEBRUARY, 2017
Last Revised March 3, 2020 (See underlined text, pg.16)

**KANSAS CITY METROPOLITAN CHAPTER
OF THE AMERICAN PUBLIC WORKS ASSOCIATION**

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SECTION 2601 GENERAL

2601.1 Scope

This section governs the furnishing all labor, materials, and equipment necessary for the complete installation of storm sewers and appurtenances as shown on the Plans and in accordance with the Standard Drawings, the specifications and the Special Provisions. Unless otherwise noted within these specifications, the word “sewers” shall refer to pipe sewers, box culvert sewers, or open channels.

2601.2 Referenced Standards

The following standards are referenced directly in this section. The latest version of these standards shall be used. If conflicting standards exist, the more stringent standard shall apply.

APWA

Section 2100	Grading and Site Preparation
Section 2150	Erosion and Sediment Control
Section 2200	Paving
Section 2300	Incidental Construction
Section 2400	Seeding and Sodding

ASTM

A 48	Standard Specification for Gray Iron Castings
A 139	Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)
A 153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A 240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
A 615	Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
A 641	Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
A 742	Standard Specification for Steel Sheet, Metallic Coated and Polymer Precoated for Corrugated Steel Pipe
A 744	Standard Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service
A 745	Standard Practice for Ultrasonic Examination of Austenitic Steel Forgings
A 760	Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
A 761	Standard Specification for Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches
A 788	Standard Specification for Steel Forgings, General Requirements
A 929	Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
A 1064	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
C 33	Standard Specification for Concrete Aggregates
C 76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
C 88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
C 361	Standard Specification for Reinforced Concrete Low-Head Pressure Pipe
C 443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
C 478	Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
C 506	Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
C 507	Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
C 923	Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals

- C 990 Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
- C 1628 Standard Specification for Joints for Concrete Gravity Flow Sewer Pipe, Using Rubber Gaskets
- D 1683 Standard Test Method for Failure in Sewn Seams of Woven Apparel Fabrics
- D 2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
- D 3350 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
- D 3887 Standard Specification for Tolerances for Knitted Fabrics
- D 5034 Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)
- F 593 Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
- F 594 Standard Specification for Stainless Steel Nuts
- F 2306 Standard Specification for 12 to 60 in. [300 to 1500 mm] Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications
- G 152 Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

AASHTO

- M 31 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- M 36 Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drain
- M 55 Standard Method of Test for Steel Welded Wire Reinforcement, Plain, for Concrete
- M 196 Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
- M 197 Standard Specification for Aluminum Alloy Sheet for Corrugated Aluminum Pipe
- M 245 Standard Specification for Corrugated Steel Pipe, Polymer-Precoated, for Sewers and Drains
- M 246 Standard Specification for Steel Sheet, Metallic-Coated and Polymer-Precoated, for Corrugated Steel Pipe
- M 274 Standard Specification for Steel Sheet, Aluminum-Coated (Type 2), for Corrugated Steel Pipe
- M 294 Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter

ANSI/AWWA

- C 206 Field Welding of Steel Water Pipe

- ACI 301 Specifications for Structural Concrete

Federal Standard 595B

- MCIB Mid-West Concrete Industry Board Concrete Specifications - Concrete Pavement
The current editions of the "Bulletins" and Approved Sections of the "Standard Concrete Specifications" issued by the Mid-West Concrete Industry Board, Inc. (MCIB) are made a part hereof by reference. However, when the provisions of this Specification differ from the provisions of such "Bulletins" and "Sections" the provisions of this Specification shall govern.

KCMMB Kansas City Metro Materials Board Specifications

Kansas Department of Transportation

Standard Specifications for State Road and Bridge Construction, 2015 Edition

Missouri Highways and Transportation Commission

Missouri Standard Specifications for Highway Construction, 2011 Edition

2601.3 Cleanup

Cleanup shall follow the work progressively. The Contractor shall remove from the project site all rubbish, equipment, tools, surplus or discarded materials, and temporary construction items.

Streets to be opened to local traffic at the end of the day's operation shall be cleaned of dirt or mud. All equipment and material stockpiles shall be secured for safe passage of vehicles and pedestrians. If streets are to remain open to traffic, cleaning shall be performed at a minimum of once per day at the end of the day's work or as directed by the Engineer or Owner.

Clean-up shall be considered subsidiary to other items in the Contract Documents.

SECTION 2602 PIPE SEWER CONSTRUCTION

2602.1 Scope

This section governs the furnishing of all labor, materials and equipment for the construction of pipe storm sewers and appurtenances at the location and to the lines and grades indicated on the Plans.

2602.2 Materials

A. Reinforced Concrete Pipe

1. Pipe: Reinforced concrete pipe shall conform to the following ASTM Standards and be of the minimum strength designated herein or such higher strength as may be required by the Plans:
 - a. Round Pipe: ASTM C 76, Class III (minimum), Wall B (minimum)
 - b. Arch Culvert Pipe: ASTM C 506, Class A-III
 - c. Elliptical Pipe: ASTM C 507, Class HE-III

Except for fittings and closure pieces, each joint of pipe shall not be less than eight feet long for pipe diameters 48 inches or less and shall not be less than six feet long for pipe diameters larger than 48 inches.

2. Reinforcement: Circumferential reinforcement shall be full-circle type. Part-circle reinforcement will not be approved. All reinforcing shall be located and spaced as recommended by the pipe manufacturer.
3. Joints
 - a. Rubber Gasket Joints: Rubber gasket joints shall conform to ASTM C 443 or ASTM C 1628-06 with the following additions and exceptions.
 - i. Replace ASTM C 1628-06 5.1.1 with: Circular Cross-Section or "O-Ring" Gaskets for standard use shall meet Class A requirements. Non-Circular Cross-Section or "Profile" Gaskets for standard use shall meet Class E requirements.
 - ii. Replace ASTM C 1628-06 9.4 with: The manufacturer shall conduct concurrently the hydrostatic test described in 9.2 and the structural test described in 9.3. If proven watertight under these combined conditions, hairline cracks that do not leak shall not be cause for rejection. A vacuum of the American Concrete Pipe Association, may be used in lieu of the hydrostatic test referenced above.
 - iii. Joint design details shall be submitted for approval together with design data and test results verifying the adequacy of the joint design.
 - b. Preformed Flexible Joint Sealant: This sealant shall be either rope form or flat tape form

conforming to ASTM C 990. Primer, if recommended by the manufacturer, shall be applied within the manufacturers' time requirements on all bell and spigot joint surfaces. Joint shall be thoroughly sealed and watertight.

B. Corrugated Metal Pipe (CMP): Pipe, coupling bands, and end section conform to the following requirements:

1. Material

- | | | |
|----|-------------------------|-------------------------|
| a. | Aluminized Steel Type 2 | AASHTO M274, ASTM A 929 |
| b. | Polymer-Coated Steel | AASHTO M246, ASTM A 742 |
| c. | Aluminum Alloy | AASHTO M197, ASTM B 744 |

2. Pipe

- | | | |
|----|--|-------------------------------------|
| a. | Steel (Aluminized Steel, Type 2, CSP and Spiral Rib) | AASHTO M36, ASTM A 760 |
| b. | Steel (Polymer-Coated, GSP, Spiral Rib, Smooth Interior CSP) | AASHTO M36, AASHTO M245, ASTM A 745 |
| c. | Aluminum (CMP, Spiral Rib) | AASHTO M196, ASTM A 788 |

Minimum wall thickness of the pipe shall be as follows:

Circular Culvert Pipe (2-2/3" x 1/2" Corrugations)					
Under Roadways or In Street Right-of-Ways		Under Railroads		Not Under Roadways	
Diameter	Minimum Thickness	Diameter	Minimum Thickness	Diameter	Minimum Thickness
12"-21"	.064"	12"-18"	.079"	12"-30"	.064"
24"-30"	.079"	21"-24"	.109"	36"-54"	.079"
36"-54"	.109"	30"-36"	.138"	60"-84"	.109"
60"-72"	.138"	42"-84"	.168"		
84"	.168"				

Circular Culvert Pipe (3" x 1" and 5" x 1" Corrugations)			
Under Roadways or In Street Right-of-Ways		Not Under Roadways	
Diameter	Minimum Thickness	Diameter	Minimum Thickness
36" – 54"	.079"	36" – 54"	.064"
60" – 84"	.109"	60" – 84"	.079"

Circular Culvert Pipe (3/4" x 3/4" x 7-1/2" Spiral Rib)			
Under Roadways or In Street Right-of-Ways		Not Under Roadways	
Diameter	Minimum Thickness	Diameter	Minimum Thickness
12" – 24"	.064"	12" – 42"	.064"
30" – 42"	.079"	48" – 60"	.079"
48" – 66"	.109"	66" – 84"	.109"
72" – 84"	.138"		

Arch Culvert Pipe (2-2/3" x 1/2" Corrugations)			
Under Roadways or In Street Right-of-Ways		Not Under Roadways	
Equivalent Diameter	Minimum Thickness	Span*	Rise*
15"	.064"	17"	13"
18"	.064"	21"	15"
21"	.064"	24"	18"
24"	.079"	28"	20"
30"	.079"	35"	24"
36"	.109"	42"	29"
42"	.109"	49"	33"
48"	.109"	57"	38"
54"	.109"	64"	43"
60"	.138"	71"	47"

* Subject to manufacturing tolerances.

Arch Culvert Pipe (3" x 1" Corrugations)			
Equivalent Diameter	Minimum Thickness	Span*	Rise*
36"	.064"	40"	31"
42"	.064"	46"	36"
48"	.064"	53"	41"
54"	.079"	60"	46"
60"	.079"	66"	51"
66"	.079"	73"	55"
72"	.079"	81"	59"
78"	.109"	87"	63"
84"	.109"	95"	67"
90"	.109"	103"	71"

* Subject to manufacturing tolerances.

Arch Culvert Pipe (3/4" x 3/4" x 7-1/2" Spiral Rib)			
Equivalent Diameter	Minimum Thickness	Span*	Rise*
18"	.064"	20"	16"
21"	.064"	23"	19"
24"	.064"	27"	21"
30"	.079"	33"	26"
36"	.079"	40"	31"
42"	.079"	46"	36"
48"	.109"	53"	41"
54"	.109"	60"	46"
60"	.109"	66"	51"
66"	.109"	73"	55"

* Subject to manufacturing tolerances.

3. Joints: Joints shall have a gasket and may be either bell and spigot joints or made with external coupling bands. The bands shall be drawn and secured on the pipe by connecting devices as furnished by the manufacturer. Pipe ends for annular corrugation shall be identical to the rest of the pipe barrel (plain ends), or in the case of helical pipe, the pipe ends at the joint shall be reformed to an annular corrugation and flange (reformed end). Gaskets shall be furnished in accordance with the Plans and Special Provisions. Coupling bands shall be reviewed and approved by the Engineer prior to installation.
- C. Structural Plate Pipe and Pipe Arches:** Structural plate and galvanizing shall conform to the requirements of ASTM A 761. Bolts, nuts, and washers for reconnecting plates shall be galvanized in accordance with ASTM A 153 and meet manufacturer's recommendations.
- D. High Density Polyethylene (HDPE) Pipe**
1. Material: Pipe manufactured for this specification shall comply with and be certified to meet the requirements for test methods, dimensions and markings found in ASTM F 2306 and AASHTO M-294, current additions. Pipe and blow molded fittings shall be made from PE compounds which conform to the requirements of cell class 435400C in the latest version of ASTM D3350.
 2. Pipe Sizes: Nominal sizes for this specification include 12-60 inch diameters designated in AASHTO M294 and ASTM F 2306 as full circular cross section with an outer corrugated pipe wall and essentially smooth inner wall (waterway). Pipe corrugations shall be annular.
 3. Joints: Joints shall have a gasket and may be either bell and spigot joints or made with external coupling bands. The fittings and couplings bands shall be fabricated from the same material as the pipe conforming to AASHTO M294. The coupling bands shall cover at least two full corrugations of each section of pipe and shall prevent infiltration of soil into the pipe. Gaskets shall be furnished in accordance with the Plans and Special Provisions. Coupling bands shall be reviewed and approved by the Engineer prior to installation.
 4. Certification: All high-density polyethylene (HDPE) pipe used for culvert and storm sewer applications shall conform to the requirements of AASHTO M294 and ASTM F 2306, current edition. Pipe shall be provided only by manufacturers that are certified through the National Transportation Product Evaluation Program (NTPEP) Third Party Certification program.

5. Pipe Usage: High density polyethylene pipe (HDPE) may not be used for crossroad applications of collector roadways or higher unless approved by the Engineer. If approved by the engineer, HDPE in accordance with ASTM F2648, latest version, may be used in lieu of ASTM F2306 and AASHTO M294 in drainage applications that are designated as private.

E. Dual Walled Polypropylene Pipe

1. For 12-inch to 60-inch pipe, polypropylene pipe shall have a double wall with a smooth interior and annular exterior corrugations and conform to ASTM F2881 and AASHTO M330. The pipe shall not be perforated unless otherwise specified.
2. For 12-inch to 60-inch pipe, pipe shall be joined with a gasketed integral bell and spigot joint meeting the requirements of ASTM F2881.
3. Coupling bands shall cover at least two full corrugations on each section of pipe and shall prevent the infiltration of soil into the pipe.
4. Certification: All polypropylene (PP) pipe used for culvert and storm sewer applications shall be provided only by manufacturers that are certified through the National Transportation Product Evaluation Program (NTPEP) Third Party Certification program.

F. Dual and Triple Walled Polypropylene Pipe

1. For 12-inch to 30-inch pipe, polypropylene pipe shall have a double wall with a smooth interior and annular exterior corrugations and conform to ASTM F2881 and AASHTO M330 Type S. For 36-inch and larger pipe sizes, polypropylene pipe shall have a triple wall with smooth interior and exterior surfaces with inner corrugations and conform to ASTM F 2764 and AASHTO M330 Type D. The pipe shall not be perforated unless otherwise specified.
2. For 12-inch to 30-inch pipe, pipe shall be joined with a gasketed integral bell and spigot joint meeting the requirements of ASTM F2881. For 36-inch and larger pipe, pipe shall be joined with a gasketed integral bell and spigot joint meeting the requirements of ASTM F2764.
3. Coupling bands shall cover at least two full corrugations on each section of pipe and shall prevent the infiltration of soil into the pipe.
4. Certification: All polypropylene (PP) pipe used for culvert and storm sewer applications shall be provided only by manufacturers that are certified through the National Transportation Product Evaluation Program (NTPEP) Third Party Certification program.

G. Granular Bedding Material: Refer to Section 2100 Clearing and Site Preparation.

H. Flowable Backfill (CLSM): Refer to Section 2100 Clearing and Site Preparation.

2602.3 Construction

A. Trench Excavation: Refer to Section 2100 Clearing and Site Preparation.

1. Unclassified Excavation: Refer to Section 2100 Clearing and Site Preparation.

2. Rock Excavation: Refer to Section 2100 Clearing and Site Preparation.
3. Earth Excavation: Refer to Section 2100 Clearing and Site Preparation.
4. De-watering: Refer to Section 2100 Clearing and Site Preparation.
5. Cribbing and Sheeting: Refer to Section 2100 Clearing and Site Preparation.
6. Unstable Foundation: Refer to Section 2100 Clearing and Site Preparation.
7. Protection of Property: The Contractor shall satisfactorily shore, support, and protect any and all structures and all pipes, sewers, drains, conduits, and other facilities, and shall be responsible for any damage resulting thereto. The Contractor shall not be entitled to any damages or extra pay on account of any postponement, interference, or delay caused by any such structures and facilities being on the line of work, whether or not they are shown on the Plans; specifically, but not limited to, damage due to delay in utility relocation.

B. Laying and Jointing

1. Handling and Protection: All pipe shall be protected during installation against shock and free fall, and be installed without cracking, chipping, breaking, bending, or damage to coating materials. Damaged pipe materials shall be replaced with new materials.
2. Grade Control: Maximum deviation from indicated alignment of any pipe after installation and backfilling shall not be greater than 0.1 foot. All pipe shall have a continuous slope free from depressions that will not drain. The Contractor shall establish such grade control devices as are necessary to maintain the above tolerances.
3. Laying: The laying of pipe in finished trenches shall commence at the lowest point, and pipe shall be installed with the bell end forward or upgrade. All pipe shall be laid with ends abutting and true to line and grade. Pipe laid shall be carefully centered to form a sewer with a uniform invert.
4. Bedding: Bedding shall be rodded, spaded, and consolidated as necessary to provide firm uniform support for the pipe, and not subject pipe to settlement or displacement.
5. Jointing: Preparatory to making filled, bonded, and watertight sealed pipe joints, all surfaces of the portions of the pipe to be jointed shall be clean and dry. Lubricants, primers, adhesives, and other substances that are used shall be compatible with the jointing material recommended or specified.

Other than for trimming sewer pipe to be flush with the inside walls of storm sewer structures, no pipes may be trimmed unless ordered by the Engineer.

Trenches shall be kept water-free and as dry as possible during bedding, laying, and jointing, and for as long a period as required to protect the pipe joints and concrete in structures.

As soon as possible after the joint is made, sufficient bedding material shall be placed alongside each side of the pipe to offset conditions that might tend to move the pipe off line and grade.

a. Concrete Pipe

- i. Plastic Joint Sealant: Plastic joint sealant shall be applied to the tongue and spigot prior to its insertion into the bell or groove. A sufficient amount of sealant shall be

- used to fill the annular joint space with some excess. Wipe the outside surface of the joint with additional material to assure a complete seal.
- ii. Flexible Gaskets: Flat gaskets may be cemented to the pipe tongue or spigot. O-ring gaskets shall be recessed in a groove on the pipe tongue or spigot and confined by the bell or groove after the joint is completed. Roll-on gaskets shall be placed around the tongue or spigot and rolled into position as the joint is assembled. Flat gaskets and O-ring gaskets shall be lubricated as recommended by the manufacturer.
 - a) Flat gasket: Flat flexible gaskets shall conform to ASTM C 443. If there is no recess provided for the gasket, the surface of the tongue shall be cleaned and rubber adhesive applied. Using quick-drying adhesive, gaskets may be applied ahead of the laying operation or in the plant.
 - b) O-ring gasket: O-ring or roll-on flexible gaskets shall conform to ASTM C 361, Section 4.10. The entire surface of the bell that comes in contact with the rubber gasket shall be well lubricated with a soap lubricant. The entire gasket shall be greased with soap. Only the soap lubricant supplied by the pipe manufacturer shall be used. Adhesive type cements shall not be used.
 - b. Corrugated Metal Pipe. Corrugated metal pipe joints shall have a gasket and may be either bell and spigot joints or made with external coupling bands. The bands shall be drawn and secured on the pipe by connecting devices as furnished by the manufacturer. Pipe ends for annular corrugation shall be identical to the rest of the pipe barrel (plain ends), or in the case of helical pipe, the pipe ends at the joint shall be reformed to an annular corrugation and flange (reformed end). Gaskets shall be furnished in accordance with the Plans and Special Provisions. Coupling bands shall be reviewed and approved by the Engineer prior to installation.
 - c. HDPE Pipe: HDPE pipe shall be assembled, installed, and backfilled in accordance with the manufacturer's instructions. Joints shall have a gasket and may be either bell and spigot joints or made with external coupling bands. The fittings and couplings bands shall be fabricated from the same material as the pipe conforming to AASHTO M294. The coupling bands shall cover at least two full corrugations of each section of pipe and shall prevent infiltration of soil into the pipe. Gaskets shall be furnished in accordance with the Plans and Special Provisions. Coupling bands shall be reviewed and approved by the Engineer prior to installation.
- During construction of the project in areas subjected to heavy construction equipment traffic, pipe sizes 12" - 42" shall have a minimum cover of 3 feet, and pipe sizes 48"- 120" shall have a minimum cover of 4 feet.
- d. Structure Connections: Pipes connected to structures shall be cut parallel with the inside face of the structure for structures having plane walls and parallel with the spring line of the pipe for structures having curved walls. Projection of the pipe beyond the inside face shall not exceed 1 inch (measured at the springline for structures having curved walls).

C. Backfill of Trenches

1. General: Refer to Section 2100 Clearing and Site Preparation.

SECTION 2603 BORING AND JACKING

2603.1 Scope

This section governs the furnishing of all labor, materials and equipment for the construction of steel casings, complete

with bulkheads and sand fill, by boring and/or jacking at the locations and to the lines and grades indicated on the Plans, or where constructed at the Contractor's option, when approved, to bypass obstructions without open cutting.

2603.2 Materials

A. Steel Casing

1. Steel casing for bored or jacked construction shall conform to ASTM A 139.
2. Steel shall be grade B under railroads and grade A for all other uses.
3. Minimum wall thickness for steel casing shall be in accordance with the following table:

<u>Diameter of Casing</u>	<u>Under Railroads</u>	<u>All Other Uses</u>
24"	0.406"	0.281"
26"	0.438"	0.281"
28"	0.469"	0.312"
32"	0.500"	0.312"
34"	0.500"	0.312"
36"	0.500"	0.344"

4. Casing joints shall be welded by a certified welder in accordance with ANSI/AWWA C206.

- B. End Seals: End seals shall be manufactured end seals, concrete plugs with allowances for water flow, or brick shall be in accordance with ASTM C 32, Grade SS or SM and mortar in accordance with ASTM C 270.
- C. Sand Fill: Sand fill shall comply with ASTM C 33 or MCIB Section 4, Fine Aggregate. Moisture content of the sand shall not exceed 0.5%.

2603.3 Construction Details

A. Boring and Jacking

1. Prior to starting work, complete details of the methods and the liner material to be used shall be submitted to the Engineer for approval.
2. The maximum allowable deviation from indicated alignment and grade shall be as follows except when altered by the Plans or Special Provisions:
 - a. Alignment..... 1.0%
 - b. Grade 1.0%

B. Casing Installation

1. The steel casing shall be advanced in a continuous operation without interruption. Sections of the casing pipe shall be welded together to form a continuous conduit capable of resisting all stresses including jacking stresses. The casing in its final position shall be within alignment and grade tolerances specified in Section 2603.3.A.2. There shall be no space between the earth and the outside of the casing. Any voids which do occur shall be filled by pressure grouting.

2. Boring operations shall be performed by experienced crews using a rotary type boring machine designed especially for this purpose. Boring shall be performed in a manner to prevent disturbing the overlying and adjacent materials.
3. Jacking
 - a. Jacking frame, guides, blocking, head, and reaction devices shall be arranged to apply uniform pressure about the casing circumference without damage to the casing material, and to maintain alignment within specified tolerances.
 - b. Jacking reaction device shall provide adequate resistance to withstand 200 percent of the maximum jacking pressure.
 - c. Provide jacks of adequate number and size for the required jacking pressure; but not less than two jacks.
 - d. Maintain jacking pit and pipe installation in such condition that drainage does not accumulate. Control and disposition of surface and subsurface water at the site of jacking operations shall be the Contractor's responsibility.
 - e. Excavation at the heading shall not be extended more than 1 inch outside the top and sides (upper 300-degree sector) of the casing and shall be true to grade at the invert (lower 60-degree sector).
 - f. Once jacking begins, it shall proceed without interruption until installation of the entire length of the jacked casing is complete.
4. Excavation in Jacked Casings: Perform excavation within jacked casings by hand or machine methods as necessary to remove the materials encountered without disturbing the overlying material. The jacked casing shall be advanced a sufficient distance ahead of the excavation face and/or shield used as necessary to protect the workman and the work, and to prevent the uncontrolled entry of unstable materials into the casing.
5. Unstable Materials: If materials are encountered during casing installation that cannot be excavated safely or without creating voids around the exterior of the casing, the Contractor shall discontinue casing installation and stabilize such materials by dewatering, chemical soil stabilization, grouting, or other methods, and/or modify equipment and procedures as necessary to complete the casing installation.

C. Sewer Pipe Installation

1. Pipe shall be placed inside the casing to the indicated line and grade by the use of wood skids or other equivalent methods. The wood shall be pressure-treated with a preservative in accordance with ASTM D 1760. Cut surfaces shall be given 2 heavy brush coats of the same preservative. The wood skids shall be securely fastened to the sewer pipe with steel straps.
2. End seals shall be constructed after the sewer pipe is installed and approved.
3. The annular space between the casing and sewer pipe shall be filled with sand blown in so that all space is filled without disturbing the alignment and grade of the sewer pipe. Flowable Backfill (CLSM) meeting Section 2102.2.E, may be substituted in lieu of sand fill. Alternative methods may be submitted for approval by the Engineer.

SECTION 2604 STRUCTURES

2604.1 Scope

This section governs the furnishing of all labor, materials and equipment for the performance of all work necessary for construction of cast-in-place and precast concrete structures for inlets, manholes, junction boxes, box culverts, headwalls, and incidental structures.

Masonry or brick structures shall not be allowed under these Specifications.

2604.2 Materials

- A.** Concrete Mixes: Concrete shall be MCIB Mix Number A 558-1-2-0.421 or KCMMB 4K, unless otherwise specified.
- B.** Concrete Materials
 - 1. For KCMMB mixes, concrete shall be an approved mix with admixtures that are approved for use in that mix design.
 - 2. For MCIB mixes:
 - a. Air-entraining admixtures shall provide an air content within the range of 4 1/2 to 7 1/2 percent by volume as measured by the pressure method (ASTM C 231). The air entraining admixtures shall meet the requirements of ASTM C 260.
 - b. Portland Cement: Portland cement shall conform to ASTM C 150 Type I. Where high early strength is desired, Type III can be used.
 - c. Fine Aggregate: Fine aggregate shall be clean, natural sand meeting the requirements of ASTM C 33. Grading shall be within the limits as set forth by MCIB.
 - d. Coarse Aggregate: Coarse aggregate shall be limestone meeting the requirements of ASTM C 33. The sum total of all deleterious material shall not exceed the requirements of ASTM C 33.
 - 3. Water: Water shall be clean and free from deleterious substances. Only potable water will be acceptable without testing.
- C.** Reinforcing Steel: Reinforcing bars shall conform to ASTM A 615 or AASHTO M 31, Grade 60. Welded steel wire fabric shall conform to ASTM A 1064 or AASHTO M 55.
- D.** Precast Concrete Structures
 - 1. Manholes: Precast manholes shall conform to ASTM C 478.
 - 2. End Sections for Concrete Pipe: Shall be flared end sections of the pipe manufacturer's standard design, and shall meet all applicable requirements of ASTM C 76 for Class II or higher classes of pipe.
 - 3. Rectangular Structures: Shall conform to the inside dimension indicated on the Plans and be designed for the following loads:
 - a. HS-20 live load for all structures in/or under pavement, shoulders, driveways, and other traffic areas.
 - b. 2,000-lb wheel live load for curb opening inlets and junction boxes in non-traffic areas.
 - c. 50 pcf equivalent fluid pressure for soil pressure on vertical walls.
 - d. 120 pcf for unit weight of soil cover on top slabs.

4. Joints: Joints between concrete structures shall be filled with plastic joint compound or preformed plastic compound as stated herein.
- a. Barrel Sections: Minimum cross sectional area of preformed compound between concrete barrel sections shall be 1 inch square or 1.25 inches diameter. Minimum cross-sectional area of the preformed compound between the concrete adjustment ring and cone barrel section shall be two beads of either 1 inch square or 1.25 inches in diameter.
 - b. Manhole Adjustment Rings: Rings shall be constructed of concrete, HDPE, or recycled rubber.

If HDPE adjustment rings are used, they shall be injection molded-recycled HDPE - as manufactured by LADTECH, Inc. or approved equal. They shall be bolted to the structure top section and otherwise installed as per manufacture's recommendations.

If recycled rubber adjustment rings are used, they shall consist of no less than 80%, by weight, recycled rubber and no less than 10% by volume shredded fiber as manufactured by GNR Technologies or approved equal. They shall be installed as per manufacturer's recommendations.

The top and bottom of all adjustment rings shall be sealed using a mastic filler meeting the requirements of 2503.D.6 or an epoxy paste. The epoxy paste shall be a two component, moisture insensitive, containing no solvents, and capable of bonding with all materials it is to be used on, like Epoxytex Micor C.P.P or approved equal. Minimum cross-sectional area of preformed compound between concrete adjustment rings shall be two beads of either 1 inch square or 1.25 inches in diameter.

- c. Manhole Ring and Covers: Minimum cross-sectional area of preformed compound between the concrete adjustment ring and the manhole casting shall be two beads of either 1 inch square or 1.25 inches in diameter.
- d. External Manhole Chimney Frame Seal: External frame seal shall consist of a flexible rubber sleeve, interlocking adjustment extension(s), and stainless steel compression bands. The flexible rubber sleeve and extension shall be extruded or molded from a high grade rubber compound conforming to the applicable requirements of ASTM C 923 with a minimum tensile strength of 1500 psi and minimum elongation at break of 350%. At a minimum, the compression bands shall be 16-gauge stainless steel conforming to ASTM A 240, Type 304, with a minimum width of one inch. Screws, nuts, and bolts shall be stainless steel conforming to ASTM F 593 and 594, Type 304. The compression bands shall have the capacity to tighten with enough pressure to make a watertight seal around the rubber chimney sleeve.

E. Air Entrainment: All concrete shall be air entrained. Minimum strength requirements shall be as specified in Section 2604.2.A. Concrete Mixes.

F. Manhole Castings

- 1. Rings and Covers: Castings shall be gray iron conforming to ASTM A 48, Class 35B. Castings of rings and covers shall be of the shape, dimension, minimum weight, and type as indicated on Plans or Standard Drawings and be free from manufacturing defects. All curb inlet castings shall have cam locks or approved equal. If requested by special order, castings shall be cleaned and painted with one coat of tar prior to delivery. Bearing surfaces between all rings and covers for installation in all areas

shall be machined to provide even seating and interchangeability of like pieces.

All manhole rings and covers placed in paved areas shall be rated for H20 traffic. Cam lock covers or similar shall not be placed in roadway pavement unless shown on the Plans or directed by the Engineer. All covers shall have provisions for opening, such as concealed pick holes.

2. Steps: All steps shall comply with Section 2509.3.G.2.b. Cast iron steps shall not be used.
- G. Steel End Sections: Steel end sections shall be fabricated from aluminized base metal as specified in Section 2602, and shall be flared end sections of the metal pipe manufacturer's standard design. End sections shall be furnished with a steel toe plate. Bituminous coating is not required.
- H. Toe Walls: Flared end sections for concrete and steel pipe shall be set on a concrete toe wall centered on the end of the section. Toe walls shall be 8 inches thick by 24 inches deep by the width of the end section.

2604.3 Construction

- A. Concrete Structures: Concrete construction shall conform to the current ACI 301 Specifications for Structural Concrete.
 1. Precast Structures: The Contractor may, at his option, construct precast concrete inlets, junction boxes, and box culverts, in lieu of the cast-in-place structures indicated on the Plans; except that all concrete base slabs for pre-cast inlets, manholes, and junction boxes may be cast-in-place. Solid concrete brick or block shall be used to block inlets and similar structures to grade during placement of base slab concrete.

Precast concrete box culvert sections shall be installed on a 4-inch leveling course of untreated compacted aggregate conforming to Section 2200 Paving. Leveling courses shall extend 1 foot past the line of the box section, and be finished to a true plane surface to provide uniform bearing for the precast section.

Any adjustments required for precast structures to meet field conditions shall be at the cost of the Contractor.
 2. Finishing: Exposed edges of all slabs, walls, and other concrete structures shall be beveled 3/4" or edged with a 1-1/4" radial tool.
 - a. Formed Surfaces: Immediately following removal of the forms, fins and irregular projections shall be removed. Form tie connections, holes, honeycomb spots, and other defects shall be chipped to ensure the voided area is exposed, and shall be chipped back to solid material. These areas shall be thoroughly cleaned, saturated with water, and painted with a grout approved by the Engineer. The repaired surfaces shall be cured in accordance with these specifications.
 - b. Exposed Slabs: Finish for exposed slabs shall be wood float texture. Exposed edges shall be beveled or edged with a radial tool.
 3. Form Removal: Forms shall remain in place until the concrete has attained sufficient strength to support loads imposed by backfilling, construction, and traffic. Within 24 hours of form removal, small holes and pockmarks of exposed walls shall be filled with Portland cement grout and rubbed smooth. Concrete voids and honeycombs shall be chipped open with a light hammer to expose weak areas for

inspection. At the direction of the Engineer, expansive repair grout shall be used for partial reconstruction of otherwise sound structures.

- a. Walls: Forms shall remain in place for a minimum of 5 days or until the concrete reaches a minimum strength of 2000 psi.
 - b. Slabs: Form shall remain in place for a minimum of 7 days or until the concrete reaches a minimum strength of 3000 psi.
4. Manhole Riser Adjustments: Manhole rings and covers shall be adjusted to match the slope and height, or grade, of pavements. In no case shall the surface pitch of the manhole ring and cover mismatch the pavement slope by more than 1/2 inch. The difference in height between the top of manhole cover and the top of precast cone shall not exceed 24 inches.

In lieu of replacing concrete adjustment rings that are properly seated and structurally sound but have a small fracture, an external rubber chimney may be fitted to secure a watertight seal between the casting (manhole ring and cover) and the concrete cone barrel section.

- B.** Invert Channels: Form concrete invert channels in manholes, inlets, and junction boxes to make changes in direction of flow with smooth curves of as large a radius as permitted by the inside dimension of the structure.

Grade changes and transitions shall be smooth and uniform, and all parts of the invert channel and adjacent floor shall slope to drain. Channel bottom shall be finished smooth without roughness or irregularity. Invert channels for precast concrete structures may be cast integrally with the structure base slabs at the Contractor's option.

- C.** Excavation and Backfill: Refer to Section 2100 "Clearing and Site Preparation".

SECTION 2605 OPEN CHANNELS

2605.1 Scope

This section governs the furnishing of all labor, materials and equipment for the construction of open channel lining at the location, and to the lines, grades, and dimensions indicated on the Plans. Grading shall have been previously completed in accordance with Section 2100 Grading and Site Preparation.

2605.2 Materials

- A.** Concrete Materials: Concrete shall be in accordance with 2604.2.B, unless otherwise specified. Reinforcing steel shall conform to ASTM A 615 or AASHTO M 31, Grade 60. Welded steel wire fabric shall conform to ASTM A 1064 or AASHTO M 55.
- B.** Stone: Stone for riprap, and gabion linings shall consist of quarried rock and be sound, durable, and angular in shape. No more than 10 percent shall have an elongation greater than 3:1, and no stone shall have an elongation greater than 4: 1. Material shall be free from cracks, seams, or other defects. Shale and stone with shale seams are not acceptable.
1. The minimum unit weight of the stone shall be 155 pounds per cubic foot as computed by multiplying the specific gravity times 62.4 pounds per cubic foot.
 2. Not more than 10 percent of the stone shall exhibit splitting, crumbling, or spalling when subject to 5

cycles of the sodium sulfate soundness test in accordance with ASTM C 88.

3. Riprap: Riprap shall have a minimum thickness of 15 inches, or 1.5 times as thick as the larger stones, whichever is greater.

The gradation for RipRap (Light Stone) shall be as follows:

Weight of Stone <u>In Lbs.</u>	Percent Passing <u>by Weight</u>
250	100 (minimum)
100	50 (maximum)
75	70 (maximum)
5	<u>10</u> (maximum)

The gradation for RipRap (Heavy Stone) shall be as follows:

Weight of Stone <u>In Lbs.</u>	Percent Passing <u>by Weight</u>
1,000	100 (minimum)
500	50 (maximum)
75	<u>10</u> (maximum)

The Contractor shall provide certification that the material meets the specified gradations.

4. Gabion Fill Stone: Stone shall be of the following gradations:

U.S. Standard Square <u>Mesh Sieve</u>	Percent Passing <u>by Weight</u>
10"	100
8"	85 - 100
6"	0 - 15
4"	0 - 10
3"	0

Stone shall be graded within the above limits as required to provide a unit weight in-place of 100 pounds per cubic foot or greater.

The Contractor shall provide certification that the material meets the specified gradations.

C. Filter Blanket: Filter blanket may be either of the following types at the Contractor's option:

1. Granular Filter: Granular filter material shall consist of sound, durable rock particles conforming to the following gradation:

<u>Sieve Size</u>	<u>Cumulative Percent Passing By Weight</u>
1"	100
1/2"	70 - 100
No. 4	50 - 85
No. 10	35 - 70
No. 40	20 - 50
No. 100	15 - 40

The Contractor shall provide certification that the material meets the specified gradations.

2. Filter Fabric: Filter fabric shall consist of woven or nonwoven fabric. The synthetic fiber of either the woven or nonwoven fabric shall consist of polypropylene, nylon, or polyester filaments. The percent open area shall be not less than 4 percent nor more than 10 percent. The cloth shall provide an Equivalent Opening Size (EOS) no finer than the U.S. Standard Sieve No. 100. In addition, filter fabric shall meet the following physical requirements:
 - a. Tensile Strength: Minimum grab tensile strength, both warpwise and fillingwise, shall be 200 pounds when tested in accordance with ASTM D 5034, using a 4-inch by 6-inch specimen and a jaw speed of 12 inches per minute.
 - b. Elongation: Grab elongation shall be not less than 15 percent nor more than 60 percent, both warpwise and fillingwise, when tested in accordance with ASTM D 5034.
 - c. Tear Strength: Minimum trapezoid tear strength shall be 100 pounds, both warpwise and fillingwise. Method of test for woven fabrics shall be in accordance with ASTM D 1117.
 - d. Bursting Strength: Minimum bursting strength shall be 400 psi when tested in accordance with ASTM D 3887.
 - e. Seam Strength: Woven fabric shall have a minimum seam-breaking strength of 180 pounds when tested in accordance with ASTM D 1683, using a jaw speed of 12 inches per minute.
 - f. Width: Filter fabric shall be furnished in widths of not less than 6 feet.
- D. Gabion Baskets:** Baskets shall be of the dimensions indicated on the drawings and be fabricated using hexagonal triple-twist wire mesh.
1. Wire: Wire shall be galvanized steel having a minimum tensile strength of 60,000 psi, and shall be zinc coated in accordance with ASTM A 641 Class 3.
 2. Wire Mesh: Maximum dimension of the mesh opening shall be 4-1/2 inches or less, and the maximum area of the mesh opening shall not exceed 12 square inches. Wire shall be 0.120-inch (minimum) diameter.
 3. Selvedge Wire: Selvedge wire shall be 0.1535-inch (minimum) diameter. All perimeter edges of the mesh forming the gabion shall be securely selvedged so that joints formed by tying the selvedges have a strength equal to or greater than the body of the basket.
 4. Lacing and Stay Wire: Wire shall be 0.0866-inch diameter or larger. Other connection methods, such as stainless steel clips, may be substituted with approval of the Engineer.
 5. Diaphragms: Gabions shall be divided into cells not greater than 4 feet in width by wire mesh diaphragms. Diaphragms shall be factory secured to the base of the basket by continuous spiral wire.
 6. PVC (Polyvinyl Chloride) Coating: Where specified in the Plans, all wire used in the fabrication of the baskets and in the wiring operations during construction shall, after zinc coating, have an extruded coating of PVC. The coating shall be gray in color ranging between series 26187 and 26293 or between series 26373 and 26375, semi-gloss, as per Federal Standard 595B. The PVC coating shall be a nominal thickness of 0.02165 inches and shall nowhere be less than 0.015 inches in thickness. The coating shall be resistant to the destructive effects of immersion in acidic, salt or polluted water, exposure to ultraviolet light, and abrasion and shall retain these characteristics after a period of not less than 3,000 hours under test in accordance with ASTM G 23.

- E. Sod: Sod shall conform to the requirements of Section 2400 Seeding, Sodding and Overseeding.
- F. Seed: Seeding shall conform to the requirements of Section 2400 Seeding, Sodding and Overseeding.

2605.3 Construction

- A. Foundation Preparation: After completion of grading in accordance with Section 2100, the area to receive channel lining shall be trimmed and dressed to conform to the cross sections indicated on the Plans within a tolerance of plus or minus 1 inch from the theoretical slope lines and grades. All deleterious materials shall be removed from the foundation area.
- B. Concrete Lining
 - 1. Preparation: Subgrade shall be moistened by sprinkling. Forms shall be securely staked, braced, and set to line and grade. Reinforcement and tie bars shall be held in position by bar chairs, concrete brick, or other approved devices.
 - 2. Placing and Finishing: Place, consolidate, and strike off concrete to the thickness indicated on the drawings. Concrete shall be tamped or vibrated to eliminate all voids and bring sufficient mortar to the top for finishing. Surface finish shall be a wood-float finish. Round all edges and joints with a 1/4 inch radius edging tool, except contraction joints may be sawed to a depth of 30 percent of the thickness of the concrete lining after concrete has hardened but before uncontrolled cracking occurs. Apply curing membrane as specified in Section 2000 "Paving".
- C. Filter Blanket
 - 1. Granular Filter: Place granular filter to its full thickness in a single operation. Construction methods shall be such that the material is placed without segregation. Compaction of granular filter material is not required.
 - 2. Filter Fabric: Place filter fabric with its long dimension horizontal and lay free of tension, stress, folds, wrinkles, or creases.
 - a. Place to provide 18 inches minimum overlap at each joint and anchor to prevent dislocation during construction of overlaying material.
 - b. Fabric shall not be left exposed more than two weeks prior to placement of overlaying material. Tracked or wheeled equipment or vehicles shall not be operated on the fabric.
- D. Riprap Placement: Riprap shall be placed on the prepared foundation in a manner which will provide a reasonably well-graded mass of stone with the minimum practicable percentage of voids. The entire mass of stone shall be placed so as to be in conformance with the lines, grades, and thicknesses indicated. A filter blanket of filter fabric conforming to Section 2605.2.C.2 shall be constructed under all riprap. Riprap shall be placed to full-course thickness in one operation and in such a manner as to avoid displacing the fabric. The Contractor shall place the riprap in such a way as to not tear, puncture, or shift the fabric. Riprap shall not be dropped more than 3 feet when being placed directly on the fabric. Tears or rips in the fabric shall be repaired with fabric lapped a minimum of 12 inches in all directions.
 - 1. Placing: Placing of riprap in layers, or by dumping into chutes, or by similar methods likely to cause segregation will not be permitted.

2. Distributing: The larger stones shall be well distributed and the entire mass of stone shall conform to the specified gradation. All material shall be so placed and distributed that there will be no objectionable accumulations of either the larger or smaller sizes of stone.
3. Hand Placing: It is the intent of these specifications to produce a fairly compact riprap protection in which all sizes of material are placed in their proper proportions. Hand placing or rearranging of individual stones by mechanical equipment may be required to the extent necessary to secure the specified results.

E. Gabion Baskets

1. Assembly: Assemble each gabion unit by binding all vertical edges together with a continuous piece of connecting wire stitched around the vertical edge with coils spaced at 3 inches or less. Set empty units to line and grade and join units by stitching with connecting wire along adjoining edges. Install and securely fasten internal tie wires in each cell if necessary to retain the shape of the cell during filling operations.
2. Filling: Fill gabion cells with stone carefully by hand or machine to provide a minimum of voids and avoid bulges and distortions of the gabion. After filling, secure the lid to the sides, ends, and diaphragm by stitching with connecting wire.
3. Filter Fabric/Gabion Unit Placement: A filter blanket of filter fabric conforming to Section 2605.2.C.2 shall be constructed under all Gabion Baskets. The Contractor shall place the gabions in such a way as to avoid tearing, puncturing, or shifting the fabric. Tears or rips in the fabric shall be repaired with fabric lapped a minimum of 12 inches in all directions.

- F. Sod:** Sod shall be installed as specified in Section 2400 Seeding, Sodding and Overseeding, except all sod placed in drainage channels or ditches, including both the side slopes and bottom, shall be anchored in accordance with 2204.3.D.

SECTION 2606 MEASUREMENT AND PAYMENT

2606.1 Measurement

The quantities of accepted work will be measured in the following units. All measurements will be plan measure except for authorized changes.

- A. Pipe:** By the linear foot of each size and type. Measurement will be to the nearest 0.1 foot for each line between structures, and made to the inside face of the connecting structure. Precast or prefabricated end sections will be excluded from the pipe measurement. Excavation, bedding, and backfill shall be included in the cost per linear foot of pipe per each size and type.
- B. Prefabricated or Precast End Sections:** By the number of each size and type.
- C. Concrete Box Culverts:** By the linear foot of each size and type. Measurement will be along the center line of the culvert between the back faces of the headwalls. Headwalls will be measured separately as "Structures".
- D. Structures:** Inlets, manholes, headwalls, endwalls, curb inlets, field inlets, and other similar structures will be measured by the number of each size and type as listed in the Contract Documents.
- E. Casings:** Casings for pipe installation by boring and/or jacking methods will be measured by the linear foot of

each size and type.

- F. Pipe Encasement: Pipe encasement will be measured by the linear foot of each size and type.
- G. Concrete Channel Lining: By the square yards of surface area. Measurement will be parallel to sloping surfaces.
- H. Filter Blanket: Unless otherwise stated in the Agreement, there will be no separate measurement or payment for filter blanket. All costs for such work shall be included in the price of the related item.
- I. Riprap: By the square yard of surface area per each size and depth as specified on the Plans or Standard Drawings. Measurement will be parallel to sloping surfaces. The thickness of the riprap shall conform to the plan dimension. Measurement and payment of the filter fabric shall be included in the cost per square yard of the riprap.
- J. Gabion Baskets: By the cubic yard on the basis of Plan dimensions.
- K. Sodding: Measurement shall be per square yard. Areas that are disturbed which lie outside the construction limits, as defined by the Plans, will not be measured for payment, but shall be restored to a condition equal to or better than that existing prior to construction. For lined (riprap or concrete) channels, sod placement and/or repairs shall be incidental to the cost of placement of the lining material.
- L. Seeding: Measurement shall be per square yard. Areas that are disturbed which lie outside the construction limits, as defined by the Plans, will not be measured for payment, but shall be restored to a condition equal to or better than that existing prior to construction. For lined (riprap or concrete) channels, sod placement and/or repairs shall be incidental to the cost of placement of the lining material.

2606.2 Payment

Payment will be made at the respective unit or lump sum price listed in the Contract Documents, and shall be full compensation for all labor, materials, and equipment necessary to complete the respective unit in place. There will be no separate measurement or payment for any item of work not specifically identified and listed in the Contract Documents, and all such work shall be considered a subsidiary item with all costs pertaining thereto included in the prices for other items listed in the Contract Documents. At the Engineer's option, partial payment may be made for any item listed in the Contract Documents, providing that the Contractor is diligently and satisfactorily pursuing full completion of such partially complete item in accordance with the approved progress schedule.

END OF SECTION

SECTION 2700 – STRUCTURES

CITY OF LEE’S SUMMIT, MISSOURI STANDARD SPECIFICATIONS

The City of Lee’s Summit hereby adopts Section 2700 of the Kansas City Metropolitan Chapter of APWA Construction and Material Specifications, current edition.

DIVISION II
CONSTRUCTION AND MATERIAL SPECIFICATIONS SEWERS
SECTION 2700 – STRUCTURES

APPROVED AND ADOPTED THIS 15th DAY OF FEBRUARY, 2017

KANSAS CITY METROPOLITAN CHAPTER
OF THE AMERICAN PUBLIC WORKS ASSOCIATION

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SECTION 2701 GENERAL

2701.1 Scope

This section governs the furnishing of all labor, materials, and equipment for the construction of bridges, reinforced box culverts, retaining walls, and other miscellaneous structures as shown on the Plans and in accordance with the Standard Drawings, the specifications, and the Special Provisions.

2701.2 General

The purpose of these specifications is to provide uniformity in the Metropolitan Kansas City Area for the public works structures which are designed and constructed for the many separate municipal and county jurisdictions included therein.

SECTION 2702 SPECIFICATIONS

Procedural and administrative items covered in the Contract Documents shall supersede such items covered in the specifications referenced below unless specifically noted.

2702.1 Jurisdiction in Kansas

For jurisdictions in Kansas, the current edition of the Standard Specifications for State Road and Bridge Construction, State Highway Commission of Kansas and latest version of Special Provisions shall apply. This specification is available from:

Kansas Department of Transportation
Bureau of Fiscal Services
Docking State Office Building
7th Floor
Topeka, Kansas 66612
(913) 296-3545

2702.2 Jurisdiction in Missouri

For jurisdictions in Missouri, the current edition of the Missouri Standard Specifications for Highway Construction, Missouri Highway and Transportation Commission and latest version of Job Special Provisions shall apply. This specification is available from:

Division Engineer
Surveys and Plans
Missouri Department of Transportation
P.O. Box 270
Jefferson City, Missouri 65102
(314) 751-2551

END OF SECTION

SECTION 2800 – STREET LIGHTING

CITY OF LEES SUMMIT, MISSOURI STANDARD SPECIFICATIONS

The City of Lee’s Summit hereby replaces Section 2800 of the Kansas City Metropolitan Chapter of APWA Construction and Material Specifications with the City of Lee’s Summit Design and Construction Manual Section 2800.

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STREET LIGHTING

2801 GENERAL

2801.1 Scope

This work shall consist of furnishing of all material, equipment, and labor for the installation and testing of a complete, operational street lighting system.

2801.2 Codes and Standards

All work and material shall be in accordance with the latest requirements of the Illuminating Engineering Society of North America (IESNA), National Electrical Code (NEC), National Electrical Safety Code (NESC), Standards of the American Society of Testing Materials (ASTM), American Standards Associations (ASA), National Electrical Manufacturers Association (NEMA), and all applicable local ordinances. The standard referred to shall be the latest revision of said standard as amended at the time of the Advertisement, except as noted on the Plans or in the Project Special Provisions.

2801.3 Modification of Specifications

These Specifications may be modified or deleted by appropriate items in the Project Special Provisions or by written authorization by the City Engineer.

2801.4 Appurtenances

All appurtenances shall be installed as shown on the Plans, or as specified in the Project Special Provisions. Any deviations must be established by the Contractor and authorized by the City Engineer.

2801.5 Incidental Work and Parts

Work incidental to the installation of a street lighting system that is not covered in these Specifications shall be performed in accordance with the City of Lee's Summit specifications and standards. All incidental parts, which are not shown on the Plans or specified in the Specifications and which are necessary to complete the street lighting system, shall be supplied and installed by the Contractor to the satisfaction of the City Engineer. No additional payments will be made for incidental work or parts.

2801.6 Existing Lighting

Existing lighting shall be maintained in effective operation by the Contractor except for shutdowns with approval from the City Engineer for alterations or final removal. The Contractor shall take all precautions necessary to minimize the downtime of the existing street lighting systems to be modified.

2801.7 Permits and Inspections

The Contractor shall contact the Public Works Department before any project work begins to notify the City Engineer of the construction schedule and to request project inspections. The Contractor is responsible for obtaining all necessary permits from the City, and is responsible for all associated costs, before any work can begin.

2801.7.1 Owner's Building Permit

The Contractor is responsible for obtaining the owner's building permit from the City's Codes Administration Department before electrical service can be delivered to a power supply. The Contractor shall contact the City's Codes Administration Division for an electrical inspection when each power supply is ready for operation. The Inspector will obtain an address for each power supply, which the Contractor shall use when dealing with the electrical utility company.

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2801.8 Electrical Service

The Contractor is responsible for contacting the electrical utility company in advance to schedule delivery of service to each power supply. The City shall pay the electrical utility company's fees to deliver electrical service. The Contractor shall be billed for all electrical utility service charges until the entire project is substantially complete and the burn test is successfully completed. After those milestones the electrical service can be transferred to the City.

2801.9 Maintenance Work

The Contractor is responsible for making all repairs and replacements, including downed poles, damaged or cut cables, and burnt out lamps, to the street light system, regardless of the cause or responsible party, until the work is determined by the City to be substantially complete.

2802 MATERIALS AND EQUIPMENT

2802.1 Scope

This section governs the furnishing of all luminaires, poles, conduits, cables, and other material and equipment supplied by the Contractor, as required, to complete the street lighting system as shown on the Plans, the Standard Drawings, and as specified in the Project Special Provisions. All lighting equipment shall be of new stock unless the contract provides for relocation of existing units or use of units furnished by others. New equipment and material shall be of the best grade, and shall meet the approval of the City Engineer.

2802.2 Street Light Poles

The type of pole and length of bracket arm shall be as specified on the Plans. This specification is in addition to the City of Lee's Summit "Pole and Luminaire Details" Standard Drawing, which describes the Specifications and pertinent design details. It is the responsibility of the fabricator to verify and attest that the material sizes proposed are structurally adequate and in full compliance with this specification and Standard Drawings.

The aluminum street light pole shaft assembly shall be spun from one piece of seamless tubing, and after fabrication it shall have mechanical strength of not less than T6 temper. The cross section of the pole shall be round, and the shaft shall be fabricated in a continuous true taper from at least 6" above the hand hole to the top of the shaft. The shaft shall have a vibration damper bolted to the inside of the shaft, except for the 14-foot poles. The shaft shall have no longitudinal or circumferential welds, except at the lower end, joining the shaft to the shoe base. The shaft shall have a factory applied protective paper wrapper conforming to the manufacturer's standard practice to protect the shaft during shipping. For all poles except the 14-foot poles, the top of the shaft shall be equipped with a cast aluminum removable pole cap held securely in place by means of set screws. All 14-foot poles shall have a 3" O.D. slipfitter end, without a tenon, for mounting the post-top luminaire.

Pole dimensions shall be as specified on the Standard Drawings. It is the responsibility of the fabricator to verify and attest that the material sizes proposed are structurally adequate and in full compliance with this specification and the pole detail drawing.

The aluminum shoe base shall be a permanent mold casting. The base shall be free of cracks, pits, and blow holes and of sufficient size and strength to withstand full design loads. The base shall telescope the shaft; and one weld shall be on the inside of the base at the end of the shaft while the other weld shall be on the outside at the top of the base. The shoe base and the two (2) welds shall develop the full strength of the pole assembly. The base shall be cast with four (4) slotted

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holes to receive the anchor/connecting bolts and tapped holes for attaching the four (4) cast aluminum alloy removable bolt covers provided for each pole. The bolt covers shall attach to the upright portion of the body of the base. The bolt circle diameter is provided in standard the drawings.

If poles are to be placed on existing bases or structures with anchor bolts in place, the Contractor shall furnish poles with a shoe base to fit the anchor bolt spacing.

2802.3 Bracket Arms

The bracket arm assembly shall be a one piece welded assembly consisting of an upper arm and lower arm (brace) securely joined by a vertical strut and a connector or weld at the outboard end of the arm assembly. The upper arm shall be tapered by cold working from round tubing. After tapering, the upper arm shall then be flattened to produce an elliptical cross-section with the major diameter in the horizontal plane, parallel to the wind. The outboard end of the upper arm shall remain round with a two inch (2") slipfitter for mounting the luminaire. The lower arm shall be 2 inch (2") IPS aluminum pipe. The outboard end of the lower arm (brace) shall be covered by an end cap. The bracket arm shall be capable of being mounted to the pole shaft with aluminum clamp-on style plates. Small holes shall be drilled at the ends of both arms on the bottom side to allow for drainage of condensation.

All poles, except 14-foot poles, shall be attached to a cast aluminum breakaway base sized according to the Standard Drawings. The breakaway base shall conform to the breakaway criteria of *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*, 1994 edition.

2802.4 Screw-In Anchor Bases

Screw-in anchor bases shall be of the size and type specified in the Standard Drawings, based on the pole mounting height. It is the responsibility of the fabricator to verify and attest that the material sizes proposed are structurally adequate and in full compliance with the Standard Drawings.

2802.5 Flowable Backfill

All flowable backfill shall be mix design Type A as described in Section 2600 of the City of Lee's Summit Design and Construction Manual.

2802.6 Concrete

All concrete for bases and pads, whether reinforced or non-reinforced, shall be a KCMMB 4k psi, or higher, approved concrete mix. Concrete construction shall be in accordance with ACI 301 Standard Specifications for Structural Concrete.

2802.7 Reinforcing Steel for Concrete Bases

All reinforcing steel shall meet the requirements of steel bars for concrete reinforcement. AASHTO specifications, when referenced, will control the physical properties, chemical properties and handling and storage of the material, except as otherwise specified herein or shown on the Plans.

Unless otherwise specified, reinforcement shall be deformed bars in accordance with AASHTO M 31, AASHTO M 42 or AASHTO M 53. Bars in accordance with AASHTO M 42 and M 53 shall be in straight lengths only. Splicing of bars is not allowed.

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Upon request, Contractor shall provide documentation of reinforcing steel that shall include the steel manufacturer's certified mill test report showing complete chemical and physical test results for each heat.

2802.8 Anchor Bolts

Anchor bolts shall be steel with 50,000 PSI minimum yield. Anchor bolts shall be threaded for the length of the bolt that is to be exposed. The anchor bolts shall be hot dipped galvanized on the top ten inches (10") of the threaded end, after threading. All accessories shall be galvanized to ASTM A153 standards. Threads shall be Coarse Thread Series as specified in ANSI B1.1 and may be formed by cutting or rolling.

2802.9 Luminaires

The manufacturer, type, and model of luminaires shall be supplied as shown on the Plans, Standard Drawings, or as specified in the Project Special Provisions.

2802.9.1 Cobra Head Luminaires

Cobra Head style luminaires shall be a power door or drop ballast type and be constructed of a single piece die-cast aluminum upper housing and one-piece or two-piece bottom door, hinged at the back and latched on the street side. The luminaire shall be equipped with an integral slipfitter for 2-inch luminaire arm mounting. The mounting device shall allow the luminaire to be mounted absolutely level and shall have no more than four (4) fasteners serving both the leveling and clamping functions. It shall allow one person to install the luminaire by simultaneously holding it in position and tightening the fasteners, such that the luminaire will be properly level at the first attempt. The luminaire shall be equipped with a 'trigger latch' for easy, one-hand, no-tools opening of the fixture for installation and servicing. A factory installed bird guard shall fit snugly around the mounting device. The luminaire shall provide a moisture proof and dust proof chamber and weather protection for the ballast. A removable power-pad/module with quick-connect electrical hookup for easy installation of the electrical system and easy access to the ballast compartment shall be mounted on the door. Top housing mounting or a bridge assembly configuration will not be accepted.

The lens shall be a single piece of optically clear, flat, heat-resistant, impact resistant glass. The sealed optical assembly shall be fully shielded (emitting no direct uplight). The reflector shall be natural unpainted alzak aluminum and shall be secured to the top housing.

The lamp socket shall be preset at the factory to meet the requirements of the IESNA classification for Type III cutoff light distribution at a minimum.

The luminaire shall not be provided with a photocell receptacle unless otherwise noted on the Plans or Project Special Provisions.

Luminaires shall be pre-wired, requiring only connection of service wires to a terminal board. The ballast shall be a regulator type, high power factor, for high-pressure sodium at a voltage of 120/208/240/277 volts. The ballast shall be capable of reliably operating the lamp with a line voltage varying plus or minus 5 percent from normal. The entire ballast, including condensers, shall be mounted on a power door or drop assembly and be easily removable and replaceable with gloved hands and without tools through the use of quick disconnecting mechanical devices and electrical plugs.

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2802.9.2 Post-Top Luminaire

The luminaire housing shall be constructed of cast aluminum and shall have a gray appearance. The ballast shall be a regulator type, high power factor, for high-pressure sodium at a voltage of 120/208/240/277 volts. The ballast components shall be housed in a totally enclosed integral compartment, and the optical section of the unit shall be completely sealed and gasketed. The pressed prismatic refractor shall be one piece polycarbonate plastic. The refractor shall be for IESNA Type III distribution, unless otherwise specified on the plans.

2802.10 Lamps

Luminaires shall be equipped with high-pressure sodium (HPS) vapor lamps. Lamp life shall be rated not less than twenty-four thousand (24,000) hours. Burnout at twenty thousand (20,000) hours shall not exceed twenty percent (20%). Rated initial lumen output shall be as follows:

- A. 150 watt lamps shall be rated 16,000 lumens.
- B. 250 watt lamps shall be rated 30,000 lumens.
- C. 400 watt lamps shall be rated 50,000 lumens.

2802.11 Conduit

The location and type of conduit shall be as shown on the Plans or Standard Drawings. The Contractor may furnish and install polyvinyl chloride (PVC), or high-density polyethylene (HDPE) conduit for the distribution system. Galvanized Rigid Steel (GRS) conduit shall be used where conduit is to be installed externally on a structure. For projects where the surface is largely unpaved, it is the Contractor's option to furnish and install cable-in-duct, instead of separate conduit and cables for the distribution system.

2802.11.1 Polyvinyl Chloride (PVC)

Rigid non-metallic conduit shall be polyvinyl chloride (PVC), Schedule 40 or Schedule 80, and shall conform to NEMA Standard TC-2 and NEMA TC-3. The conduit shall bear an Underwriters' Laboratories (U.L.) label and shall conform to Federal Specification WC-1094A (latest version). The conduit shall be clearly and durably marked at least every 10 feet with the material designation, nominal duct size, and the name and/or trademark of the manufacturer. Fittings for PVC conduit shall be in accordance with U.L. 514. Cement used for the fittings shall be in accordance with the conduit manufacturer's recommendations. Conduit, fittings, and cement shall be supplied by the same manufacturer.

2802.11.2 High Density Polyethylene (HDPE)

Flexible non-metallic conduit shall be high-density polyethylene conduit (HDPE). The conduit shall be smooth walled inside and out, and shall be gray in color. The conduit shall be a plastic duct which is intended for underground use and which can be manufactured and coiled or reeled in continuous transportable lengths and uncoiled for further processing and/or installation without adversely affecting its properties of performance. The conduit shall be manufactured to NEMA Standard TC-7 and ASTM D 3035 SDR11 specifications. The conduit shall be clearly and durably marked at least every 10 feet with the material designation, nominal duct size, and the name and/or trademark of the manufacturer. Fittings for HDPE conduit shall be in accordance with ASTM D 2683. Epoxy used for the fittings shall be in accordance with the conduit manufacturer's recommendations.

An approved factory coupling shall be used for connection of the HDPE conduit to a 90° factory PVC elbow or between two lengths of HDPE conduit. The coupling shall be of high density polyethylene material. The coupling shall provide an airtight and watertight lock connection.

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2802.11.3 Galvanized Rigid Steel (GRS)

Galvanized rigid steel conduit shall be in accordance with ANSI C80.1. GRS conduit shall be galvanized on both the inside and the outside surfaces. The weight (mass) of zinc coating shall be no less than 0.5 ounce per square foot of coated surface, as determined in accordance with AASHTO T 65. The interior or exterior surface, or both, may be given a coating of suitable material to facilitate installation of wires and cables and to permit the conduit to be readily distinguished from pipe used for purposes other than electrical. All metal conduit ends shall be provided with a bushing to protect the cable from abrasion. Fittings shall be in accordance with ANSI C80.4. A sufficient number of conduit hangers shall be supplied to attach the GRS conduit to the structure, as recommended by the manufacturer. One (1) No. 6 AWG, bare copper ground wire shall be attached to each end of the GRS conduit with a grounding bushing. The ground wire shall be connected to a ground rod at each end of a GRS conduit run, or extended to an adjacent GRS conduit or ground rod.

2802.11.4 Cable-In-Duct

Cable-In-Duct shall consist of three low voltage, insulated power cables, factory installed in conduit intended for direct burial. The duct shall meet all the specifications for high density polyethylene, as described in Section 2802.11.2. The duct shall be clearly and durably marked at least every 10 feet with the material designation, nominal duct size, and the name and/or trademark of the manufacturer. The cables shall meet all the specifications for distribution cable, as described in Section 2802.13.

2802.12 Pull and Junction Boxes

Pull and junction boxes shall be as shown on the Plans and shall be fiberglass reinforced polymer concrete of a size and shape as indicated on the Standard Drawings. Junction boxes may be either Type 1 or 2, and pull boxes shall be Class 1. Pull and junction box material is to be an aggregate consisting of sand and gravel bound together with a polymer and reinforced with continuous woven glass strands. Pull boxes shall withstand a wheel load of 20,000 pounds and junction boxes shall withstand a wheel load of 15,000 pounds. All pull and junction boxes are to have an open bottom.

Each pull or junction box shall be equipped with a bolt down cover. The threaded hole that receives the cover lock-down bolt shall be open at the bottom to allow the cleanout of sand, dirt and other debris. Lock-down bolts shall be stainless steel with a hex-head. Pull and junction box covers shall be polymer concrete and shall have a minimum wheel load rating of 20,000 pounds and 15,000 pounds respectively. A lift opening or pull slot shall be provided on all covers. Covers shall be embossed with "STREET LIGHTING".

2802.13 Cable

The types and lengths of cables shall be supplied as shown on the Plans, Standard Drawings, or as specified in the Project Special Provisions. All cable shall be stranded annealed soft drawn copper wire, and shall be the AWG size as listed on the Plans. Cable shall be 600-volt and be thermoplastic or thermosetting polyethylene insulated. All cable shall be plainly marked on the outside with the manufacturer's name and identification in accordance with industry practice.

2802.13.1 Distribution Cable

Distribution cables shall be insulated three-conductor cables (3c), type RHH, RHW-2 or USE-2, meeting the requirements of ICEA S-95-658. Average thickness of insulation shall be no less than 60 mils. The conductors should be no larger than No. 4 AWG and no smaller than No. 8 AWG.

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2802.13.2 Pole and Bracket Cable

Pole wiring above handhole, inside the pole to luminaire(s) shall be insulated two-conductor No. 10 AWG cables (2c #10), type THHN/THWN. For poles with dual luminaires separate cables will be required for each luminaire, which will extend up from the break-away fused connectors.

2802.14 Break-Away Fused and Non-Fused Connectors

Break-away fused connectors shall be in-line waterproof pre-molded fused slip connector assemblies with rubber insulating boots as shown in the Standard Drawings. Fused connectors shall be used for each hot cable, and non-fused connectors shall be used for the ground. Connectors shall have one or two copper set screw type terminals to accommodate the wire sizes indicated in the Plans. Fuses shall be high interrupting 8-Amp fuses.

2802.15 Splices

Splices shall be made in junction boxes with copper type K split bolt connectors. All splices shall be protected with a waterproof resin splice kit installed in accordance with the manufacturer's recommendations.

2802.15.1 Resin Splice Kits

Resin splice kits shall consist of a waterproof protective plastic case designed for the split bolt connector, filled with a resin insulating compound mixed in accordance with the manufacturer's recommendations.

2802.16 Power Supplies

Power supplies shall consist of all equipment and material necessary for the distribution of secondary electrical power as shown on the Plans. Power supplies shall be underground service type, rated for 100 amperes, 240 volts, capable of operating either one or four-circuits.

All power supply assemblies shall be warranted by the manufacturer to be free from defects in workmanship and material for at least one year from the date of project acceptance. Any components found to be defective during the warranty period shall be replaced free of charge. All warranties provided shall be transferred to the City upon project acceptance.

Insofar as practical, major items of electrical equipment supplied under a single contract or tied contracts shall be of the same type and consist of products of the same manufacturer to secure uniformity and satisfactory service.

2802.16.1 Cabinets

Power supply cabinets shall be of the type and size listed in the Plans or Standard Drawings. Cabinets shall be NEMA 3R construction, dust-tight, watertight, corrosion resistant, and constructed of 0.125-inch minimum non-anodized aluminum alloy and be of clean-cut design and appearance. The cabinet shall include individual meter, panel, contactor, and a service pull "compartment". The meter and panel/contactor compartments shall have piano hinged doors. All hinges, catches and other hardware shall be non-ferrous metal or stainless steel. The meter compartment shall include padlocking provisions, and the panel/contactor outer door shall have a factory installed Corbin lock assembly designed for a standard number 2 key. The panel/contactor compartment shall have an inside panel door. The outer and inside panel doors shall be equipped with an approved doorstop. Cabinets shall have a control panel constructed of the same material as the cabinet. All equipment such as photoelectric cells, contactors, relays, terminal blocks, circuit breakers, and lightning arrestors shall be installed on the panel as shown on the Plans. The panelboard shall have silver plated copper buss and shall accept the required number of 1 inch (1") plug-in breakers. Panelboard compartment shall contain photoelectric cell, and test switch.

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All factory installed wire shall be 600 volt rated copper. All terminals shall be approved for copper or aluminum wire. The cabinet shall have a natural aluminum finish.

2802.16.2 Photoelectric Cells

Photoelectric cells shall be of the solid-state type operating on 240 volts, and shall operate on a line supply of 50 to 60 hertz. The load capacity of the photoelectric cell relays shall be a minimum of 1000 watts. Photoelectric cells shall operate a lighting system through mercury load relays. The photoelectric cell circuitry shall be designed to be normally closed at night. The photoelectric cell shall be configured such that in the event of failure, the lights shall be on. The photoelectric cell shall be mounted inside the power supply cabinet such that all luminaires within the system operate simultaneously and shall illuminate only during hours of darkness or low visibility. Turn-on shall occur at 2.6 footcandles \pm 0.5 footcandles. The photoelectric cell shall have an inverse off/on ratio for energy savings. Photoelectric cells shall sense light levels with a non-drifting phototransistor. The photoelectric cell shall have a time delay to avoid turn off due to lightning and transient light. A suitable bracket for mounting the photoelectric cell shall be provided. The photoelectric cell shall be mounted into a three-prong twist lock socket, on the side of the cabinet. Test switches used with photoelectric controls shall be three-position switches as shown on the Plans. Test switches shall be clearly labeled and mounted in the cabinet.

2802.16.3 Contactors, Relays, and Terminal Blocks

Contactors, relays and terminal blocks shall be housed in the cabinet and shall be of the type shown in the Standard Drawings. The components shall be sized for each lighting circuit as shown on the Plans. Contactors shall not be electrically or mechanically held, nor shall they include any fusing.

2802.16.4 Circuit Breakers

All circuit breakers shall be molded-case thermal-magnetic Type B plug-on circuit breakers. The number and trip rating of circuit breakers shall be as shown on the Plans. All breakers shall be designed for panel mounting with cable connections on the line and load sides. Type B circuit breakers shall have a minimum of 10,000 amps alternating current interrupting rating at 240 volts alternating current. Type B circuit breakers shall have a nominal size no greater than one inch (1") wide by four inches (4") high by three inches (3") deep. Terminals shall be configured for the wire sizes as shown on the Plans. If the breaker terminals are not designed for the required wire sizes, suitable terminal adapters, connectors or terminal blocks shall be used to convert the wire sizes.

2802.16.5 Lightning Arrestors

Lightning arrestors shall be rated at 650 volts alternating current.

2802.17 Spare Equipment

If spare equipment is included in the contract, such equipment shall conform to these Specifications. The items shall be delivered new and undamaged at the place and time specified by the City Engineer. All existing equipment in excess of the requirements of this project shall be completely removed from the project site by the Contractor and delivered at the place and time specified by the City Engineer.

2803 CONSTRUCTION REQUIREMENTS

2803.1 Scope

This section governs the construction of all bases and the installation of all luminaires, poles, conduits, cables and other material and equipment as required to complete the street lighting

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system as shown on the Plans, the Standard Drawings, and as specified in the Project Special Provisions.

2803.2 Screw-in Anchor Base Installation

The Contractor is responsible for verifying the correct line and grade of all screw-in anchor bases prior to installation. The Contractor shall stake the location of all street lighting poles to be installed. The City Inspector shall inspect the staking prior to any excavation and/or construction. Minor relocation of equipment to avoid conflicts may be allowed with the approval of the City Engineer.

Screw-in anchors shall be of the size and type required for the pole. If rock is encountered, the screw-in anchor may be installed in a pre-drilled hole and backfilled with concrete, in accordance with Section 2802.6, or Type B flowable backfill in accordance with Section 2600 of the City of Lee's Summit, Missouri Design and Construction Manual.

The base shall be screwed straight into the ground and the steel base plate shall be at the proper elevation and properly oriented to receive the shoe base. During installation the anchor shall be plumbed with a level. The base plate shall be flush with the finished grade. Minor leveling adjustments may be made with the use of leveling shims or washers. Shims and washers shall be galvanized or cadmium-plated steel no more than one-quarter inch (0.25") thick. Only one shim or washer will be allowed at any one anchor bolt. The installing torque for screw anchor bases shall be between the maximum and minimum torque ratings shown on the Standard Drawings or per the manufacturer's recommendations.

Conduit bends shall be installed into all screw-in anchors through the slots in the base of the anchors. After conduit bends are installed and capped, the internal cavity of the screw in anchor shall be backfilled with sand or other fine aggregate material, as approved by the City Engineer.

2803.3 Concrete Base Installation

The Contractor is responsible for verifying the correct line and grade of all concrete bases prior to installation. The Contractor shall stake the location of all street lighting poles and power supplies to be installed. The City Inspector shall inspect the staking prior to any excavation and/or construction. Minor relocation of equipment to avoid conflicts may be allowed with the approval of the City Engineer.

All concrete bases shall be of the size and type show in the Standard Drawings, including all reinforcing steel.

Reinforcing steel for concrete bases shall be accurately cut and bent to the dimensions and shapes shown on the Plans. Cutting and bending tolerances for reinforcing steel shall be in accordance with the Concrete Reinforcing Steel Institute's *Manual of Standard Practice*. Flame-cutting of uncoated reinforcing steel may be permitted. Reinforcing steel shall be protected from damage at all times. When placed in the work and before concrete is placed, reinforcing steel shall be free from dirt, oil, paint, grease, loose mill scale, thick rust, any dried mortar and other foreign substances. A thin layer of powdery rust may remain. Reinforcing bars shall be positively secured against displacement. The bars shall be firmly tied at alternate crossings or closer. The steel shall be spot welded or tied in the correct position with proper clearance maintained between the forms and the reinforcement. The Contractor shall construct the unit as shown on the Plans. Measurements to reinforcing steel will be made to the centerline of bar, except where the clear distance from face of concrete is shown on the Plans. Splicing of bars shall not be allowed.

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PVC conduits and conduit bends should be set in the forms for concrete bases. Pole and power supply bases shall have separate conduits for exiting/entering cables and a separate one inch (1") conduit for the ground wire. The direction of the exiting conduits and the orientation of the power supply shall be as shown in the Plans. Conduit set in concrete bases shall extend approximately three inches (3") above the base vertically and a minimum of three inches (3") outside the base horizontally underground.

The bottom of all concrete bases shall rest on firm ground. Forms shall be true to line and grade. The top of the base for street light poles, except raised bases, shall be finished to curb or sidewalk grade, or as directed by the City Engineer. Forms shall be rigid and securely braced in place. Conduits and anchor bolts shall be placed in proper position, to proper heights, and held in place by means of a template until the concrete sets. Conduits shall be covered before concrete is poured to prevent concrete from entering the conduits. All portions of the anchor bolts extending above the base shall be threaded. Anchor bolts shall align with the bolt holes on the shoe base. Anchor bolts shall be provided with two (2) hex head nuts, flat washer, and lock washer. One nut shall be installed on each anchor bolt to be embedded in the concrete base, to within 1/8" above flush with the top of the base. Both forms and ground which will contact the concrete shall be thoroughly moistened before placing concrete.

Pole base and power supply bases shall be poured monolithic. Bases shall be consolidated by an internal type vibrator. The vibrator shall operate at frequencies of vibration not less than 5,000 cycles per minute under load. The amplitude of vibration shall be adequate to consolidate concrete properly. The concrete shall be cured with an approved moisture barrier such as wet burlap, polyethylene, etc., for a period of seventy-two (72) hours. Cold weather curing shall be such that the concrete temperature shall be maintained above freezing for the entire curing period. Forms shall not be removed until the concrete is thoroughly set. The exposed portions of the base shall be finished to present a neat appearance. Finishing should be done with the positioning jig in place. If the jig must be removed for finishing, it shall be re-installed immediately after finishing and left in place throughout the cure period. A safety device (traffic cone, Type I barricade, etc.) shall be installed over each pole base immediately after finishing and remain in place until the pole is installed. Prior to installing the pole, the positioning jig shall be removed and loose concrete cleaned from around the anchor bolts and conduits.

Cinders, broken concrete, broken rock or other hard or undesirable material shall not be used for backfilling around the finished base. The backfill material shall be placed in layers not to exceed six inches (6") deep, and each layer shall be thoroughly compacted to the approximate density of the adjacent material before the next layer is placed.

2803.4 Conduit Installation

Conduit shall be installed as shown in the Plans and the Standard Drawings. The size of the conduit used shall be as shown on the Plans. It shall be the privilege of the Contractor, at his own expense, to use larger size conduit if desired, as approved by the City Engineer. Where larger size conduit is used, it shall be for the entire length of the run from outlet to outlet. No reducing couplings will be permitted. No additional payment will be made for larger conduit.

Wherever a conduit passes beneath a curbed street, aluminum conduit markers shall be installed in the curb immediately over the conduit location. Conduit markers shall be furnished by the Contractor as detailed in the Standard Drawings and shall be installed in the top of the curb by drilling the curb and epoxying the conduit marker in place. Conduit markers are subsidiary to the installation of conduit.

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The ends of all conduits shall be well-reamed to remove burrs and rough edges. All conduits shall be cleaned and swabbed prior to installation of cable. Field cuts shall be made square and true so that the ends will butt or come together for the full diameter thereof. The end of each conduit run shall be covered to prevent water or debris from entering the conduit while the system is being constructed.

Existing underground conduit to be incorporated into a new system and GRS conduits shall be cleaned with a mandrel and blown out with compressed air.

An approved factory coupling shall be used for connection of the HDPE conduit to a 90° factory PVC elbow or between two lengths of HDPE conduit.

Conduit bends, except factory bends, shall have a radius of not less than six times the inside diameter of the conduit. Where factory bends are not used, conduit bends shall be made without crimping or flattening, using the longest radius practicable and utilizing an appropriate conduit bending tool.

The conduit shall be installed continuous from outlet to outlet or as otherwise shown on the Plans. With respect to HDPE conduit, no couplings or joints will be allowed at intermediate points unless approved by the City Engineer. The conduit may be directional bored to minimize disruption to the existing improvements or may be plowed or trenched. Conduit shall be installed under pavement sections at a depth not less than 24 inches (24"); and where laid in trenches in unpaved areas, conduit shall be laid to a depth of 24 to 36 inches (24" to 36") below natural ground level or finish grade.

At all outlets, conduit shall enter from the direction of the run. PVC conduit bends shall enter all junction or pull boxes from below the box and shall extend into the box a minimum of 4 inches (4") as shown on the Plans. GRS conduits may enter a pull or junction box from the side. The side of the box shall be drilled per the manufacturer's recommendations. The hole shall be no more than one-half inch (½") larger than the conduit. The gap between the box and conduit shall be filled with sealing compound.

2803.4.1 External Conduit on Structure

GRS conduit shall be used when conduit is to be installed externally on structures. Conduit on structures will include conduit on bridges, retaining walls or other structures, and shall be installed as shown on the Plans or as directed by the City Engineer. The final location of all conduit and junction boxes shall be approved by the City Engineer before installation begins. Conduit shall not be attached to prestressed concrete girders or prestressed, precast concrete deck panels. The conduit shall be secured to the concrete with clamps at no more than 5-foot intervals. Concrete anchors shall be in accordance with federal specification FF-S-325, Group II, Type 4, Class I, and shall be galvanized in accordance with ASTM A 153, B 695-91 Class 50, or constructed of stainless steel. The minimum embedment in concrete shall be 1 3/4 inches. If it is necessary to anchor the conduit to steel bridge members, the attachment method shall not involve drilling, grinding or welding. Attachment method to steel members shall be approved by the City Engineer. Expansion fittings shall be installed at each end of a bridge and each location where the conduit crosses a bridge expansion joint. The expansion fitting shall provide a minimum movement in either direction as shown on the Plans or as specified by the City Engineer. Clamps, concrete anchors, expansion fittings, and any hardware or material required for conduit installation on structures shall be at the Contractor's expense.

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2803.4.2 Trenching

Trenches shall be excavated to a maximum width of six inches (6") and deep enough to provide the minimum cover for conduits as shown in the Standard Drawings. Trenches leading to screw-in anchor bases shall not be wider than the shaft of the anchor. Conduit shall be allowed to "snake" in the trench, but there shall be no sharp bends and if two or more conduits are placed in a common trench, the conduits shall not cross each other. If the bottom of the trench is in rock or rocky soil, the conduit shall be placed on a six inch (6") protective layer of clean, tamped backfill material. Trenches shall be backfilled as soon as practical after the installation of conduit, but after inspection of the trench by the City Engineer or designee. Backfill material installed within six inches (6") of the conduit shall be free of rock or other solid material that might cause mechanical damage to conduit. The backfill material shall be placed in layers not to exceed 6 inches (6") deep, and each layer shall be thoroughly compacted to the approximate density of the adjacent material before the next layer is placed. Red burial tape imprinted with "CAUTION - BURIED CABLE BELOW" shall be installed in all trenches at approximately 1/3 to 1/2 of the depth of the trench. The four to six inches (4" to 6") of backfill material directly below finished grade shall be topsoil. All disturbed areas shall be restored to the satisfaction of the City Inspector.

2803.4.3 Plowing

Conduit may be installed by plowing in unpaved areas. The equipment used for plowing conduit is designed specifically for that purpose with the power and versatility to easily and accurately bury the various sizes of conduit under all normal soil conditions. This equipment places the conduit without twisting, kinking, or damaging the material in any way. The vibrating unit shall be attached to a tractor unit in such a manner that the tractor does not dampen the vibration. The cable way and guides shall be smooth, free of obstructions and sharp edges and shall not cause bending of the conduit at shorter than the minimum bending radius recommended by the manufacturer, nor cause excessive strain to the conduit. Conduit reels may be mounted on the tractor or conduit unreeled along the proposed route before plowing in such a manner to allow as direct a line as possible to the trench to avoid unnecessary bending of the conduit or rubbing of the conduit against the reel. The plow shall not be backed onto the conduit. If an underground obstruction is encountered, the plow shall be lifted out of the ground and the obstruction removed. Conduit may be installed utilizing the pull plow method if approved by the City Engineer. After installation of conduit by plowing, the disturbed earth shall be leveled and, if necessary, compacted by a device approved by the City Engineer. Ends of conduit shall be capped immediately after cutting to prevent moisture and debris from entering the conduit. Red burial tape imprinted with "CAUTION - BURIED CABLE BELOW" shall be installed in all trenches at approximately 1/3 to 1/2 of the depth of the trench. All disturbed areas shall be restored to the satisfaction of the City Inspector.

2803.4.4 Boring

Pavement shall not be disturbed without the written permission of the City Engineer and then only in the event insurmountable obstructions are encountered. Conduit shall be placed under existing pavement by boring. The Contractor shall complete the boring as to maintain minimum permissible clear distances, both horizontally and vertically, from all underground utilities. Boring pits shall be kept two feet (2') clear of the edge of any type of pavement wherever possible. Boring alignment shall be perpendicular to the curb line in order to achieve the shortest possible crossing distance. Excessive use of water such that pavement might be undermined or subgrade softened, will not be permitted. The Contractor shall at all times and for the entire length of the boring alignment be able to demonstrate the horizontal and vertical position of the alignment. All disturbed areas shall be restored to the satisfaction of the City Inspector. Boring may be used instead of trenching at all other locations.

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2803.5 Pull and Junction Box Installation

Pull and junction boxes shall be installed as shown on the Plans, Standard Drawings, or as directed by the City Engineer.

The top surface of all pull or junction boxes shall be flush with surfaced areas and approximately one inch above earth or sodded areas. All boxes shall have one-half inch (1/2") clean crushed aggregate or other porous material for a minimum depth of twelve inches (12") below the box for drainage. The excavated opening outside the junction box shall be wide enough to allow compaction of the backfill material. Cinders, broken concrete, broken rock or other hard or undesirable material shall not be used for backfilling. The backfill material shall be placed in layers not to exceed six inches (6") deep, and each layer shall be thoroughly compacted before the next layer is placed. All disturbed areas shall be restored to the satisfaction of the City Inspector.

A pull or junction box placed in an unpaved area shall have a concrete pad around the perimeter as shown on the Plans. Concrete for the pad shall be per Section 2802.6. The concrete shall be reinforced with welded wire fabric. Concrete pads will not be required for boxes installed in concrete. Pull or junction boxes shall not be installed in sidewalk ramps.

Each Class 1 Pull Box shall be equipped with cable hooks as shown on the Plans. Cable hooks shall be galvanized steel or brass with a minimum diameter of 3/8 inch and a minimum length of five inches (5").

Additional pull or junction boxes may be installed when approved by the City Engineer. If it becomes necessary to increase the excavation depth and extend the box, no direct payment will be made.

2803.6 Power Supply Installation

The power supply, including the cabinet, photoelectric cell, contactors, circuit breakers, lightning arrestor, and any other required materials or equipment shall be constructed and installed as shown on the Plans or as directed by the City Engineer. The Contractor shall coordinate his activities with the electrical utility company to insure delivery of power to the power supply when and where required. The cabinet shall be cleaned of wrapping, shipping material, dirt, grease, etc. Scratches, abrasions or other surface damage shall be repaired to like new condition. The photoelectric cell shall be oriented to the North or to the East.

2803.7 Circuit Wiring

Installation of wiring shall be in accordance with the Plans and Specifications and appropriate articles of the NEC.

Distribution cables shall be continuous and unspliced from the control panel to the first light pole. Cable shall be pulled with minimal dragging on the ground or pavement. Frame mounted pulleys or other suitable devices shall be used for pulling cables out of conduits into pull boxes. Powdered soapstone, talc or other approved lubricant shall be used to facilitate pulling cable in conduits. All cable to be installed in one conduit shall be pulled by the Contractor in one operation, and all ends shall be taped to exclude moisture and shall be so kept until the splices are made or terminal appliances attached. Ends of spare conductors shall be taped. Tape shall be Scotch (3M) No. 33+ "Electrical Tape" or approved equivalent. After cables are installed all conduit ends shall be sealed around the cables with a readily workable, soft, sealing compound. The compound shall be workable at 30° F and shall not melt or run at temperatures up to 175° F.

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Underground cable splices shall be made in a pull or junction box. Splices in the distribution cable will only be permitted where circuits branch or tee. Tee splices shall be made with split bolt connectors or an approved equivalent. All splices shall be protected with a waterproof resin splice kit installed in accordance with the manufacturer's recommendations. All cables passing through a pull or junction box shall be coiled once around the inside of the box to allow for splicing and connecting wires in the future. Wiring within power supplies and boxes shall be neatly arranged and laced up.

All circuits shall be properly labeled in all power supplies and boxes by means of round brass or aluminum identification tags with a minimum thickness of 0.1 mil attached to the cables with copper wire. The ends of the copper wire should be wrapped with electrical tape. Circuits shall be labeled with the power supply ID number and the circuit number.

2803.8 Cable-In-Duct Installation

All applicable portions of the conduit installation and circuit wiring sections apply to cable-in-duct installation. Cable-in-duct may be installed by boring, trenching, or plowing operations. Cable-in-duct runs shall be continuous without splice between the control panel, pole bases, and junction or pull boxes. Cable-in-duct shall extend far enough to provide the required amount of cable slack at all terminations or connections. For concrete bases, rigid conduit of sufficient size to facilitate the pulling of cable-in-duct shall be cast in the base as shown on the Plans. The cable-in-duct shall be installed through the rigid conduit in the base. The plastic duct of the cable-in-duct is to be terminated six inches (6") above the bottom of junction or pull boxes and bases, leaving the cables exposed for connection. All terminations of this plastic duct are beveled free from any sharp edges or burrs. The insulation of the electrical conductor may not be damaged when cutting the duct.

2803.9 Street Light Pole Installation

Street light poles and luminaires shall be installed as shown on the Plans and Standard Drawings, and as specified in the Project Special Provisions or as directed by the City Engineer. Street light poles are to be kept dry and out of the weather until time for erection. The manufacturer's protective paper wrapper may be removed for inspection upon receipt from the manufacturer. Poles and luminaires shall be cleaned of dirt, grease, etc. Scratches, abrasions or other surface damage shall be repaired to like new condition.

Street light poles shall be fastened to screw-in anchor bases or concrete with a break-away base using galvanized hardware, except the 14-foot pole which does not require a break-away base. The pole shall be checked for plumb, minor corrections made using galvanized or cadmium plated steel shim stock, the nuts tightened, and the removable bolt covers installed. Hand holes in the pole and break-away base shall be oriented so that they are 180° from the direction of oncoming traffic. In a median, the hand holes should be oriented 180° from one direction of oncoming traffic, facing either North or East, for all poles installed in medians. The opening in the breakaway base should be located on the same side of the pole as the hand hole.

2803.9.1 Bracket Arm Installation

Bracket arms for luminaires shall project from the street side of the pole and be perpendicular to the roadway. Install a one inch (1") rubber grommet around the hole at the top of the light pole for the cable entrance. Sufficient lengths of pole and bracket cable shall be run inside the length of the street light pole shaft, out through the grommet at the top of the pole, and through the bracket arm. The bracket arm is to be attached to the pole with clamp-on style supports using stainless steel hardware. Cables shall not be pinched when bracket arms are attached to poles.

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For poles with dual luminaires, different color pole and bracket cables shall be run to each luminaire to indicate the directional orientation of each luminaire. When looking at the hand hole, red cables shall be run to the luminaire on the right-hand side of the pole, and black cables shall be run to the luminaire on the left-hand side of the pole.

2803.9.2 Cover Skirt

An aluminum cover skirt must be installed around all four (4) sides of the base plate of screw-in anchor bases if a gap of more than one inch (1") is visible between the bottom face of the base plate and the finished grade. The cover skirt is to be made of two solid sheets of aluminum, alloy designation 3003-H14, which are field cut and shaped to fit flush against the base plate and extend down to the finished grade. The aluminum sheets should overlap each other, and be fastened together with stainless steel self tapping screws.

2803.9.3 Luminaire Installation and Adjustment

Cobra head luminaires shall be installed on the slipfitter at the end of the bracket arm. To give proper illumination on the roadway, the frontal view of the luminaire should be parallel to the grade of the road surface, while in the side view the luminaire should be horizontal. Post-top luminaires not equipped with terminal blocks shall be connected to the pole wiring with approved butt connectors.

2803.9.4 Lamp Installation

The installation date shall be marked on the base of the lamp prior to installing it in the luminaire housing.

2803.10 Electrical Connections

Each distribution cable shall be connected to the corresponding pole and bracket cable in each pole base using a fused or non-fused break-away connector as shown on the Plans.

Two (2) fused connectors should be used for the hot leads, and one (1) non-fused connector should be used for the ground. Each break-away connector should allow two (2) cables to be attached to the terminal on the line side. The load side of the fused connectors should allow one (1) cable to attach to the terminal for single luminaires and two cables (2) for dual luminaires on a single pole. Two (2) pole and bracket cables are to be run from the load side of the fused connectors to each luminaire on the pole. One (1) pole and bracket cable is also to be run from the load side of the non-fused connector to the grounding lug on the street light pole. The connectors shall be installed convenient to the hand hole in the street light pole.

One foot of surplus cable shall be coiled at the line side of each connector and on the load side of each connector. Connectors shall be installed with the fuse or ground slug attached to the load side of the connector. From the load side of the non-fused connector, the ground wire shall be fastened to the factory installed ground lug in the base of the light pole by a 3/8" ring terminal and 3/8" - 16 x 3/4" long hex bolt.

2803.11 Grounding

At each concrete base a ground rod shall be driven in the trench adjacent to the base. This shall also include screw-in anchor bases backfilled with concrete or flowable backfill.

At each power supply base a ground rod shall be driven in the same trench as the 3" conduit for the secondary service connection. The completed ground rod installation and connection to the ground wire shall not be backfilled until it the power supply passes inspection by the City's

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Codes Administration Department. The grounding clamp connection and the listing mark on the rod must be visible for inspection.

The ground rod shall be copper coated to meet NEC requirements, not less than one-half inch (1/2") in diameter, and ten feet (10') in length. Ground rods shall be driven to a minimum depth of twelve inches (12") below the finished surface. If subsurface conditions exist which prohibit the placement of the ground rod in a vertical position, the rod may be driven at an oblique angle, not to exceed 45-degrees from vertical, or when authorized by the City Engineer, buried in a trench at least thirty inches (30") deep. The driven ground rod shall be connected to the grounding lug by a No. 6 AWG copper wire attached to the rod with a galvanized grounding clamp. The ground wire is to be run through a one inch (1") diameter conduit in the base.

2803.12 System Testing

The Contractor is responsible for testing the completed street lighting system. Prior to acceptance by the City, the Contractor shall notify the City Engineer for an inspection as soon as the system(s) is (are) ready.

After a power supply is energized, the resistance to ground shall be tested. The Contractor shall provide a suitable measuring device capable of measuring ground resistance from 0 to 1,200 ohms for the resistance test. The resistance test shall be performed by the Contractor in the presence of and documented by the City Engineer. The ground rod shall have a resistance to ground of 25 ohms or less. If the resistance is more than 25 ohms, the Contractor shall install additional ground rods which are bonded to the first ground rod, until the required resistance is achieved. No payments will be made for additional ground rods.

2803.12.1 Burn Test

All street lighting system elements shall function properly as a complete system for a minimum period of fifteen (15) days before acceptance by the City. The fifteen (15) day period shall be cyclical and initiated by the City Engineer. Any malfunction observed or recorded shall stop the test period for the entire system as of the time of the malfunction. A period shall start when the malfunction has been repaired to the satisfaction of the City Engineer. After the burn test is completed, the street light system(s) must remain in operation if the street is open to vehicle traffic.

2803.13 Maintenance Information

Before acceptance of the work, the Contractor shall furnish the City Engineer four copies of the manufacturers' written instructions for maintenance and operation of all lighting equipment and wiring diagrams of the installation or system. At a minimum, the manufacturer's instructions shall include documented, organized instructions, wiring and component layout diagrams, and parts lists with part numbers.

2803.14 As-Built Plans

Prior to acceptance of the work, the Contractor shall submit marked-up or corrected plans showing in detail all construction changes, especially the location and depth of conduit. The Designer will produce as-built plans from the Contractor's marked-up plans.

2803.15 Final Clean Up

Before final acceptance, the Contractor shall restore to a condition equal to or better than that existing prior to construction, for all property, both public and private, within, adjacent to and beyond the limits of construction that have been disturbed or damaged while executing the work. This includes, but not limited to, existing curb and gutter, sidewalk, pavement, drainage

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structures, irrigation systems, street lighting and traffic signal equipment. All unpaved areas damaged during construction shall be restored to the original condition. Unless otherwise directed, grassy areas which were originally sodded shall be re-sodded. Restoration work shall be at the Contractor's expense. All restoration work shall be acceptable to the Inspector.

2804 MEASUREMENT AND PAYMENT

See Division I – General Requirements for CIP, Section 01120.

SECTION 3000 –TRAFFIC CONTROL

CITY OF LEES SUMMIT, MISSOURI STANDARD SPECIFICATIONS

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3011 SIGNING GENERAL

3011.1 Scope

This work shall consist of furnishing of all material, equipment, and labor for the complete installation of permanent signs. Temporary signing shall conform to the temporary traffic control requirements in Section 3031.

3011.2 Codes and Standards

All work and material shall be in accordance with the latest requirements of the Manual on Uniform Traffic Control Devices (MUTCD), Standard Highway Signs (SHS), and all applicable local ordinances.

3011.3 Modification of Specifications

These Specifications may be modified or deleted by appropriate items in the Project Special Provisions or by written authorization by the City Engineer.

3011.4 Incidental Work and Parts

Work incidental to permanent signage that is not covered in these Specifications shall be performed in accordance with the City of Lee's Summit specifications and standards. All incidental parts, which are not shown on the Plans or specified in the Specifications and which are necessary to complete the installation of signage, shall be supplied and installed by the Contractor to the satisfaction of the City Engineer. No additional payments will be made for incidental work or parts.

3011.5 Existing Signing

The Contractor shall maintain all existing signs not shown on the Plans as to be removed. At the onset of the project, the Contractor should verify and document the condition of each sign that is to be re-used. The Contractor shall be responsible for the appropriate care of all existing signs that are to be re-used. Any signs that are damaged, lost or stolen shall be replaced by the Contractor at the Contractor's expense.

All Stop, Yield, or street name signs shall be maintained in a conspicuous location for the driving public. All Stop and Yield signs removed for construction purposes can be temporarily erected in reflectorized drums (no less than 7 feet above the pavement surface) until they can be reinstalled. Any temporary Stop or Yield sign installation to be left in place overnight will require prior approval from the City Inspector.

3011.6 Permits and Inspections

The Contractor shall contact the Public Works Department before any project work begins to notify the City Engineer of the construction schedule and to request project inspections. The Contractor is responsible for obtaining all necessary permits from the City, and is responsible for all associated costs, before any work can begin.

3011.7 Maintenance Work

The Contractor is responsible for making all repairs and replacements, including downed or damaged signs, regardless of the cause or responsible party, until the work is completed, inspected, and accepted by the City.

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3012 SIGNING MATERIALS AND EQUIPMENT

3012.1 Scope

This section governs the furnishing of all signs, posts, and other material and equipment supplied by the Contractor, as required to complete the installation of permanent signs as shown on the Plans, the Standard Drawings, and as specified in the Project Special Provisions. All signing material and equipment shall be of new stock unless the contract provides for relocation of existing units or use of units furnished by others. New material and equipment shall be of the best grade, and shall meet the approval of the City Traffic Engineer.

3012.2 Sign Blanks

Sign blanks shall be of aluminum, 6061-T6 alloy. Sign blanks shall be degreased and coated with an alodized finish to ensure that sign sheeting adheres to the surface. Sign blank thickness shall be 0.125 inches for signs with an area greater than nine square feet (9 sq. ft.). Sign blanks for overhead street name signs shall also have a thickness of 0.125 inches. Sign blanks for signs with an area less than or equal to 9 sq. ft. shall be 0.080 inches thick. Sign blanks shall have corner radii and holes punched according to the Federal Highway Administration's Standard Highway Signs, or as specified in the Plans.

3012.3 Sign Sheeting

Sign blanks shall be covered with retroreflective, high intensity prismatic sign sheeting, meeting the requirements of ASTM D4956-04 Spec. Type III. Screen-printed signs are no longer acceptable and shall not be used. Signs containing blue, red or green lettering and/or symbols shall be made with acrylic overlay film manufactured by 3M, or approved equal. Signs containing black lettering and/or symbols shall be made of black vinyl. All sign sheeting shall be applied without splices, and shall be free from air bubbles, wrinkles or other blemishes.

3012.4 Sign Posts

The type of sign post shall be supplied as shown on the Plans, Standard Drawings, or as specified in the Project Special Provisions.

3012.4.1 Square Steel Posts

All square steel sign posts shall be 2" x 2", 14 gauge galvanized steel, square tubular posts, with 3/8-inch (3/8") diameter holes at one inch (1") spacing on all sides. Square steel posts shall be galvanized according to ASTM A653. All square steel posts shall be furnished with a 12 gauge, two-piece break-away anchor as shown on the Standard Drawings. All components of the break-away anchor shall be galvanized.

3012.4.2 Decorative Posts

The City Traffic Engineer may authorize the use of decorative sign posts. Decorative sign post shall be 2" x 2", 14 gauge galvanized steel, square tubular posts, with 3/8-inch (3/8") diameter perforated holes at one inch (1") spacing on all sides. The holes on the post shall NOT be punched through. The posts shall be galvanized per AASHTO M-120 specifications. The post should also have a conversion coating, a clear organic polymer topcoat, and be powder coated black. All decorative post shall have a break-away anchor, as specified for square steel posts.

3012.4.3 U-Steel Posts

All U-Steel sign posts shall be steel, U-shaped channel, weighing three pounds per linear foot (3 lb/ft). The posts shall have 3/8-inch (3/8") diameter holes at one inch (1") spacing along the center of the

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channel. U-steel posts shall be hot dip galvanized per ASTM A123. U-Steel posts shall have an anchor as shown in the Standard Drawings.

3012.5 Sign Mounting Hardware

All sign mounting hardware shall be stainless steel, with the exception of a 5/16 inch flat plastic washer to be installed against the sign face, as shown on the Standard Drawings. All strap type sign supports, including brackets and seals shall be 3/4" wide Type 201 stainless steel, 0.030" thick.

3013 SIGNING CONSTRUCTION REQUIREMENTS

3013.1 Scope

This section governs the installation of permanent signs as shown on the Plans, the Standard Drawings, and as specified in the Project Special Provisions.

3013.2 Sign Post Installation

The Contractor shall stake the location for all proposed sign posts. The City Inspector shall inspect the staking before installation begins. Minor relocations to avoid conflicts may be allowed by the City Traffic Engineer.

Sign posts shall be located so that the nearest edge of the sign is not less than two feet (2') laterally from the back of the curb line, or six feet (6') laterally from the edge of pavement on a non-curbed facility. Street name signs shall be located so that the nearest edge of the sign is not less than one foot (1') laterally from the back of the curb line, or six feet (6') from the edge of pavement on a non-curbed facility. The minimum height to the bottom edge of the sign shall be as shown in the Standard Drawings.

The Contractor shall be responsible for determining post lengths to ensure that all signs mounted on a post have the required clearance as shown on the Standard Drawings. Field cutting of posts will be permitted, however torch-cutting steel posts is prohibited.

Sign posts shall be plumbed vertical. The cross-sectional dimensions of the posts and/or the coating shall not be damaged during installation. Any post bent or otherwise damaged to the extent that the post is considered unfit for use shall be removed and replaced with an acceptable post at the Contractor's expense.

3013.3 Storage of Signs

Signs delivered for use on a project or existing signs to be reinstalled shall be stored in a manner meeting the approval of the City Traffic Engineer. Any sign damaged, discolored or defaced during transportation, storage, or installation may be rejected.

3013.4 Sign Installation

Signs shall be mounted directly to the sign post with 5/16" bolt, nut and appropriate washers per the Standard Drawings. A flat plastic washer shall be installed between the sign face and stainless steel mounting hardware.

Signs on traffic signal posts or street light poles shall be mounted with strap or clamp type sign supports, or brackets as shown on the Plans or as approved by the City Traffic Engineer. The requirements for signs mounted on mast arms are described in Section 2900 of the City of Lee's Summit Design and Construction Manual.

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3013.5 Removal and Reinstallation of Existing Signs

Removal, transportation, storage, and reinstallation of existing signs should be as indicated in the Plans, Specifications, or Project Special Provisions. The Contractor is responsible for repair or replacement of any existing signs damaged during the removal and reinstallation operations at the Contractor's expense.

All sign blanks and sign posts that are removed and are not to be reinstalled on the project shall be delivered to the City's Public Works Maintenance Facility, 1971 SE Hamblen Road. The Contractor is responsible for disposal of any items that are damaged or any items not to be salvaged.

New bolts, nuts, washers, and other required appurtenances shall be provided by the Contractor in order to reinstall existing signs. Such items shall be considered subsidiary to sign reinstallation.

3013.6 Final Clean Up

Before final acceptance, the Contractor shall restore to a condition equal to or better than that existing prior to construction all property, both public and private, within, adjacent to and beyond the limits of construction that have been disturbed or damaged while executing the work. This includes, but not limited to, existing curb and gutter, sidewalk, pavement, drainage structures, irrigation systems, street lighting and traffic signal equipment. All unpaved areas damaged during construction shall be restored to the original condition. Unless otherwise directed, grassy areas which were originally sodded shall be re-sodded. Restoration work shall be at the Contractor's expense. All restoration work shall be acceptable to the City Inspector.

3014 SIGNING MEASUREMENT AND PAYMENT

See Division I – General Requirements for CIP, Section 01120.

3021 PAVEMENT MARKING GENERAL

3021.1 Scope

This work shall consist of furnishing of all material, equipment, and labor for the complete installation of permanent pavement markings. Temporary pavement markings shall conform to the temporary traffic control requirements in Section 3031.

3021.2 Codes and Standards

All work and material shall be in accordance with the latest requirements of the Manual on Uniform Traffic Control Devices (MUTCD) and all applicable local ordinances.

3021.3 Modification of Specifications

These Specifications may be modified or deleted by appropriate items in the Project Special Provisions or by written authorization by the City Engineer.

3021.4 Incidental Work and Parts

Work incidental to pavement markings that is not covered in these Specifications shall be performed in accordance with the City of Lee's Summit specifications and standards. All incidental parts, which are not shown on the Plans or specified in the Specifications and which are necessary to complete the installation of pavement marking, shall be supplied and installed by the Contractor to the satisfaction of the City Engineer. No additional payments will be made for incidental work or parts.

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3021.5 Integrity of Design and Installation Standards

The Contractor shall make no design modification, material substitution, or revision of any kind without prior approval of the City Traffic Engineer. Materials or installation procedures deemed unsatisfactory by the City Traffic Engineer, with regard to retroreflectivity, bead distribution, paint thickness, overspray, accuracy, line width, consistency, tracking, or failure to comply with approved specifications shall not be used for pavement marking.

3021.6 Permits and Inspections

The Contractor shall contact the Public Works Department before any project work begins to notify the City Engineer of the construction schedule and to request project inspections. The Contractor is responsible for obtaining all necessary permits from the City, and is responsible for all associated costs, before any work can begin.

3021.7 Warranty

The Contractor shall warranty both the labor and the pavement marking materials used for a minimum period of one year from the date of application; the warranty period and time referenced deficiency measures noted below shall be extended for the duration of applicable project bonds. The Contractor shall submit a written warranty on company letterhead, which at a minimum shall require the Contractor to replace any line or symbol with any of the following deficiencies:

- More than 10% of a 1,000 foot length of a longitudinal line is damaged within one year of the date of application,
- More than 10% of an individual symbol is damaged within one year of the date of application, or
- A line or symbol has retroreflectivity values less than 150 millicandelas/sq m/lux for white and 100 millicandelas/sq m/lux for yellow within one year of the date of application.

3021.8 Property Damage

The Contractor shall be responsible for work-related accidents and damages to public or private property caused by pavement marking installation. All property damage shall be reported to the City Engineer. Claims of damage to private property made directly to the City will be forwarded to the Contractor for resolution. Repair of damage to private property shall be completed prior to City acceptance of completed work. An amount equal to the claim for damage sustained to public or private property may be withheld from payment to Contractor until the City Engineer determines that the claim has been satisfactorily resolved.

3022 PAVEMENT MARKING MATERIALS AND EQUIPMENT

3022.1 Scope

This section governs the furnishing of all material and equipment supplied by the Contractor, as required to complete the installation of pavement markings as shown on the Plans, the Standard Drawings, and as specified in the Project Special Provisions.

3022.2 Material Selection

The type of pavement marking material to be used on a specific project depends on the type of marking and surface. If the material to be used is not specified in the Plans or in the Project Special Provisions, the table on the following page shall be used for material selection. Selected material shall be approved by the City Traffic Engineer prior application.

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TABLE OF PAVEMENT MARKING MATERIALS

Marking Surface	Longitudinal Lines	Diagonal Lines	Crosswalk & Stop Lines	Dashed Lines	Symbols
Asphalt	Thermoplastic* or High-Build Paint	Thermoplastic* or High-Build Paint	Pre-Formed Thermoplastic	Pre-Formed Thermoplastic	Pre-Formed Thermoplastic
Concrete	Urethane or High-Build Paint	Urethane or High-Build Paint	Pre-Formed Thermoplastic	Pre-Formed Thermoplastic	Pre-Formed Thermoplastic
Nova-Chip/ Microsurface	Thermoplastic*	Thermoplastic*	Pre-Formed Thermoplastic	Pre-Formed Thermoplastic	Pre-Formed Thermoplastic
Slurry Seal	Thermoplastic* or High-Build Paint	Thermoplastic* or High-Build Paint	Pre-Formed Thermoplastic	Pre-Formed Thermoplastic	Pre-Formed Thermoplastic

* Binder-sealer recommended by the manufacturer will be required on surfaces older than two months.

3022.3 High-Build Paint

High-build paint shall be white or yellow paint that is specifically manufactured for use as pavement markings. The paint shall consist of acrylic resin, lead-free pigments, dryers, water as solvent, and sufficient pigment suspending agents to insure soft settlement during storage.

The paint supplied shall be from freshly prepared stock and shall be formulated and manufactured from first grade materials. The paint shall be a fast-drying, waterbase, acrylic resin type paint capable of withstanding air and roadway temperatures without bleeding, staining, discoloring, or deforming. The dried film shall be capable of maintaining its original dimensions and placement without chipping, spalling, or cracking. In addition, it shall not deteriorate because of contact with sodium chloride, calcium chloride, mild alkalies and acids, or other ice control materials, oil, gasoline, or diesel fuel droppings from vehicles.

The paint must comply with the following requirements:

- A. Formulation: The pigment of the Yellow paint shall consist of the following for each 100 gallons of paint:
 - i. 30 lbs. of approved Hansa Yellow
 - ii. 17 lbs. of Rutile Titanium Dioxide
 - iii. Other such extender pigments as necessary to produce a close match to the yellow color requirement.

White and yellow paint shall be composed of 100% acrylic polymer, which shall be Rohm and Haas HD-21 acrylic resin.

- B. Consistency (viscosity): The consistency shall not be less than 75 nor greater than 90 K.U. as determined by ASTM D562.
- C. Dry-Opacity: A contrast ratio of not less than 0.96 when the paint is applied with a 0.012 inch film applicator. Dry-opacity will be determined according to method 4121.1, Federal Test Method Standard No. 141c.

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- D. Dry to No Pick-Up Time: Maximum 5 minutes.
- E. Fineness of Grind: The fineness of grind shall be no less than 3 Hegman units when tested according to ASTM D1210.
- F. Daylight Reflectance: Daylight Reflectance of the white paint shall not be less than 80% relative to magnesium oxide when tested according to ASTM E1347.
- G. Color: Yellow color must meet the following minimum chromaticity coordinates:

CIE Chromaticity Coordinate Limits (Initial)								
Color	1		2		3		4	
	x	y	x	y	x	y	x	y
Yellow	0.475	0.450	0.490	0.433	0.520	0.450	0.495	0.475

Yellow paint must display a nighttime presence of yellow when viewed from automobile headlights.

White paint shall be pure white (free of tint)

- H. Bead Embedment: At least 90% of the glass beads must be embedded between 50% and 70%.
- I. Retroreflectivity: The following minimum retroreflectivity requirements shall be met when using an acceptable 30-meter retroreflectometer between 2 and 14 days after application:
 - i. White 250 millicandelas/sq m/lux (min.)
 - ii. Yellow 175 millicandelas/sq m/lux (min.)

Each batch of paint shall be tested and certified in the factory. Receipt of certification shall be provided to the City. High Build Paint shall be tested in accordance with the requirements of Federal Specification TT-P-1952B.

No paint shall be used that is more than 6 months old.

3022.4 Pre-Formed Thermoplastic

Pre-formed thermoplastic materials shall be suitable for use on either asphalt or concrete pavements. A manufacturer recommended heat source fuses the markings to the asphalt or concrete pavements. Glass beads are pre-mixed into the material furnished, and also must be applied to the surface either before or after fusion to the pavement. Upon cooling, the material produces an adherent reflectorized marking of specified thickness and width, capable of resisting deformation by traffic. Pre-formed thermoplastic materials shall comply with AASHTO M 249 with exception of the relevant differences due to the material being supplied in a pre-formed state, and must meet the following requirements:

- A. Material shall have a minimum thickness of 90 or 125 mils as supplied by the manufacturer.
- B. Material shall be resistant to deterioration due to exposure to sunlight, water, oil, gasoline, salt, or adverse weather conditions.
- C. All pigments must be heavy metal free, including, but not restricted to lead, cadmium, and mercury.
- D. After application, the material must exhibit no appreciable deformation or discoloration, remain tack free, and not lift from the pavement under normal traffic conditions within a road temperature range of 20° F to 150° F.

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- E. Material shall be capable of conforming to pavement contours, breaks, and faults through the action of traffic at normal pavement temperatures.
- F. Color: Yellow color must meet the following minimum chromaticity coordinates:

CIE Chromaticity Coordinate Limits (Initial)								
Color	1		2		3		4	
	x	y	x	y	x	y	x	y
Yellow	0.475	0.450	0.490	0.433	0.520	0.450	0.495	0.475

White color shall be pure white (free of tint)

- G. Retroreflectivity: The following minimum retroreflectivity requirements shall be met when using an acceptable 30-meter retroreflectometer within 14 days after application:
 - i. White 300 millicandelas/sq m/lux (min.)
 - ii. Yellow 225 millicandelas/sq m/lux (min.)

3022.5 Thermoplastic

Thermoplastic pavement marking material shall be applied to asphalt surfaces in a molten state, and which upon cooling to normal pavement temperature, produces an adherent reflectorized stripe capable of resisting deformation. Thermoplastic material shall meet the requirements of AASHTO M249-79. Thermoplastic shall only be applied to surfaces that are less than two months old, unless a binder-sealer recommended by the manufacturer is applied.

3022.6 Urethane

Urethane pavement marking material shall consist of a homogeneous blend of modified urethane resins and pigments designed to provide a simple volumetric mixing ratio of two components (must be two volumes of Part A to one volume of Part B). No volatile solvent or fillers will be allowed.

- A. Pigmentation: The pigment content by weight of component A shall be determined by low temperature ashing according to ASTM 0 3723. The pigment content shall not vary more than \pm two percent from the pigment content of the original qualified paint.

White Pigment shall be Titanium Dioxide meeting ASTM D 476 Type II, Rutile.

Yellow Pigment shall be an Organic Yellow and contain no heavy metals.

- B. Upon heating to application temperature, the material shall not exude fumes, which are toxic or injurious to persons or property when handled according to manufacturer specifications. The urethane pavement marking material compositions shall not contain free isocyanate functionality.
- C. Daylight Reflectance: The daylight directional reflectance of the cured modified urethane material (without reflective media) shall be a minimum of 80 percent (white) and 50 percent (yellow) relative to magnesium oxide when tested using a color spectrophotometer with a 45 degrees circumferential /zero degrees geometry, illuminant C, and two degrees observer angle. The color instrument shall measure the visible spectrum from 380 to 720 nm with a wavelength measurement interval and spectral bandpass of 10 nm. In addition, the color of the yellow modified urethane shall visually match Color Number 33538 of Federal Standard 595a with chromaticity limits as follows:

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CIE Chromaticity Coordinate Limits (Initial)								
Color	1		2		3		4	
	x	y	x	y	x	y	x	y
Yellow	0.490	0.470	0.475	0.438	0.485	0.425	0.539	0.456

- D. **Weathering Resistance:** The modified urethane, when mixed in the proper ratio and applied at 14 to 16 mils wet film thickness to an aluminum alloy panel (Federal Test Std. No. 141, Method 2013) and allowed to cure for 72 hours at room temperature, shall be subjected to accelerated weathering for 75 hours. The accelerated weathering shall be completed by using the light and water exposure apparatus (fluorescent UV - condensation type) and tested according to ASTM G 53.

The cycle shall consist of four hours UV exposure at 50nC (122 OF) and four hours of condensation at 40°C (104 OF). UVB 313 bulbs shall be used. At the end of the exposure period, the material shall show no substantial change in color or gloss.

- E. **Drying Time:** The modified urethane material, when mixed in the proper ratio and applied at 14 to 16 mils wet film thickness and with the proper saturation of glass spheres, shall exhibit a no-tracking time of three minutes or less when tested according to ASTM D 711.
- F. **Adhesion:** The catalyzed modified urethane pavement marking materials when applied to a 100 x 100 x 50 mm (4 x 4 x 2 in.) concrete block shall have a degree of adhesion which results in a 100 percent concrete failure in the performance of this test

The concrete block shall be brushed on one side and have a minimum strength of 3,500 psi. A 2 in. square film of the mixed modified urethane shall be applied to the brushed surface and allowed to cure for 72 hours at room temperature. A 2 in. square cube shall be affixed to the surface of the modified urethane by means of an epoxy glue. After the glue has cured for 24 hours, the modified urethane specimen shall be placed on a dynamic testing machine in such a fashion so that the specimen block is in a fixed position and the 2 in. cube (glued to the modified urethane surface) is attached to the dynamometer head. Direct upward pressure shall be slowly applied until the modified urethane system fails. The location of the break and the amount of concrete failure shall be recorded.

- G. **Hardness.** The modified urethane marking materials, when tested according to ASTM 0-2240, shall have a Shore D Hardness greater than 75. Films shall be cast on a rigid substrate at 14 to 16 mils in thickness and allowed to cure at room temperature for 72 hours before testing.
- H. **Abrasion.** The abrasion resistance shall be evaluated on a Taber Abrader with a 1,000 gram load and CS-17 wheels. The duration of test shall be 1,000 cycles. The wear index shall be calculated based on ASTM test method 0-4060 and the wear index for the catalyzed material shall not be more than 80. The tests shall be run on cured samples of modified urethane material which have been applied at a film thickness of 14 to 16 mils to code S-16 stainless steel plates. The films shall be allowed to cure at room temperature for at least 72 hours and not more than 96 hours before testing.
- I. **Tensile.** When tested according to ASTM 0-638, the modified urethane pavement marking materials shall have an average tensile strength of not less than 6,000 pounds per square inch. The Type IV Specimens shall be pulled at a rate of X" per minute by a suitable dynamic testing machine. The samples shall be allowed to cure at 75 °F± 2°F for a minimum of 24 hours and a maximum of 72 hours prior to performing the indicated tests.
- J. **Compressive Strength.** When tested according to ASTM D-695, the catalyzed modified urethane pavement marking materials shall have a compressive strength of not less than 12,000 pounds per square inch. The cast sample shall be conditioned at 75°F± 2°F for a

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minimum of 72 hours before performing the indicated tests. The rate of compression of these samples shall be no more than 1/4" per minute.

3022.7 Drop-On Glass Beads

Drop-on glass beads shall be specifically manufactured to be compatible with pavement markings, and shall comply with AASHTO M 247, Type I.

3023 PAVEMENT MARKING CONSTRUCTION REQUIREMENTS

3023.1 Scope

This section governs the installation and removal of pavement markings as shown on the Plans, the Standard Drawings, and as specified in the Project Special Provisions.

3023.2 Surface Preparation

The surface on which markings are to be placed shall be clean and dry. The street surface shall be cleaned of debris, sand, or any other deleterious material by sweeping and or use of jets of compressed air immediately preceding the application of markings. New PCC pavements shall be blast-cleaned to remove all curing compounds.

3023.3 Weather Limitations

The pavement surface temperature and air temperature shall be determined before the start of each day of marking operation and at any other time deemed necessary by the City Traffic Engineer. Temperatures shall be obtained with appropriate devices using the manufacturer's recommended procedure.

The pavement markings shall not be applied if the pavement shows any visible signs of moisture or it is anticipated that damage causing moisture, such as rain showers, may occur during the installation and curing periods.

3023.4 High-Build Paint Application

Paint shall be machine applied using spray guns designed and adjusted to apply paint at the required thickness and width. If there is any evidence of gun clogging, splattering or uneven paint distribution, painting operations shall cease until equipment is restored to proper operation. Paint shall be applied from a vehicle that was specifically manufactured for pavement marking applications.

The pavement surface temperature and ambient air temperatures shall be above 50° F during all times when paint is being applied. Paint shall not be applied if the forecast conditions for the eight hours immediately following final application include precipitation. High-build paint shall be applied to a minimum wet thickness of 20 mils. Paint may be heated to a maximum temperature of 150° F before application.

Drop-on glass beads shall be mechanically applied to the wet paint directly behind the paint spray guns. Glass beads shall be applied evenly at a minimum rate of 9 pounds per gallon of paint. Glass beads shall be applied evenly and shall completely cover the painted area. If beads do not embed properly in the paint, all marking operations shall cease until the Contractor can demonstrate that the problem has been corrected.

The glass beads shall appear uniform on the entire marking surface. The cured paint shall properly adhere to the pavement surface. If the marking paint does not provide initial retroreflectivity or if the

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marking does not have the required minimum thickness or required color, the Contractor shall re-apply the marking paint to the required thickness, at the Contractor's expense, and shall meet all requirements as previously described.

3023.5 Pre-Formed Thermoplastic Application

To apply pre-formed thermoplastic, use a heating device recommended by the material manufacturer to fuse the pre-formed thermoplastic to the pavement. Apply the pavement markings as recommended by the manufacturer. When recommended by the manufacturer, use solvent or other type of adhesive primer. Remove all existing markings or exposed aggregate before applying pre-formed thermoplastic.

3023.6 Thermoplastic Application

Thermoplastic material shall be applied to the pavement by the extrusion method wherein one side of the shaping die is the pavement and the other three sides are contained by, or a part of, suitable equipment for heating and controlling the flow of material. The equipment used to install hot thermoplastic materials under this Specification shall be constructed to provide mixing and agitation of the materials. Conveying parts of the equipment between the main material reservoir and the shaping die shall be so constructed as to prevent accumulation and clogging. All parts of the equipment that come in contact with the material shall be constructed as to be easily accessible and exposable for cleaning and maintenance. The equipment shall be constructed so that all mixing and conveying parts up to and including the shaping die will maintain the materials at a temperature not less than 375° F. To assure that the thermoplastic does not fall below the minimum temperature, the shaping die shall be heated by means of a gas-fired infrared heater or a heated, oil-jacketed system. The equipment shall be so constructed as to insure continuous uniformity in the dimensions of the stripe. The applicator shall provide a means for cleanly cutting off square stripe ends and shall provide a method of applying "skip" lines. The use of pans, aprons or similar appliances that the die overruns will not be permitted under this Specification. The equipment shall be so constructed as to provide for varying die widths and to produce varying widths of traffic marking.

A special kettle shall be provided for melting and heating the thermoplastic material. The kettle must be equipped with a thermostat so that heating can be done by controlled heat transfer liquid rather than by direct flame, so as to provide positive temperature control and prevent overheating of the material. The heating kettle and applicator shall be so equipped and arranged as to meet the requirements of the National Board of Fire Underwriters, of the National Fire Protection Association, of the state and local authorities.

Glass beads applied to the surface of the completed strip shall be applied by an automatic bead dispenser attached to the striping machine in such a manner that the beads are dispensed almost instantaneously upon the installed line. The glass bead dispenser shall be equipped with an automatic cut-off control synchronized with the cut-off of the thermoplastic material.

The equipment shall be so arranged as to permit preheating of the pavement immediately prior to application of the thermoplastic material if preheating is recommended by the thermoplastic manufacturer. The applicator shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc. The applicator shall be capable of containing a minimum of 125 pounds of molten material.

The pavement and ambient air temperatures shall be not less than 55° F, and the thermoplastic material shall be applied in a melted state at a temperature of 375° F to 450° F. The temperature of the thermoplastic in the shaping die shall be maintained at the manufacturer's recommended application temperature, but in no case shall the temperature fall below 375° F.

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The finished lines shall have well defined edges and be free of waviness. All lines will have minimal dribbles, runs and overlaps. In the event that thermoplastic long lines must stop and then continue, the restart shall line up to within 0.5 inches of the existing long line and maintain a totally straight line. The minimum thickness of thermoplastic lines shall be not less than 90 mils near the edges, nor less than 125 mils at the center. The drop-on glass beads shall be applied at a rate of one pound per 20 square feet of line.

3023.7 Urethane Application

The urethane pavement marking compounds shall be applied through equipment specifically designed to precisely meter the two components in the ratio of 2:1. This equipment shall produce the required amount of heat at the mixing head and gun tip and maintain those temperatures within the tolerances specified. This equipment shall also have as an integral part of the gun carriage, a high pressure air spray capable of cleaning the pavement immediately prior to the marking application.

The equipment shall be capable of spraying both yellow and white urethane, according to the manufacturer's recommended proportions and be mounted on a truck of sufficient size and stability with an adequate power source to produce lines of uniform dimensions and prevent application failure. The truck shall have at least two urethane tanks each of 110 gallon minimum capacity and shall be equipped with hydraulic systems and agitators. It shall be capable of applying glass beads by the double drop pressurized bead system. The system shall apply both the first drop glass beads and the second drop glass beads at a rate of 10 lb/gal. The equipment shall be equipped with pressure gauges for each proportioning pump. All guns shall be in full view of operators at all times. The equipment shall have a metering device to register the accumulated installed quantities for each gun, each day. Each vehicle shall include at least one operator who shall be a technical expert in equipment operations and urethane application techniques.

The pavement markings shall be applied at a minimum uniform wet thickness of 20 mils in accordance with the manufacturer's installation instructions. At the time of installation the pavement surface temperature and the ambient temperature shall be above 35° F and rising. Urethane shall not be applied if the forecast conditions for the eight hours immediately following final application include precipitation.

3023.8 Pavement Marking Removal

All pavement marking removal shall be per the Plans or as authorized by the City Traffic Engineer. Pavement markings shall be completely removed with minimal damage to the pavement. No more than five percent of the existing marking shall remain. The pavement surface shall not be left scarred with an image that misleads traffic. Any excess damage or scarring of the pavement shall be repaired at the Contractor's expense.

3023.9 Deficiencies

The Contractor shall remove and replace, at the Contractor's expense, any finished markings that have the following deficiencies:

- Drag marks, gashes, gouges, foreign covering, discolored areas, or areas that have failed to solidify
- Improper adhesion, length or thickness
- Ragged appearance with areas that do not present sharply defined edges
- Lateral deviation in excess of two inches in a length of 200 feet of marking

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3023.10 Final Clean Up

Before final acceptance, the Contractor shall restore to a condition equal to or better than that existing prior to construction all property, both public and private, within, adjacent to and beyond the limits of construction that have been disturbed or damaged while executing the work. The Contractor shall be responsible for removing all pavement marking material spilled upon the road surface or adjoining area. All restoration work shall be acceptable to the City Inspector.

3024 PAVEMENT MARKING MEASUREMENT AND PAYMENT

See Division I – General Requirements for CIP, Section 01120.

3031 TEMPORARY TRAFFIC CONTROL GENERAL

3031.1 Scope

The safety and mobility of all right-of-way users, including workers, drivers, and pedestrians throughout the project area is of paramount importance and shall be the responsibility of the Contractor. All work performed, whether in the right-of-way or adjacent to the right-of-way, that impacts vehicular or pedestrian traffic in any way shall be properly signed, marked, barricaded, and otherwise protected. This work shall consist of furnishing of all material, equipment, and labor to provide safe temporary traffic control within or adjacent to the area of work.

3031.2 Codes and Standards

All work and material shall be in accordance with the latest requirements of the Manual on Uniform Traffic Control Devices (MUTCD), Standard Highway Signs (SHS), American Traffic Safety Services Association (ATSSA) Quality Standards for Work Zone Traffic Control Devices, Standards of the American Society of Testing Materials (ASTM), National Cooperative Highway Research Program (NCHRP) Report 350, Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG), City of Lee's Summit Pavement Marking and Signing specifications and standards, and all applicable local ordinances.

3031.3 Modification of Specifications

These Specifications may be modified or deleted by appropriate items in the Project Special Provisions or by written authorization by the City Engineer.

3031.4 Traffic Control Plans

If a traffic control plan is not part of the Plans the Contractor shall submit a traffic control plan in accordance with the Manual on Uniform Traffic Control Devices (MUTCD) as well as all federal, state, and local regulations and ordinances. Contractor is responsible for obtaining the City Traffic Engineer's approval of said traffic control plan, before implementation.

If the Contractor would prefer to use a traffic control plan that differs from the approved plans, the Contractor may request modifications to the traffic control plan. The Contractor will submit a plan based on the timeframes and requirements of the Contract. Contractor is responsible for obtaining the City Traffic Engineer's approval of said traffic control plan, before implementation.

Based on field conditions or unforeseen circumstances, the Contractor and/or City Traffic Engineer may request modifications to the traffic control plan, whether it is the approved plan or the Contractor's plan.

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The Contractor is required to maintain access to all properties served by the streets within the construction site limits.

3031.5 Minimum Requirements

The temporary traffic control requirements shown on the Plans are minimum requirements only and do not attempt to address in depth the variety of situations that may occur once construction has begun. In no way do the requirements shown on the Plans relieve the Contractor of his responsibility for selecting proper traffic control devices and implementation procedures that will assure the safety of motorists, pedestrians, and workers at all times. The Contractor shall be fully responsible for damage or injuries whether or not traffic control devices have been provided.

3031.6 Incidental Work and Parts

Work incidental to temporary traffic control that is not covered in these Specifications shall be performed in accordance with the City of Lee's Summit specifications and standards. All incidental parts, which are not shown on the Plans or specified in the Specifications and which are necessary to provide proper traffic control, shall be supplied and installed by the Contractor to the satisfaction of the City Engineer. No additional payments will be made for incidental work or parts.

3031.7 Permits and Inspections

The Contractor shall contact the Inspector 48 hours prior to installing any traffic control devices. The Contractor is responsible for obtaining all necessary permits from the City, and is responsible for all associated costs, before any work can begin. The City Inspector shall inspect and approve the final location of all traffic control devices.

3032 TEMPORARY TRAFFIC CONTROL MATERIALS AND EQUIPMENT

3032.1 Scope

This section governs the furnishing of all channelizers, construction signing, barricades, and other material and equipment supplied by the Contractor, as required, to implement the temporary traffic control as shown on the Plans, the Standard Drawings, and as specified in the Project Special Provisions. All equipment and material shall be in good condition, and shall meet the approval of the City Traffic Engineer.

3032.2 Construction Signs

All construction signs shall comply with the size, shape, legend, layout, and color requirements of the MUTCD and Standard Highway Signs book. For all signs that will be used at night, the legend, border, and background other than black shall be made from high intensity retro-reflective sheeting.

Supports or posts used for mounting signs or devices shall be designed to yield upon impact to minimize hazards to motorists, and be approved by NCHRP Report 350. Portable sign supports should not be used for durations of more than three (3) days. Sand bags shall not be used as ballast for sign supports for durations of more than seven (7) days. Supports and posts shall not be installed in pavement.

For mobile operations, a sign may be mounted on a work vehicle, a shadow vehicle, or a trailer stationed in advance of the work area or moving along with it.

3032.3 Channelizers

Channelizers, including cones, tubular markers, drums, and trim-lines shall be per the sizes shown on

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the Plans or Standard Drawings. Orange shall be the predominant color on the channelizers, with bands of white high intensity retro-reflective sheeting. Trim-line channelizers are the preferred channelizing devices. Channelizers shall have a broadened base and may be constructed of polyethylene or other material to withstand impact without damage to themselves or to vehicles. Cones may not be used at nighttime.

3032.4 Barricades

Barricades shall be per the sizes shown on the Plans or Standard Drawings and in compliance with NCHRP Report 350. Stripes on barricade rails shall be alternating orange and white retro-reflective sheeting sloping downward at an angle of 45 degrees in the direction road users are to pass. Sand bags used as ballast for barricades shall be kept in good condition. Contractor shall be responsible for removing and cleaning up any sand bags that have sand escaping from them.

3032.5 Arrow Panels

Arrow panels are a matrix of lamps capable of flashing or sequential displays, to be used where necessary to divert traffic. Two types of arrow panels are acceptable for use on City streets; Type C and Type D, meeting the requirements listed in the MUTCD.

Type C arrow panels shall be used during nighttime operations. They shall have a minimum width of 96 inches and a minimum height of 48 inches. Type C arrow panels shall be mounted on a portable chassis at a minimum height of seven feet (7') measured from the bottom of the panel to the road surface.

Type D arrow panels can be used during daylight hours, for mobile operations, or for emergencies. They shall have a minimum width of 48 inches and a minimum height of 24 inches. Type D Arrow panels are mounted on work vehicles at a minimum height of seven feet (7') measured from the bottom of the panel to the road surface. Any vehicle displaying an arrow panel shall be equipped with high-intensity rotating beacon, flashing beacon, oscillating beacon, or strobe lights.

3032.6 Warning lights

Type A, B, and C Warning lights shall be portable, battery powered, yellow, enclosed lights. All types of warning lights shall be in accordance with the current edition of "Purchase Specification for Flashing and Steady-Burn Warning Lights", published by the Institute of Transportation Engineers.

3032.7 Temporary Pavement Markings

Temporary pavement markings on finish surface pavement or existing surface pavement shall be removable retro-reflective polymer marking tape. When installed on pavement that will be removed, surfaced, or resurfaced, temporary pavement markings shall be water-borne traffic paint or removable retro-reflective polymer marking tape.

3032.8 Portable Changeable Message Boards

Portable changeable message boards may be provided by the City at the discretion of Public Works. The City Traffic Engineer shall coordinate the use of portable changeable message boards with the City's Public Works Operations Division. The Operations Division shall be notified at least five (5) days before a portable changeable message board is required. All messages displayed on the boards shall be approved by the City Traffic Engineer.

3032.9 Temporary Concrete Traffic Barrier

Temporary concrete traffic barrier shall be per the standards and specifications of the Missouri

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Department of Transportation (MoDOT).

3033 TEMPORARY TRAFFIC CONTROL CONSTRUCTION REQUIREMENTS

3033.1 Scope

This section governs the installation and placement of traffic control devices as shown on the Plans, the Standard Drawings, and as specified in the Project Special Provisions. All temporary traffic control shall be in conformance with the MUTCD.

3033.2 Sign Installation

The installation of all construction signage shall be in compliance with the MUTCD and the City of Lee's Summit Standard Drawings for Signing. All existing and temporary construction signs shall be removed or covered when they are not applicable. No sign posts shall be installed in paved surfaces in a manner that could cause damage to the finished surface.

Signs shall be properly maintained for cleanliness, visibility, and correct positioning. Signs that have lost significant legibility shall be promptly replaced.

Signs mounted on portable sign supports or Type 2 barricades must be installed at least one foot above the road surface. Signs mounted on Type 3 barricades should not cover more than 50 percent of the top two rails or 33 percent of the total area of the three rails.

Type B warning lights shall be installed in conjunction with all construction warning signs that will be in place at nighttime, which alert road users about a change in alignment, traffic control, lane closure, or road closure. Warning lights shall be mounted on signs in a manner that, if hit by an errant vehicle, they will not be likely to penetrate the windshield.

3033.3 Temporary Pavement Marking Installation

Temporary pavement markings are required to delineate the travel way for vehicles when the intended traffic pattern differs from the normal traffic pattern for a duration of three calendar days or more. The installation of all temporary pavement markings shall be in compliance with the MUTCD and the City of Lee's Summit Standard Drawings for Pavement Marking.

All travel lanes should be at least 11 feet wide, however a minimum lane with of 10 feet may be allowed if approved by the City Traffic Engineer. A "Narrow Lanes" sign should be installed in advance of any location where the lane width is reduced to less than 11 feet.

Where temporary pavement markings are to be placed on a surface which has existing markings, the incorrect markings shall be removed or obscured to the fullest extent possible without damage to the pavement surface. Any appreciable damage or different appearance from the surrounding surface shall be repaired by the Contractor at his expense, by methods approved by the City Engineer.

On the finish surface of pavement, interim markings are required if the permanent pavement markings cannot be installed within 24 hours. Interim markings on finish surface of pavement shall consist of four inch (4") wide by two feet (2') long stripes on the center line of the street or lane line, at approximately 50 foot spacing. Interim markings shall be the same color and configuration as the permanent pavement markings.

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3033.4 Placement of Channelizers

Channelizers shall be used to delineate the travel way for vehicles when the intended traffic pattern differs from the normal traffic pattern on a street. Channelizers shall be spaced as indicated on the Standard Drawings.

Type C warning lights may be mounted on channelizers that delineate the edge of the travel way. If warning lights are installed on channelizers, they shall be mounted in a manner that, if hit by an errant vehicle, they will not be likely to penetrate the windshield.

3033.5 Lane Closures

Lane closures are not permitted on arterial or collector streets before 9:00 A.M. and after 4:00 P.M. Monday thru Friday, nor anytime on Saturday, Sunday or holidays observed by the City unless prior approval is received through the City Traffic Engineer. Emergency repairs will be evaluated on a case-by-case basis. The Contractor shall not store materials or park vehicles within an otherwise moving lane of traffic.

All lane closures for durations longer than 30 minutes shall be signed and delineated with traffic control devices as illustrated in the Standard Drawings. Lane closures for durations of 30 minutes or less are considered to be short duration or mobile operations. Lane closures for short duration or mobile operations, at a minimum, shall require that a vehicle be equipped with high-intensity rotating beacon, flashing beacon, oscillating beacon, or strobe lights. Warning signs, channelizers, and/or arrow panels should also be considered, if possible.

The City Engineer reserves the right to suspend or delay certain operations to adequately provide for the movement of traffic. This may include periods of inclement weather or unusually heavy traffic.

3033.6 Flaggers

Flaggers are required anytime vehicles are directed to cross into an opposing lane of traffic on arterial or collector streets. If proper line-of-sight cannot be provided at intersections, drives, or curves, flaggers will also be required. Flaggers shall be trained by an ATSSA certified program. Flaggers shall be equipped with a STOP/SLOW paddle, and must be properly attired per the requirements of the MUTCD.

3033.7 Street or Sidewalk Closures

All street or sidewalk closures must be approved by the City Traffic Engineer. If a detour route will be provided around the closure, the detour route signing must be inspected and approved before the street or sidewalk can be closed.

When a section of street is completely closed to traffic, Type 3 barricades shall be erected at the points of closure. Barricades must extend completely across a roadway and its shoulders or from curb to curb. Type A warning lights should be installed on each Type 3 barricade used to alert drivers of a closure. Where provisions must be made for access of equipment and authorized vehicles, the Type 3 barricades should be provided with gates or movable sections that can be closed when work is not in progress, or with indirect openings that will discourage public entry. Where access is provided through the Type 3 barricades, the Contractor shall assure closure at the end of each working day.

When a street is closed, but access must still be allowed for local traffic, the Type 3 barricades usually are not erected completely across a roadway. Instead, an arrangement should be devised that will

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permit local use but effectively discourage use by through traffic. A sign with the appropriate legend concerning permissible use by local traffic shall be installed.

Whenever possible, a section of sidewalk that is removed should be replaced the same day, or other materials may be used to temporarily fill the area in order to maintain pedestrian traffic.

3033.8 Detours

All detour routes are subject to the approval of the City Traffic Engineer. Where detours are permitted, all necessary detour route signing must be installed a minimum of 48 hours before the detour is in effect to allow for inspection. All detour signing shall utilize high intensity retro-reflective sheeting. While traffic is detoured, construction operations shall be expedited. Periods when detours are allowed will be strictly enforced.

3033.9 Excavations, Embankments, and Obstructions

The Contractor shall be responsible for maintaining all safeguards around excavations, embankments, obstructions, or open trenches on an around-the-clock basis, whether or not work is being actively pursued.

An all-weather surface wedge capable of supporting vehicles should be provided adjacent to an edge drop-off of more than two inches (2"), but less than four inches (4"). Such a wedge should have a slope no greater than 1:1. An all-weather surface wedge capable of supporting vehicles shall be provided adjacent to an edge drop-off of more than four inches (4"). For drop-offs of more than four inches (4"), the maximum slope of the wedge shall be 3:1. Concrete traffic barrier may be used in lieu of wedge; and should be considered if an edge drop-off exceeds twenty-four inches (24"), or for other factors such as the presence of heavy machinery or workers. "Shoulder Drop Off" signs (MUTCD No. W8-9) shall be installed adjacent to any edge drop-off of more than two inches (2") that is not protected by a wedge or barrier.

If it is necessary to leave a trench excavated in the street open during times when work is not actively being pursued, the Contractor shall provide structurally adequate steel plates to bridge the excavation. All steel plates shall be A36 certified steel, minimum one inch (1") thick, with lift hooks, securely fastened to the pavement with stakes or pins. Steel plates shall be installed per the requirements of the City of Lee's Summit specifications and standards.

Orange mesh temporary fencing shall be installed around all excavations outside the street during times when work is not actively being pursued. Fencing shall be at least four feet (4') in height, bright orange in color, and attached to posts capable of supporting the fencing without significant sagging or bowing. If the excavation or an obstruction extends into a sidewalk or driveway, a Type 2 barricade with a Type A warning light should be placed adjacent to the fencing or obstruction to warn of the hazard.

3033.10 Additional Traffic Control

The City Traffic Engineer may require additional signs, channelizers, barricades, warning lights, flaggers, or other traffic control devices at any time or at any place that, in his opinion, are necessary for proper protection of vehicular or pedestrian traffic and workers.

3033.11 Maintenance Work

The Contractor shall be responsible for maintaining all traffic control devices on an around-the-clock basis, whether or not work is actively being pursued. All traffic control devices shall be maintained in

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acceptable condition as defined by the latest ATSSA "Quality Standards for Work Zone Traffic Control Devices." Devices in unacceptable or marginal condition as determined above shall be removed from the job site and replaced with devices in acceptable condition. The Contractor shall be responsible for cleaning all temporary traffic control devices as needed so that they have a neat and clean appearance at all times.

The Contractor shall be responsible for periodic checks of traffic control devices at night to verify that all devices are visible to drivers.

3033.12 Deficiencies

Deficiencies in traffic control shall be corrected immediately. Should the Contractor fail to enforce the traffic control plan or fail to clean, replace, or otherwise maintain the traffic control devices within 24-hours of verbal or written notice from the City Engineer, the City may take one or more of the actions listed on the following page:

- A. City or another agency employed by the City may correct deficiencies in signing or warning devices and deduct the cost from the Contractor's pay estimate,
- B. Stop the work until deficiencies are corrected,
- C. Suspend all pay estimates until deficiencies are corrected, or
- D. Place the Contractor in default.

3033.13 Final Clean Up

Before final acceptance, the Contractor shall restore to a condition equal to or better than that existing prior to construction all property, both public and private, within, adjacent to and beyond the limits of construction that have been disturbed or damaged while executing the work. This includes, but not limited to, existing curb and gutter, sidewalk, pavement, drainage structures, irrigation systems, street lighting and traffic signal equipment. All unpaved areas damaged during construction shall be restored to the original condition. Unless otherwise directed, grassy areas which were originally sodded shall be re-sodded. Restoration work shall be at the Contractor's expense. All restoration work shall be acceptable to the City Inspector.

3034 TEMPORARY TRAFFIC CONTROL MEASUREMENT AND PAYMENT

See Division I – General Requirements for CIP, Section 01120.

SECTION 3500 - SANITARY SEWERS
CITY OF LEE'S SUMMIT, MISSOURI
STANDARD SPECIFICATIONS

3501 MATERIALS

- A. General: All materials shall conform to the latest revision of the reference standard applying to that particular material.
- B. Pipe and Fittings for Sanitary Sewers
1. Allowable Materials: Pipe and fitting materials used in the construction of sanitary sewers shall be:
 - a. Ductile Iron (DI) special thickness Class 50
 - b. Polyvinyl Chloride (PVC)
 - c. High Density Polyethylene (HDPE) (for force mains only)
 2. Requirements: The pipe manufacturer shall furnish pipe of materials, joint types, sizes, and strength classes indicated and specified. The Contractor shall furnish maximum pipe lengths normally produced by the manufacturer except for fittings, closures, and appurtenances.
 3. Manufacturer's Experience: The Manufacturer shall be experienced in the design, manufacture, and commercial supplying of the specified material.
 4. Inspection and Testing: Inspection and testing shall be performed by the Manufacturer's quality control personnel in conformance with applicable standards.
 5. Markings: Each pipe or fitting shall have the following information plainly and permanently marked by indenting in the outside surface of the pipe or painted thereon with waterproof paint:
 - a. Pipe size and class or designation.
 - b. Date manufactured and lot number.
 - c. Manufacturer's name or trademark.
 - d. For ductile iron pipe, in lieu of the above listed markings, the information may be provided on an adhesive bar code labeling system that complies with AWWA Standards. The adhesive label shall be provided on the outside surface near the bell.
 6. Handling: The Manufacturer and Contractor/Developer shall use equipment and methods adequate to protect the pipe and joint elements and to prevent shock contact of adjacent units during moving or storage. Damaged sections that cause reasonable doubt as to their structural strength or water-tightness shall be rejected.
 7. On-Site Inspection: All pipe and appurtenances shall be inspected by the Inspector prior to installation, and all damaged pieces, as well as any pieces not complying with

the City of Lee's Summit Standard Specifications, shall be immediately removed from the job site and replaced by pipe and appurtenances as may be acceptable to the Inspector at the expense of the Contractor/Developer.

8. Certification: Suppliers shall submit certifications with their material delivery. These certifications shall be given to the Inspector.

C. PVC Sewer Pipe and Fittings

1. Type PSM PVC Sewer Pipe and Fittings (4-inch through 15-inch diameters only): Pipe and fittings shall conform to ASTM D 3034 and F1336, except as otherwise specified herein.
 - a. Material: The pipe shall be made of PVC plastic having a cell classification of 12454B or 12364B as defined in ASTM D 1784. The fittings shall be made of PVC plastic having a cell classification of 12454B or 13343B as defined in ASTM D1784.
 - b. Design: Pipe shall have an integral wall bell and spigot joint and a minimum wall thickness complying with SDR 26. Fittings shall have a minimum wall thickness complying with SDR 26.
 - c. Joints: Joints shall conform to ASTM D 3212. Joints shall be push-on type only with the bell-end grooved to receive a gasket. Elastomeric seals (gasket) shall have a basic polymer of synthetic rubber complying with ASTM F 477. Natural rubber gaskets shall not be accepted.
 - d. Fittings:
 - i. Fittings defined as wye connections suitable for assembly to 4- or 6-inch building sewers shall be bell-end with a minimum wall thickness complying with SDR 26 and shall be furnished by the pipe manufacturer.
 - ii. Fittings shall be clearly marked with their SDR number. The markings shall be applied to the fittings in such a manner that they remain legible after installation and inspection has been completed.
2. PVC Pressure-Rated Pipe (SDR Series): Pipe shall conform to ASTM D 2241 except as otherwise specified herein.
 - a. Material: The pipe shall be made of PVC plastic having a cell class of 12454B or 14333B, as defined in ASTM D 1784.
 - b. Design: Pipe shall have an integral wall bell and spigot joint. Pipe shall have a minimum wall thickness complying with Table 2 in ASTM D 2241.
 - c. Joints: Joints shall conform to ASTM D 3212 for gravity lines and ASTM D 3139 for pressure lines. Joints shall be push-on type only with the bell-end grooved to

receive a gasket. Elastomeric seals (gasket) shall have a basic polymer of synthetic rubber complying with ASTM F 477. Natural rubber gaskets shall not be accepted.

- d. Fittings: Fittings shall be DI and shall conform to the requirements of Paragraph 3501.D.
- 3. PVC Plastic Pipe, Schedule 40: Pipe and fittings shall conform to ASTM D 1785 and ASTM D 2466, respectively, except as otherwise specified herein.
 - a. Material: The pipe and fittings shall be made of PVC plastic having a cell class of 12454B, as defined in ASTM D 1784.
 - b. Design: Pipe shall have an integral wall bell and spigot joint. Pipe shall have a minimum wall thickness complying with Table 2 in ASTM D 1785. Fittings shall have a minimum wall thickness complying with Table 1 in ASTM D 2466.
 - c. Joints: Joints shall conform to ASTM D 3212. Joints shall be push-on type only with the bell-end grooved to receive a gasket. Elastomeric seals (gasket) shall have a basic polymer of synthetic rubber complying with ASTM F 477. Natural rubber gaskets shall not be accepted.
 - d. Fittings:
 - i. Fittings shall be bell-end with a minimum wall thickness complying with Schedule 40 and shall be furnished by the pipe manufacturer.
 - ii. Fittings shall be clearly marked with their schedule number. The markings shall be applied to the fittings in such a manner that they remain legible after installation and inspection has been completed.
- D. Ductile Iron Pipe (DIP) and Fittings: Pipe and fittings shall conform to ANSI/AWWA C151/A21.51, ANSI/AWWA C110/A21.10, and ANSI/AWWA C153/A21.53 except as otherwise specified herein.
 - 1. Design: All DIP shall meet the requirements of ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51. The minimum thickness shall be Special Thickness Class 50.
 - 2. Joints: Mechanical and push-on joints for pipe and fittings shall conform to the requirements of ANSI/AWWA C111/A21.11. Natural rubber gaskets shall not be accepted.
 - 3. Restrained Joint Pipe and Fittings: Restrained joint pipe and fittings shall be per the pipe manufacturer's recommendation. American Flex-Ring, US Pipe TR Flex, Griffen Snap-Lok, Griffen Bolt-Lok and McWane TR Flex are considered restrained joints.
 - 4. Coatings: The pipe exterior shall be coated with a layer of arc-sprayed zinc per ISO 8179 with a mass of 200 g/m². Pipe markings shall include the word "ZINC". The

zinc shall be covered with a standard thickness exterior bituminous coating complying with ANSI/AWWA C151/A21.51.

5. Linings: Pipe and fittings shall have a hydrogen sulfide resistant ceramic quartz filled amine cured novalac epoxy interior lining, 40 mil nominal thickness. Refer to the Water Utilities List of Acceptable Manufacturers and Models.
 6. Polyethylene Encasement: All ductile iron pipe and fittings shall be installed with a polyethylene tube encasement having a thickness of 0.008 inches (8 mils) and complying with Section 4.1.1. of ANSI/AWWA C105/A21.5.
- E. HDPE Pipe and Fittings: Pipe and fittings shall conform to ANSI/AWWA C901 and ANSI/AWWA C906 except as otherwise specified herein.
1. Material: The pipe and fittings shall be made of polyethylene (PE) plastic having a grade of PE34 with a minimum cell classification of 345464C, as defined in ASTM D 3350.
 2. Design: All HDPE pipe and fittings shall meet the requirements of ANSI/AWWA C901 and ANSI/AWWA C906. Pipe shall have a minimum wall thickness complying with DR 11. The pressure class shall be 1.5 times the working pressure plus 100 psi surge allowance.
 3. Fittings: HDPE fittings shall comply with ANSI/AWWA C906 and the requirements of ASTM D 2683 for socket-type fittings, ASTM D 3261 for butt heat fusion fittings, and ASTM F 1055 for electrofusion type fittings.
- F. Concrete: Concrete shall be a MCIB mix with a design strength of 4500 psi, unless otherwise shown on plans. Mix shall meet MCIB Specifications November 2007 as listed on the Concrete Promotional Group Website www.concretepromotion.com.
- G. Granular Bedding Aggregate Material: See Section 2100.
- H. Backfill: See Section 2100.
- I. Flowable Backfill: Flowable backfill shall consist of Controlled Low Strength Material (CLSM) complying with the requirements of Section 2100, Mix Design Type A.
- J. Trench Checks: Trench checks shall consist of flowable backfill as specified in Paragraph 3501.I.
- K. Pipe Encasement: Concrete used for pipe encasement shall be a 4500 psi MCIB mix. Reinforcing steel shall be new billet steel complying with the requirements of ASTM A 615, Grade 60.
- L. Pipe Collars: Concrete, whether reinforced or non-reinforced, used for pipe collars shall be a 4500 psi MCIB mix. Reinforcing steel, when required, shall be new billet steel complying with the requirements of ASTM A 615, Grade 60.

M. Pipe Anchors: Concrete, whether reinforced or non-reinforced, used for pipe anchors shall be a 4500 psi MCIB mix. Reinforcing steel, when required, shall be new billet steel complying with the requirements of ASTM A 615, Grade 60.

N. Building Sewer Stubs: Building sewer stubs shall be SDR 26 (minimum) PVC.

O. Casing pipe

1. Pipe

a. The casing pipe shall be made of steel, meeting the requirements of ASTM A 139, grade B, with a minimum yield strength of 35,000 psi.

b. The minimum wall thicknesses required are shown in the following table:

c.

Casing Diameter (inch)	Minimum Wall Thickness
10, 12, 14, 16	0.188" (3/16")
18, 20, 22	0.250" (1/4")
24, 26	0.281" (9/32")
28, 30, 32, 34	0.312" (5/16")
36, 38, 40, 48	0.344" (11/32")

2. Pipe Supports:

a. Casing Spacers: Casing spacer shall be a two-piece shell or band made from T-304 stainless steel of a minimum 14 gauge thickness. The shell/band shall have risers made of 10 gauge T-304 stainless steel and have a PVC liner. The bearing surface (skid or runner) shall be made of an ultra high molecular weight polymer, glass reinforced polyester, or fiberglass reinforced nylon. The shell/band shall be bolted together with T-304 stainless steel bolts. The configuration of the carrier pipe in the casing pipe shall be centered. End seals shall be made by the same manufacturer as the casing spacers and shall use stainless steel bands to hold end seals to pipes.

b. Wood Skids:

i. Wood skids shall be made of 4-inch by 4-inch pressure treated lumber, 3 feet long.

ii. Skids shall be attached to sewer pipe with two stainless steel bands.

iii. When wood skids are used, sand shall be blown into the annular space between the sewer and casing pipes.

iv. Skids shall be spaced at 120° intervals around the circumference of the pipe. Two skids shall be used on each end of the pipe joint.

3. Ends of the Casing Pipe: The ends of the casing pipe shall be closed with one of the following (see the Standard Drawings):
 - a. Manufactured end seal.
 - b. Concrete plug with allowances for water flow.

P. Manholes

1. Precast Sections: Precast concrete manholes shall conform to ASTM C 478 with the following modifications.
 - a. Wall thickness not less than one-twelfth of inside diameter, or 4 inches, whichever is greater, shall be used.
 - b. Cement, fine aggregate, coarse aggregate and water used in the manufacture of precast manholes shall be as specified in MCIB, Section No. 1 (Materials).
 - c. Integral cast bases shall be used unless prior approval is obtained from the City Engineer. The diameter of the base pad shall be 8 inches greater than outside diameter of the manhole.
 - d. Pipe penetrations shall be fitted with a flexible pipe-to-manhole connector. Refer to the Water Utilities List of Acceptable Manufacturers and Models.
 - e. The minimum distance from the invert of the downstream pipe to the top surface of the base shall be 3 inches.
 - f. Riser Rings
 - i. Concrete: Precast riser rings shall be 4 inches or 6 inches in thickness. The use of lightweight concrete with fiber reinforcement is recommended. Reinforcing shall conform to ASTM C 478. Tongue and groove joints shall be used.
 - ii. HDPE: Injection-molded HDPE adjusting rings as manufactured by Ladtech, Inc.
2. Cast-In-Place-Concrete: Concrete shall comply the requirements of a 4500 psi MCIB mix.
3. Reinforcing Steel: Reinforcing steel shall be new billet steel complying with the requirements of ASTM A 615, Grade 60.
4. Joint Sealant
 - a. Between Precast Sections: Joints between precast manhole pipe sections and between the manhole casting frame and precast manhole pipe sections shall be sealed with preformed butyl joint sealants meeting the requirements of ASTM C 990. The minimum bead dimension shall be 1 square inch. The butyl component

of the preformed joint sealant shall consist of 60 percent (minimum) butyl rubber. Preformed joint sealants shall remain flexible at temperatures as low as 0° F. Refer to the Water Utilities List of Acceptable Manufacturers and Models.

- b. Exterior of Joints: The exterior of all joints including the joint between the manhole casting frame and the precast manhole pipe sections shall be sealed with one of the following:
 - i. Press-Seal EZ-Wrap Butyl joint wrap with rubber backing, 6-inch wide, or an approved equal: The butyl component of the tape shall consist of 50 percent (minimum) butyl rubber, shall contain 2 percent or less volatile matter, and shall be 0.030 inches thick. The backing component shall be EPDM rubber. A release paper may be utilized. Refer to the Water Utilities List of Acceptable Manufacturers and Models.
 - ii. Heat-shrinkable joint wrap complying with ANSI/AWWA C216: The wrap system shall consist of a two-part material (backing + adhesive) with a closure system and a compatible primer. It shall consist of an irradiated and cross-linked polyolefin sheeting, pre-coated with a layer of anti-corrosion adhesive. The backing shall have a minimum recovery of 22%. The adhesive shall be a mastic-type, specially formulated to become fluid at temperatures achieved during installation and maintain flexibility in cold climates with installation temperatures down to -40°F. Upon cooling the adhesive shall form a tough, elastomeric protective layer. The wrap shall employ a closure seal to allow sealing of the overlap area. The overall thickness of an applied sleeve shall nominally measure 0.100 inches (2.5 mm). Refer to the Water Utilities List of Acceptable Manufacturers and Models.
 - iii. The casting shall be sealed to the structure with an external sealing system. The seal shall be a continuous band, made of EPDM (Ethylene Propylene Diene Monomer) rubber with a minimum thickness of 65 mils. Each unit shall have a 2" wide mastic strip on the top and bottom edge rubber band. The mastic shall be non-hardening butyl rubber sealant, with a minimum thickness of 1/4", and shall seal to the cone/top of the manhole and over the lip of the casting. Refer to the Water Utilities List of Acceptable Manufacturers and Models. Prior to placement of the mastic against the manhole or casting, the surfaces shall be coated with a primer capable of enhancing the mastic adhesion. The primer coat shall cover the entire surface area where the mastic is intended to adhere. Refer to the Water Utilities List of Acceptable Manufacturers and Models.
- 5. Non-Shrink Grout: Non-shrink grout shall be in the plastic state and show no expansion after set as tested in accordance with ASTM C 827 and shall develop compressive strength not less than 3,000 pounds per square inch with a trowelable mix within 24 hours per ASTM C 109. The placement time shall be not less than 45 minutes based on initial set per ASTM C 191.

6. Gasket: Pipe openings shall contain flexible gaskets complying with the requirements of ASTM C 923. Refer to the Water Utilities List of Acceptable Manufacturers and Models.
7. Waterproofing: All precast sections shall be waterproofed prior to shipment to the project site. Waterproofing shall be accomplished using one of the following coatings:
 - a. When a sewage force main terminates in a manhole, the internal surface of the first two receiving manholes shall be lightly sandblasted and coated with a total dry film thickness of not less than 8.0 mils of Tnemec Series 69 Hi-Build Epoxiline II or approved equal.
 - b. Exterior manhole surfaces shall be coated with one of the following materials:
 - i. A total dry film thickness of not less than 14.0 mils of bituminous coating.
 - ii. A total dry film thickness of not less than 4.0 mils of Tnemec Series 66 Hi-Build Epoxiline or approved equal.
8. Manhole Steps: Steel core plastic coated steps shall meet the following minimum requirements:
 - a. The standard plastic coated step shall be as referenced in the Water Utilities List of Acceptable Manufacturers and Models.
 - b. The plastic coating shall be a copolymer polypropylene complying with ASTM D 4101 with a classification of PP0344B33534Z02 or better.
 - c. The steel core shall be a minimum of ½ inch in diameter and shall conform to ASTM A 615, grade 60.
9. Manhole Castings
 - a. Material for all iron castings shall comply with the requirements of “Drainage Structure Castings,” AASHTO M306, Section 3, except if cast iron is used, it shall be ASTM A48/AASHTO M105, Class 30B or better.
 - b. Workmanship and Finish: Manhole castings shall comply with the requirements of AASHTO M306, Paragraphs 4.1 and 5.1. All castings shall be manufactured true to pattern and component parts shall fit together in a satisfactory manner.
 - c. Seating and Bearing Surfaces: All horizontal-bearing surfaces shall be machined. Castings shall conform to the requirements of AASHTO M306, Paragraph 4.3.
 - d. Rating: Castings shall be heavy duty and capable of handling loads of at least 40,000 pounds. Proof-load testing shall conform to the requirements of AASHTO M306, Section 7. Proof-load testing is not required for the adapters (Lee’s Summit ID Nos. LS106A-D, LS107A-D).

e. Markings:

- i. Imported castings shall meet the country-of-origin markings as required in Title 19, Code of Federal Regulations, Part 134 (19 CFR 134).

Lettering for country-of-origin marking shall not exceed 1 ½ inches.

- ii. Castings shall conform to the requirements of AASHTO M306, Section 11. Julian heat date shall be cast, not stamped, into the castings.

- f. Dimensional Tolerances: The dimensions of all castings shall be within the permissible variations specified in AASHTO M306, Paragraph 4.2, except 4.2.4 shall be replaced with the following: No casting shall weigh less than 95 percent of the specified weight shown on the Standard Drawings.

- g. Frames and Covers: Frames and covers shall meet the following minimum requirements:

- i. Critical dimensions and Lee's Summit part numbers shown in the Standard Drawings.
- ii. All manhole frames (except the slab bolt-down manhole frame) shall be designed and delivered with a full mud ring. Partial projections shall not be accepted.
- iii. All covers shall have two concealed pickholes that meets the manufacturer's requirements.
- iv. All covers shall have the "City of Lee's Summit" and "Sewer" cast into the piece in 1 ½-inch and 3-inch letters, respectively.
- v. Castings shall be fully interchangeable in the field with the equivalent Clay & Bailey models indicated in Paragraph 3501.P.9.h.vi.below.
- vi. All parts shall have a Lee's Summit part number cast into the piece in 1-inch letters. Location of the part number shall be such that when the part is installed, part number shall be readily visible without excavation of adjacent material. Part numbers shall be as shown below:

Part No.	Description
LS101A	Standard 24" Manhole Frame (Clay & Bailey 2007MR) - Matching cover is LS101B
LS101B	Standard 24" Manhole Cover (Clay & Bailey 2007) - Matching frame is LS101A
LS102A	Bolt-down Manhole Frame (Clay & Bailey 2014OR) - Matching cover is LS102B
LS102B	Bolt-down Manhole Frame Cover (Clay & Bailey 2014OR)

	- Matching frame is LS102A
LS103A	Slab Manhole Frame (Clay & Bailey 2002) - Matching cover is LS103B
LS103B	Slab Manhole Cover (Clay & Bailey 2007) - Matching frame is LS103A
LS104A	Slab Bolt-down Manhole Frame (Clay & Bailey KCMO R4) - Matching cover is LS104B
LS104B	Slab Bolt-down Manhole Cover (Clay & Bailey KCMO R4) - Matching frame is LS104A

vii. Covers marked with other cities' names and/or logos shall not be accepted.

viii. Covers located in the street right-of-way or adjacent utility easement shall be hot-dipped asphalt coated.

ix. Refer to the Water Utilities List of Acceptable Manufacturers and Models.

10. Epoxy Manhole Liner: Epoxy manhole liners shall be installed inside the first two receiving manholes downstream of force main sanitary sewer system and shall meet the following minimum requirements:

- a. Epoxy Manhole Liner for Manholes: The epoxy manhole liner shall be chemical resistant (below a pH of 2.0), VOC compliant, moisture tolerant, 100% solids, two (2) component epoxy system with the following properties:

Flexural Strength [ASTM D-790]: >10,000 psi

Compressive Strength [ASTM D-695]: >10,000 psi

Tensile Strength [ASTM D-638]: >7,000 psi

Adhesion: Concrete Substrate Failure

- b. Refer to the Water Utilities List of Acceptable Manufacturers and Models.

Q. Utility Markers:

- Utility marker tape shall be minimum 2 inches wide, 4-mil thick green plastic tape with the word "SEWER" lettered in permanent black graphics.
- In addition to utility marker tape, PVC and HDPE force main shall have a tracer wire installed along the top of the pipe. The wire shall be insulated, no smaller than 12 gauge, and for underground applications.
- Splices in wiring shall be made with epoxy/silicon splice connector.
- Tracer wire shall be installed along the top of service laterals. The wire shall have HDPE insulation, be no smaller than 12 gauge, and intended for underground applications. The tracer wire shall be green in color. Tracer wires shall terminate at

the ground surface inside a tracer box. Tracer box lids shall be green in color. Tracer wire shall be grounded to a minimum one pound magnesium anode at the sewer line.

3502 CONSTRUCTION AND INSTALLATION

A. General

1. Notification

a. Disruption of Sanitary Sewer Service:

- i. When a disruption of sanitary sewer service will occur, the Contractor shall notify Water Utilities Operations at least 48 hours in advance to make the necessary arrangements.
- ii. It shall be the Contractor's responsibility to place door hangers on the affected premises at least 24 hours in advance of the disruption. The door hanger shall indicate the date and time of the disruption and its anticipated length.

b. The Contractor's work shall be scheduled in a manner to accommodate the schedules of the City and the affected customers.

2. Protection of Existing Water Mains, Sewers, Structures, or Utilities

- a. Where new lines approach, cross, connect to, or run parallel to existing water or sewer mains, the Contractor shall be held completely responsible for protecting, preserving, and otherwise maintaining existing line during construction of new line. Any damage inflicted to water and sanitary sewer mains or structures must be promptly reported to Water Utilities Operations and arrangement made for the repair. Any damage inflicted to storm sewer lines or structures must be reported promptly to the Public Works Operations Division and arrangement made for repair. Any damage inflicted to any other utility must be reported promptly to the respective utility and arrangement made for the repair.
- b. Where new construction interferes with operation of existing mains, Contractor shall provide bypass lines or other temporary connections are required to maintain continuous service.
- c. The Contractor shall protect all existing structures, utilities, and work of any kind against damage or interruption of service that may result from the operations of the Contractor. Damage or interruption of service resulting from failure to do so shall be repaired or restored promptly at the expense of the Contractor.
- d. The Contractor shall give reasonable notice to utility companies and to other owners of property when such property is liable to damage or injury could result from the execution of the Work, so that the owners of such utility or property may take precautionary measures.

- e. The Contractor shall be responsible to adjust to finish grade any existing utility/appurtenances (i.e. valves, meter wells, sanitary sewer manhole, storm junction box etc.) that is affected by construction.
3. Handling and Storage
- a. Handle pipe materials and fittings in a manner to assure installation in sound and undamaged condition. Use slings, lifting bags, hooks, and other devices designed to protect pipe, joint elements, and coatings. In handling plastic pipe of 10 feet long or greater, a double sling will be required.
 - b. Ship, move, and store with provisions to prevent movement or shock contact with adjacent units.
 - c. Pipe shall be handled in a manner that minimizes the damage to the coating. Damaged coating shall be repaired in a manner complying with the pipe manufacturer's recommendations.
4. Inspection of Materials: All pipe, fittings, and accessories shall be examined by the Inspector prior to installation for soundness and specification compliance. Rejected materials shall be marked and removed from the project site, and replaced with approved materials.
5. Alignment: Pipe shall be laid to the lines and grades as shown on the approved Engineering Plans.
6. Cleaning: All pipe, fittings, and accessories shall be kept clean of foreign matter while being handled or stored. During installation, foreign matter shall not enter the pipe or appurtenances. At the end of each working day, a temporary plug shall be installed at the termination of the pipeline.

B. Sanitary Sewer Installation

1. Installation Standards: All pipes shall be installed in accordance with the following standards:
- a. DIP - ANSI/AWWA C 600.
 - b. PVC Pipe - ASTM D 2321.
 - c. HDPE Pipe - Plastics Pipe Institute, "Underground Installation of Polyethylene Pipe".
2. Installation
- a. Governmental Requirements: Sanitary sewer main installation shall comply with applicable local, State, and Federal requirements.

- b. Trench Dewatering: See Section 2100.
- c. Drainage Course Crossings: See Section 2100.
- d. Trench Widths
 - i. Minimum Widths: Trench widths and pipe clearances shall be not less than those shown in the following table.

MINIMUM TRENCH WIDTHS AND PIPE CLEARANCES (in)			
Nominal Pipe Diameter	Trench Width¹	Pipe Side Clearance² (Soil/Rock)	Pipe Bottom Clearance (Soil/Rock)
6	22	6/6	6/6
8	22	6/6	6/6
10	24	6/6	6/6
12	27	6/6	6/6
15	30	6/6	6/6
18	34	6/6	6/6
21	39	7/9	6/9
24	43	7/9	6/9
27	48	8/9	6/9
30	54	8/9	6/9
¹ Measured below a horizontal plane 6 inches above the top of the pipeline. ² Measured from the outside face of pipe barrel to inside face of trench.			

- ii. Maximum Widths
 - (a) Maximum trench widths shall not exceed the manufacturer's recommendations.
 - (b) The allowable maximum trench widths hereinafter specified apply only to that portion of the trench below the horizontal plane parallel to and 6 inches above the top of the pipe.
 - (c) The allowable maximum widths may be exceeded at manholes, bore pits, tees, and in unstable earth material. Where the maximum trench width is exceeded, the Contractor shall provide appropriate embedment as indicated by the Design Engineer and the City Engineer.
 - iii. Trench Slope: See Section 2100.
 - iv. Trench Shields: See Section 2100.
 - e. Compacted Fill: See Section 2100.

- f. Pipe Embedment: All pipe shall be bedded in bedding material with a minimum thickness beneath the pipe as specified in Paragraph 3502.B.2.d. See Section 2100.
 - g. Bedding Installation: See Section 2100.
- 3. Backfill: See Section 2100.
- 4. Utility Marker Tape: Install utility marker tape above the centerline of each sewer line. Bury marker tape 18 to 24 inches below finished grade, along the full length of the sewer line. When tracer wire is required, the tracer wire shall be installed along the top of the pipe on all mains and services so that the wire is in relatively continuous contact with the pipe and shall be for underground applications. The wire shall be accessible at every manhole, vault or tracer box. Marker tape and tracer wire shall be inspected by the public works inspector prior to backfill. All tracer wires shall be tested before acceptance. Any tracer wire broken during installation shall be repaired by the Contractor.
- 5. Wyes and Building Sewer Stubs: Wyes and building sewer stubs shall be installed as shown on the Engineering Plans or specified herein.
 - a. Building sewer stubs shall be adequately plugged to prevent foreign matter from entering the pipe during construction.
 - b. Wyes shall be installed at a maximum of 45 degrees and not less than 30 degrees with pipe spring-line, for pipe sizes 8- through 16-inch diameters. Wyes shall not be installed in pipe sizes equal to or greater than 18 inches in diameter.
 - c. When the building sewer stub grade exceeds 20 percent, pipeline anchors shall be installed as required under Paragraph 6501.E.7 with the first anchor not more than 12 or less than 5 feet upstream of the wye.
 - d. All building sewer stubs shall be constructed bell to spigot.
 - e. For new construction, where a wye has been provided for a private building sewer, a second wye shall not be provided (cut-in by the builder).
 - f. The Contractor shall maintain an accurate record for submittal to the Design Engineer of location, size, and direction of each wye and insertable fitting and the elevation, location, size, and length of each building sewer stub. Locations shall use the pipeline stationing as shown on the Engineering Plans.
- 6. Gravity Sewers: All gravity sewers shall be installed to the alignment, elevation, slope, and with pipe embedment as specified and/or shown on the Engineering Plans.
- 7. Pipe Encasement, Collars, Anchors, and Trench Checks
 - a. Concrete construction shall comply with ACI 301, Specifications for Structural Concrete.

- b. Total or partial encasement of pipe in concrete shall be used where the required safe supporting strength of the pipe cannot be obtained by other bedding methods. Concrete encasement shall also be provided at locations to protect public water supplies or where there exists the possibility that standard bedding may be eroded by currents of water under and around the pipe.
 - c. Concrete encasement shall be constructed at locations indicated and in accordance with details as shown on the Engineering Plans and in the Standard Drawings. Start and terminate encasement at a pipe joint. Adequately support and block the pipe to maintain position and prevent flotation. Form to dimensions indicated or construct full width of a trench.
 - i. Longitudinal reinforcement shall be continuous.
 - ii. Concrete encasement shall be protected and cured so as to prevent excessive evaporation of moisture or freezing. Backfilling will not be considered as a suitable method of curing the encasement.
 - iii. Backfill trench only after concrete encasement has obtained a minimum of 2000 psi. All backfilling shall be done in accordance with Section 2100.
 - d. Collars shall be constructed at locations indicated on and in accordance with details shown on the Engineering Plans and in the Standard Drawings.
 - e. Anchors shall be constructed at locations indicated on and in accordance with details shown on the Engineering Plans and in the Standard Drawings.
 - f. Trench Checks: Trench checks shall be constructed at locations indicated on and in accordance with details shown on the Engineering Plans and in the standard drawings. They shall consist of flowable backfill and extend 12 inches below the bottom of the pipe. Length shall be a minimum of 12 inches and width shall be the width of the trench. The height of the trench check shall extend to 12 inches above the top of the pipe.
8. Pipe Laying: All pipe shall be installed in accordance with the pipe manufacturer's recommendations, except as modified herein.
- a. Pipe laying shall not proceed if the trench width as measured at the top of pipe exceeds the maximum allowable trench width. If this occurs, the Contractor shall submit to the Design Engineer for approval a better bedding for the pipe or pipe of sufficient strength to provide safe supporting strength.
 - b. All pipe and fittings shall be stored and handled with care to prevent damage thereto. Do not use hooks to transport or handle pipe or fittings. Do not drop pipe or fittings.
 - c. Pipe and fittings rejected by the Inspector shall be marked and removed from the project site. All pipe and fittings shall be examined for soundness and

specification compliance prior to placement in the trench and rejected pipe or fittings shall not be incorporated into the pipeline. Check the class or pipe strength to be sure proper pipe is installed.

- d. Clean joint contact surfaces prior to jointing. Use lubricants, primers, or adhesives as recommended by the pipe or joint manufacturer. Keep lubricants and applicators clean.
- e. Pipe laying shall begin at the lowest point. The Contractor will not be allowed to lay any pipe if manholes are not on the project site. The pipe laying upstream of a manhole shall not proceed until the base of the manhole has been placed and leveled.
- f. Unless otherwise required, lay all pipe straight between manholes. Excavate bell holes for each pipe joint. When jointed, the pipe shall form a true and smooth pipeline.
- g. The alignment of all pipelines between adjacent manholes shall be true to line and grade. The pipeline from manhole to manhole shall reflect the full bore of the pipe. The pipe shall be truly centered into the abutting pipe.
- h. The grade lines shown on the profile drawings extend from the centerline of the top manhole to the centerline of the bottom manhole. The pipes and appurtenances shall be truly laid to line and grade throughout, all junctions and other pieces required shall be properly excavated for and laid as shown on the Engineering Plans, and the following tolerances from true horizontal alignment and vertical grade shall be maintained:

Horizontal Alignment:	± 12 inches
Vertical Grade:	± 0.1 feet

Pipe installed but not meeting these tolerances shall be ordered removed and replaced at the Contractor's expense.

- i. The sewer trench shall be excavated to sufficient depth to allow embedment to be placed in the bottom of all trenches. At the pipe joints, the trench shall be excavated to an additional depth so that the bell will not rest on the bottom of the trench, and all the weight of the pipe shall be evenly distributed along the entire length of the barrel of the pipe.
- j. The sewer must be made watertight at all points; any leaks or other defects discovered at any time before the final acceptance of the Work shall be immediately repaired or that portion of the sewer shall be rebuilt if necessary.
- k. In all cases, full length sticks of pipe shall be used, except in making closures.
- l. Clean interior of all pipe, fittings, and joints prior to installation. To exclude entrance of foreign matter during discontinuance of installation, close open ends of

pipe with snug fitting closures. Take reasonable precautions to not let water fill the open trench, and include provisions to prevent pipe flotation. Remove water, sand, mud, and other undesirable backfill materials from trench before removal of end cap.

- m. In forming joints, each length of pipe shall be carefully aligned in such manner as to form an accurate concentric joint, thus providing a uniform circular pipe opening. Each length of pipe shall thrust into the bell and shall be securely held in position until the next length of pipe has been placed. Insofar as possible, commence laying of downstream end of line and install pipe with spigot or tongue end downstream.
- n. The pipeline trench excavation shall be dewatered sufficiently to allow pipe joints to be made under dry conditions. No joints shall be made under water.
- o. Joints:
 - i. Joints shall in general be made in accordance with the manufacturer's recommendations and as specified herein. All joints to be welded or fused shall be performed by a technician certified by the manufacturer.
 - ii. Clean and lubricate all joint and gasket surfaces with lubricant recommended by pipe manufacturer.
 - iii. Care shall be exercised by the Contractor to insure against damage to joint material in storage, handling, or placing operations.
 - iv. No damaged joint material shall be permitted to be used, and the same shall be removed from the job site.
 - v. All pipe joints shall be completed by insuring that the ends of the pipe to be joined are in contact and completely shoved into "home" position.
- p. Pipe shall be cut in a neat workmanlike manner without damage to pipe. Cutting of pipe with a torch is not permitted. Smooth cut by power grinding to remove burrs and sharp edges. Repair the lining as required and approved by the Inspector.
- q. All pipelines shall be plugged at the end of each day's progress. Plugs or other positive methods of sealing shall be utilized at all times to protect any existing system from entrance of storm water or other foreign matter.
- r. When a sanitary sewer line crosses an existing pipeline (water lines and storm), and the clearance is less than 18 inches, concrete encasement shall be required in a manner approved by the City's on-site representative.

9. Temporary Plugs

- a. Provide and install plugs as manufactured by pipe supplier or as fabricated by Contractor if approved. Plugs shall be watertight against hydraulic heads up to 20 feet. Secure plugs in place in a manner that facilitates removal when required to connect pipe.
 - b. Plugs shall be installed as specified or where shown on Engineering Plans. Also the open end of the sewer shall be plugged at the end of the work day with a suitable mechanical plug to prevent entry of foreign material until work is resumed.
10. Removal of Water: The Contractor shall provide dewatering as specified in Section 2100. Damaged pipe or structures of any kind resulting from insufficient dewatering facilities or similar lack of proper conduct of the work shall be replaced by the Contractor at their own expense. No structure or pipes shall be laid in water, and no water shall be allowed to run into or over any concrete work or pipe, or into or through any pipe.
11. Sewer Main Connections to Existing Pipelines and Structures
- a. General: Connect pipe to existing structures and pipelines where indicated.
 - b. Tying a Sewer Main to an Existing Manhole: Prepare structure by making an opening with manufacturer's recommended clearance all around fitting to be inserted. The concrete structure shall be core drilled, and a flexible pipe-to-manhole connector/gasket shall be installed in such a manner that a watertight condition will result. Refer to the Water Utilities list of Acceptable Manufacturers and Models for flexible pipe-to-manhole connectors/gaskets.
 - c. Adding a Manhole onto an Existing Sewer Main:
 - i. The Contractor shall cut the existing sewer main, set a pre-cast base onto a 6-inch thick (minimum) crushed rock bedding layer, and insert sewer pipe through the manhole to connect the existing ends of the sewer main. The ends may be connected to the existing sewer through the use of rigid couplings if a bell(s) is (are) not available. The inverts may be formed using non-calcium chloride high-early strength concrete.
 - ii. Any portion of the existing sewer damaged by the Contractor shall be repaired or replaced. Any damaged vitrified clay pipe shall be replaced with PVC pipe, as a minimum, or DIP if required by its location.
 - iii. Bypass pumping shall be required and shall be coordinated with Public Works Inspections.
 - d. Pipe Connecting to a Structure: Pipe connecting to a structure shall be supported with bedding aggregate as specified in Section 2100.

12. Connection of Pipes of Dissimilar Materials:

- a. General: The connection of pipes of different materials shall be made using approved transition couplings, and shall provide a permanent and watertight connection that will withstand the hydrostatic test pressure.
- b. Pipe Diameters less than 15 Inches: Connections between different pipe materials less than 15 inches in diameter shall be made using a Maxadaptor coupling or approved equal unless otherwise specified on the Engineering Plans.
- c. Pipe Diameters Greater than or Equal to 15 Inches: Connections between different pipe materials greater than or equal to 15 inches in diameter shall be made using a Fernco Strong Back coupling. The coupling shall be encased in MCIB/KCMMB 4000 psi concrete mix to a level 6 inches above the top of the pipe material unless otherwise specified on the Engineering Plans.

13. Abandonment of Building Sewer Stubs

- a. Building Sewer Stubs shall be disconnected from the sewer main when buildings are demolished and future reuse of the sewer stub is not anticipated or the sewer stub is not compliant with the applicable codes and standards in effect at the time.
- b. Building sewer stubs shall be disconnected from the sewer main when property that contains sewer stubs is re-platted and those sewer stubs are no longer necessary for future development.
- c. A building sewer stub may be left in place and reused for future development if the stub and the connection to the main are compliant with the codes and standards in effect at the time, if it is capped with a water tight seal at or near the edge of the right-of-way and it is marked by vertically burying a 2"x4" with a steel spike from the end of the sewer stub to the surface of the ground.
- d. Building sewer stubs being disconnected from the sewer main shall be disconnected by the Water Utilities Department, after the contractor has provided access to the sewer main via an OSHA compliant excavation with proper shoring as necessary. Water Utilities staff reserve the right to not enter any trench determined to be unsafe.

14. Abandonment of Sewer Mains

- a. Prior to abandonment of a sewer main, the Contractor shall contact the Water Utilities Department to verify that no existing services will be affected. Building sewer stubs shall be properly abandoned prior to abandoning the sewer main.
- b. Sewer mains shall be abandoned by plugging each end of the line segment with a 1- foot thick plug of non-shrink grout sealed with Portland Cement Grout, or removed, backfilled and restored as directed by the Water Utilities Department.

15. Protection of Water Supplies

- a. There shall be no physical connection between a public or private potable water supply system and a sewer, or an appurtenance thereto, that would permit the passage of any wastewater or polluted water into the potable water supply.
- b. Sewer mains, i.e., house connections, building sewers, trunk lines, interceptors, force mains, etc., shall not be constructed within a 100-foot radius of a public water supply well. Greater separation may be required where soil and drainage conditions indicate the need for greater protection. Sewer mains constructed of DIP may be constructed within 10 feet of a private water supply well. Sewer mains constructed of other materials must be at least 50 feet from a private water supply well.
- c. For sewer mains paralleling or crossing water mains, see Paragraph 6501.E.1.c.
- d. Water and sewer mains shall not be placed in the same trench or excavation.

C. Acceptance Tests for Completed Sewers

1. General

- a. The Contractor shall furnish all labor, equipment, water, materials, and reports for the required acceptance tests. All pipelines, including building sewer stubs, shall undergo and pass all required tests to determine soundness and workmanship. Pipelines that do not comply with the City of Lee's Summit Standard Specifications shall be repaired and/or replaced and shall be retested until the pipeline meets said specifications.
 - b. No testing shall be performed before backfill and compaction operations have been completed unless otherwise approved by the Inspector. In general, testing for sanitary sewers shall begin at least 30 days after completion of all sanitary sewer.
 - c. After backfilling has been completed, the Contractor shall conduct all testing in the presence of the Inspector.
 - d. Each reach of sewer shall meet the requirements of the acceptance tests. All defects shall be repaired to the satisfaction of the Inspector.
 - e. The Contractor shall clean and flush with clear water the pipe of excess mortar, joint sealant, and other dirt and debris prior to inspection.
2. Sewer Pipe Alignment and Grade Testing: Alignment, grade and visible defects shall be checked as follows:
- a. Sewer Pipe Deflection Testing: Flexible pipelines (i.e., PVC pipe) shall be tested for deflection by pulling a mandrel through the entire length thereof.
 - i. The mandrel (go/no-go) device shall be cylindrical in shape and constructed with nine evenly-spaced arms or prongs. Mandrels with fewer arms will be

rejected as not sufficiently accurate. The dimensions of the mandrel shall be as listed in the table below. The mandrel diameter dimension shall carry a tolerance of ± 0.01 inch. Allowances for pipe wall thickness tolerances or ovality (from heat, shipping, poor production, etc.) shall not be deducted from the mandrel diameter dimension but shall be counted in as part of the 5 percent or lesser deflection allowance. Contact length shall be measured between points of contact on the mandrel arm. The length shall not be less than as shown in the table below.

Nominal Diameter (in)	Mandrel Length (in)	Mandrel Diameter (in) ¹	
		SDR 26 ²	SDR 21 ³
8	8	7.37	7.41
10	9	9.21	9.21
12	10	10.96	10.96
15	12	13.42	N/A
18	15	N/A	15.47
21	16	N/A	N/A
24	18	N/A	20.63
27	27	N/A	N/A

¹ Mandrel diameter = [avg. outside diameter - 2*(min. wall thickness)]*0.95

² Calculated using values from ASTM D3034.

³ Calculated using values from ASTM D2241.

- ii. The Inspector shall be responsible for approving the mandrel. In the event the Contractor provides the mandrel, he/she shall provide proving rings to verify this. No mandrel testing will be witnessed or approved by the Inspector without completion of the aforementioned verification of the mandrel size for the Work.
 - iii. The mandrel shall be hand-pulled by the Contractor through all sections of PVC sewer mains. Any sections of sewer not passing the mandrel test shall be uncovered, and the Contractor shall re-round or replace the sewer to the satisfaction of the Inspector. These repaired sections shall be retested.
 - iv. Sections of DIP sewer main shall be visually checked for deflection, i.e., not deflection tested with the mandrel due to the potential for damaging the cement mortar lining.
- b. Television/Video Inspection: Sewer mains installed as part of the Work are subject to inspection by closed circuit television prior to 1) issuing a Certificate of Substantial Completion and 2) the end of the correction period. Television / video inspection will be done twice by the City at the City's expense. If more than two television / video inspections are necessary, they shall be performed by the

contractor and the television / video and inspection report submitted to the City for its review. Any deficiencies noted shall be repaired at the expense of the Contractor.

3. Exfiltration-Infiltration Testing

a. General

- i. Air pressure or hydrostatic tests shall be conducted on sewers before acceptance by the City. The exfiltration-infiltration shall not exceed 50 gallons per day per inch of nominal diameter per mile of sewer main for any section of the Work.
- ii. Immediately prior to conducting a test, the groundwater level shall be determined by augering a vertical hole adjacent to the pipe and measuring the distance to the water level. Exfiltration head and air test pressures shall be adjusted for groundwater elevations over the top of the pipe.

- b. Sewer Pipe Exfiltration Testing: Exfiltration tests shall be performed by the Contractor using one or a combination of the methods as set forth below. The required air pressure and/or exfiltration testing shall be successfully performed on carrier conduits prior to sealing of the ends of the casing conduits. PVC gravity sewer pipe shall be air tested.

i. Air Testing for PVC and DIP Gravity Sewer Mains

- (a) The Contractor may perform air tests for all pipe sizes.
- (b) Furnish all facilities required including necessary piping connection, test pumping equipment, pressure gauges, bulkheads, regulators to avoid over pressurization, and all miscellaneous items required.
- (c) Each section of gravity pipeline between manholes and/or structures shall be tested after backfilling as outlined below and in accordance with ASTM F 1417. The time-pressure drop method specified in 8.2.2 of ASTM F 1417 shall be used.
- (d) If the groundwater level is 2 feet or more above the top of the upstream end or if the test pressure required for the test is more than 9 psig, air testing should not be used.
- (e) The pipe plug for introducing air to the sewer main shall be equipped with two taps. One tap will be used to introduce air into the line being tested through suitable valves and fittings, so that the input air may be regulated. The second tap will be fitted with valves and fittings to accept a pressure test gauge indicating internal pressure in the sewer pipe. Additional valves and fitting will be incorporated on the tap used to check internal pressure so that a second test gauge may be attached to the internal pressure tap. The

pressure test gauge will also be used to indicate loss of air pressure due to leaks in the sewer main.

- (f) The pressure test gauge shall meet the following minimum specifications:

Size (diameter)	4-1/2 inches
Pressure Range	0-15 psi
Figure Intervals	1 psi increments
Minor Subdivisions	0.05 psi
Pressure Tube	Bourdon Tube or diaphragm
Accuracy	+/-0.25% of maximum scale reading
Dial	White coated aluminum with black lettering, 270° arc and mirror edge
Pipe Connection	Low male 1/2-inch N.P.T.

Calibration data not more than one year old shall be supplied with all pressure test gauges. Certification of pressure test gauges will be required from the gauge manufacturer. This certification and calibration data shall be given to the Inspector prior to the performance of any air tests conducted for the Work.

- (g) Plug ends of line and cap or plug all connections to withstand internal pressure. Due to safety considerations, the Contractor must take care to brace both the end of the pipe and plug before introducing test pressure into the system. The Contractor can then connect the air control equipment to the air hose and begin to pressurize the system. During the pressurization process, the Contractor shall monitor the air pressure of the system so that internal pressure does not exceed 5.0 pounds per square inch gauge (psig). After reaching 4.0 psig, throttle the air supply to maintain between 4.0 and 3.5 psig for at least 2 minutes in order to allow equilibrium between air temperature and pipe walls. During this time, check all plugs to detect any leakage. If plugs are found to leak, bleed off air, tighten plugs, and again begin supplying air. After temperature has stabilized, the pressure is allowed to decrease to 3.5 psig. At 3.5 psig, begin timing to determine the time required for pressure to drop to 2.5 psig. If the pressure begins to slowly drop from 3.5 psig and if the total time, in seconds, for the air pressure to decrease from 3.5 psig to 2.5 psig is greater than that shown in the table below, the pipe shall be presumed free of defects.

Pipe Size (in)	Minimum Time (min:s)	Length for Minimum Time (ft)	Time for Longer Length (s) L = Total Length
8	7:34	298	1.520 L
10	9:26	239	2.374 L
12	11:20	199	3.418 L
15	14:10	159	5.342 L
18	17:00	133	7.692 L

21	19:50	114	10.470 L
24	22:40	99	13.674 L
27	25:30	88	17.306 L
30	28:20	80	21.366 L

If air test fails to meet above requirements, repeat the test as necessary after all leaks and defects have been repaired and backfilled.

ii. Hydrostatic Tests for Gravity Systems:

- (a) Test section shall be filled with water not less than 12 hours prior to testing. Refill the test section of pipe prior to performing the test.
- (b) Perform at depths of water as measured above center line of pipe of not less than 4 feet or more than 10 feet (consideration shall be given for a water table above said centerline). Maintain the test as necessary to locate all leaks but not less than two hours.
- (c) The Design Engineer shall determine the maximum allowable exfiltration rate for a given test section and then field verify that the maximum exfiltration rate has not been exceeded for that section. The maximum allowable exfiltration rate shall be approved by the City Engineer prior to testing.

- c. Sewer Pipe Infiltration Testing: Where sewers are laid within the groundwater table, infiltration testing shall be conducted. Where the Inspector discovers evidence of infiltration, the Design Engineer and the City Engineer shall be contacted. The Contractor shall install weirs or other suitable flow rate measuring devices adequate to determine to the satisfaction of the City Engineer that the specified infiltration limit is not exceeded for that reach of gravity sewer. Where the specified infiltration limit is exceeded, the Contractor shall repair or replace the defective reach of the pipeline. Following repair of the pipeline, the Contractor shall re-measure infiltration flow rates and make additional repairs until an acceptable infiltration flow rate is achieved.

D. Manhole Installation:

1. Bases

- a. Integral cast bases shall be reinforced in accordance with ASTM C 478. Precast integral cast bases shall be installed on a maximum of 6 inches of bedding aggregate. Depths exceeding this amount shall be filled with MCIB/KCMMB 4000 psi concrete mix.
- b. If integral cast bases cannot be used, cast-in-place concrete bases shall be used with the approval of the City Engineer. Cast-in-place bases shall be MCIB/KCMMB 4000 psi concrete mix and have a minimum thickness of 12 inches. The bottom wall sections shall be embedded in the base section a

minimum of 4 inches. The bottom precast wall section shall not be set upon a previously poured base. Wood shall not be used for supporting or leveling the wall section prior to pouring the base.

2. Inside Dimensions: The minimum horizontal clear distance in the barrel of the manholes shall not be less than 4 feet.
3. Precast
 - a. Delivery: Precast concrete components shall not be delivered to the job until representative concrete control cylinders have attained at least 80 percent of the specified minimum design strength.
 - b. Inspection: Precast concrete shall be inspected when delivered. Rejection of defective or cracked precast concrete components shall be in accordance with ASTM C 478.
 - c. Construction: Precast sections shall be cleaned of all dirt, grass, and other deleterious matter. Seal wall and cone joints with a minimum of two beads of preformed butyl joint sealant. Seal the joints between the top of the cone, adjustment or riser rings and the manhole frame with a double bead of preformed butyl joint sealant. Sections shall be placed so that steps are aligned but without rotation or damage to sealant integrity. Lift holes in excess of 2 inches in depth shall be patched with non-shrink grout.
4. Cast-in-Place:
 - a. Wall Thickness: Wall thickness shall conform to the dimensions as shown on the Engineering Plans.
 - b. Construction: Reinforcement steel shall be placed as shown on the Engineering Plans. Tie-holes shall be patched with non-shrink grout. Wall sleeves, where required, shall be installed as shown on the Engineering Plans. Water stops shall be installed at the wall and slab connection and shall be of the size, thickness, and material shown on the Engineering Plans.
 - c. Waterproofing: Interior protective coatings, where required, shall conform to the material specifications. Application shall conform to the manufacturer's recommendation.
5. Sealants. A double bead of preformed butyl joint sealer shall be applied to all joints. For the minimum bead dimension, see Paragraph 3501.P.44. The vertical spacing between manhole sections shall not exceed 1/4 inch. Joint sealants shall not be applied on damp or dirty surfaces.
6. Joint Wraps: The exterior of all joints, including the frame and cover assembly, shall be sealed with a 6-inch wide butyl joint wrap with rubber backing. Refer to the Water Utilities List of Acceptable Manufacturers and Models. The tape shall be overlapped

at least twice its width. The tape shall not be stretched during application. Primer and/or adhesive, as recommended by the tape supplier, shall be employed for adverse, critical, or other applications.

7. Epoxy Manhole Liner: Installation of epoxy manhole liner shall consist of: cleaning the entire manhole interior surface, preparation of the manhole interior surface, frame seal, grade adjustment, cone/wall joint, pipe seals, bench and invert as required, and lining the manhole interior surface with a two component, 100% solids epoxy coating system which provides a durable, high strength, monolithic lining, at an average thickness of 125 mils with a minimum thickness of 120 mils. The first two manholes downstream of a force main entering the system shall be lined along with any other manholes identified on the Engineering Plans.
8. Gaskets. When gaskets are used, two gasket clamps shall be utilized at each pipe-to-gasket connection with the take-up screws for the gasket clamps being positioned a minimum of 90° apart.
9. Steps: Steps shall be aligned vertically below the casting and spaced at 16-inch centers. The top step shall be not more than 1 foot below the top of the cone. The lowest step shall be not more than 1 foot above the invert bench. Field drilled step holes are not permitted in precast concrete manholes unless approved by the Inspector.
10. Castings:
 - a. Castings shall be installed with the mud ring inserted inside the manhole opening and resting on a minimum of two rows of preformed butyl joint sealant.
 - b. Bolt-down castings shall be held in place as shown on the Engineering Plans.
 - c. Bolt-down castings shall be bolted to the manhole, not to the adjusting ring.
11. Top Slabs: Thickness shall conform to the dimensions and reinforcement steel shall be placed as shown on the Engineering Plans.
12. Inverts: Inverts shall be at least MCIB/KCMMB 4000 psi concrete mix and steel-troweled to produce a dense, smooth finish. The invert channel shall be "U" shaped in cross section and extend upward three-fourths of the inside pipe diameter. Smooth transitions shall be formed for pipes of different sizes, elevation, and bends. The invert bench shall be sloped to drain. In no case shall the inverts extend into the pipe or create areas that will allow for the accumulation of debris or interfere with flow through the manhole. Manholes with precast inverts shall not be used, except as allowed in Paragraph 6501.H.10.a.
13. Top Elevation: The finish top elevation of manhole castings shall conform to the following unless otherwise shown on the Engineering Plans or directed by the Inspector.

- a. In paved or future paved areas, the top of the casting shall conform to the slope of the pavement and be 1/8 inch below the finished pavement elevation.
 - b. In non-pavement areas, the top of the casting shall be at the elevation shown on the Engineering Plans or as directed by the Inspector.
14. **Manhole Adjustment:** All new manholes will be provided with an adjustment ring(s) underneath the casting as shown on Engineering Plans. A maximum of two 6-inch or three 4-inch riser rings shall be installed on top of the cone section. Minimize the number of riser rings used. The joints shall be sealed with a double bead of preformed butyl joint sealant. If the top of an existing manhole is required to be raised to an elevation that will exceed 12 inches, or lowered more than the adjustment rings will allow, all vertical adjustments shall be made to the barrel of the manhole.
15. **Manhole Backfilling:** Manhole backfilling shall be governed by Section 2100. Any damage to the exterior manhole waterproofing shall be coated with 14.0 mils of bituminous coating prior to backfilling.

E. Acceptance Testing for Completed Manholes

- 1. **General:** All manholes and other structures installed or otherwise disturbed during construction shall be tested for infiltration-exfiltration by the method described herein. Infiltration-exfiltration testing shall be performed in the presence of the Inspector. The Contractor shall notify the Inspector 2 working days prior to beginning manhole testing. All visible leaks shall be repaired by the Contractor prior to testing and during the correction period.
- 2. **Infiltration-Exfiltration Testing:**
 - a. For new manholes, lift holes penetrating the manhole wall in excess of 2 inches in depth shall be plugged with an approved non-shrink grout prior to testing. All pipes entering the manhole shall be plugged at least 8 inches into the sewer pipe. The plug shall be inflated at a location beyond the manhole/pipe. The plug and pipe shall be braced securely to prevent either item from being drawn into the manhole.
 - b. **Test Method:** The vacuum test apparatus shall be placed inside or on top of the casting and the seal inflated according to manufacturer's directions as appropriate. A vacuum of 10 inches of mercury shall be drawn, and then the vacuum pump shall be shut off. With valves closed and hoses removed, the time shall be measured for the vacuum to drop to 9 inches of mercury. The manhole shall be acceptable if the time for the vacuum to drop from 10 inches to 9 inches is as follows:

Manhole Depth	Time (min)
10 feet or less	2.0
10.1 to 15.0 feet	2.5

15.1 to 25 feet	3.0
25.1 feet or greater	3.5

- c. Resealing, repairs, and retesting shall be allowed at the discretion of the Inspector.
- d. If the manhole fails the initial test, necessary repairs shall be made with a water reactive elastomeric chemical grout, such as 3M Scotch Seal Chemical Grout 5600, or a water reactive polymer solution, such as Avanti AV-202, or equivalent. Resealing and retesting shall be performed until the manhole passes the test.

3503 ACCEPTABLE MANUFACTURERS AND MODELS

- A. General: A list of acceptable manufacturers and models for various materials will be maintained by the City Engineer and updated on a regular basis. An approved list of materials can be found on the City's web site www.cityofls.net. Go to Development, then Development Regulations, then Design and Construction Manual.

SECTION 3900 - WATER MAINS
CITY OF LEE'S SUMMIT, MISSOURI
STANDARD SPECIFICATIONS

3901 MATERIALS

- A. General: All materials shall comply with the latest revision of the reference standard applying to that particular material. All pipes, fittings and appurtenances containing more than 0.25 percent lead calculated by weighted average shall not be used except materials in brass service saddles and fire hydrants.
- B. Pipe and Fittings for Water Mains
1. Allowable Materials: Pipe and fitting materials used in the construction of water mains shall be:
 - a. Ductile Iron (DI), special thickness Class 50
 - b. Polyvinyl chloride (PVC), AWWA C900 and AWWA C905.
 - c. Fusible Polyvinyl chloride (PVC), Fusible AWWA C900 and AWWA C905
 2. Requirements: The pipe manufacturer shall furnish pipe of materials, joint types, sizes, and strength classes indicated and specified. The Contractor shall furnish maximum pipe lengths normally produced by the manufacturer except for fittings, closures, and specials.
 3. Manufacturer's Experience: The Manufacturer shall be experienced in the design, manufacture, and commercial supplying of the specified material.
 4. Inspection and Testing: Inspection and testing shall be performed by the Manufacturer's quality control personnel in a manner complying with applicable standards.
 5. Markings: Each pipe or fitting shall have the following information plainly and permanently marked by indenting in the outside surface of the pipe or painted thereon with waterproof paint:
 - a. Pipe size and class or designation.
 - b. Date manufactured and lot number.
 - c. Manufacturer's name or trademark.
 - d. For ductile iron pipe, in lieu of the above listed markings, the information may be provided on an adhesive bar code labeling system that complies with AWWA Standards. The adhesive label shall be provided on the outside surface near the bell.
 6. Handling: The Manufacturer and Contractor/Developer shall use equipment and methods adequate to protect the pipe and joint elements and to prevent shock contact of adjacent units during moving or storage. Damaged sections that cause reasonable doubt as to their structural strength or water-tightness will be rejected.

7. On-Site Inspection: All pipe and appurtenances will be inspected by the Inspector prior to installation, and all damaged pieces as well as any pieces not complying with the City of Lee's Summit Standard Specifications shall be immediately removed from the job site and replaced by pipe and appurtenances as may be acceptable to the Inspector at the expense of the Contractor/Developer.
8. Certification: Suppliers shall submit certifications with their material delivery. These certifications shall be given to the Inspector.

C. Ductile Iron Pipe and Fittings

1. Design: All DI pipe (DIP) shall comply with ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51. The minimum thickness shall be Special Thickness Class 50.
2. Fittings:
 - a. All DI fittings shall comply with ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53 and shall have a pressure rating of 350 psi.
 - b. All DI fittings shall have the pressure rating and the letters "DI" or "DUCTILE" distinctly cast into the outside surface.
3. Joints: Mechanical and push-on joints for pipe and fittings shall comply with ANSI/AWWA C111/A21.11. Natural rubber gaskets shall not be accepted.
4. Restrained Joint Pipe and Fittings:
 - a. Restrained joint pipe and fittings shall be per the pipe manufacturer's recommendation. American Flex-Ring, US Pipe TR Flex, Griffen Snap-Lok, Griffen Bolt-Lok and McWane TR Flex are considered restrained joints.
 - b. Retainer glands (e.g., Megalug, Uni-Flange, etc.), and gripper gaskets (e.g., Field-Lok, Fast-Grip, etc.) are not considered a permanent restraint and must be used in conjunction with straddle or thrust blocks.
5. Coatings:
 - a. The pipe exterior shall be coated with a layer of arc-sprayed zinc per ISO 8179 with a mass of 200 g/m². Pipe markings shall include the word "ZINC". The zinc shall be covered with a standard thickness exterior bituminous coating complying with ANSI/AWWA C151/A21.51.
 - b. The interior and exterior of fittings shall be furnished with a fusion-bonded epoxy coating complying with ANSI/AWWA C116/A21.16.

- c. All glands and retainer glands shall be furnished with a fusion-bonded epoxy coating complying with ANSI/AWWA C116/A21.16 or furnished with a polyester coating applied by an electrostatic spray process and heat cured.
- 6. Linings: Pipe shall have a standard thickness cement mortar interior lining complying with ANSI/AWWA C104/A21.4. A seal coat shall be provided over the cement mortar lining.
 - a. The seal coat may be subjected to an adherence test using 3M Tartan Duct Tape 3939. Pipe will be rejected if the seal coat is removed down to the cement mortar lining by the duct tape.
- 7. Polyethylene Encasement: All DIP and DI fittings shall be installed with a polyethylene tube encasement having a thickness of 0.012 inches (12 mils) and complying with Section 4.1.1. of ANSI/AWWA C105/A21.5. The polyethylene encasement shall be clear in color.
 - a. The ends of the polyethylene encasement and joints shall be thoroughly sealed with adhesive tape. Where polyethylene wrapped pipe or fittings being installed connect to a pipe that is not wrapped (including existing pipe), extend the wrap a minimum of 3 feet onto the previously uncovered pipe. This includes service lines which may be wrapped in polyethylene or dielectric tape.
 - b. Adhesive tape shall be a general purpose adhesive tape 2-inches wide, plastic backed, and capable of bonding securely to metal surfaces and/or polyethylene material. Tape shall be Polyken No. 900, Scotch Tape No. 50, Tapecoat CT or approved equal. Duct tape will not be allowed.
- 8. Bolts: Bolts shall comply with ANSI/AWWA C111/A21.11. All bolts shall be coated with FluoroKote #1 or approved equal. After field installation, all bolts shall be coated with an aerosol applied rubberized coating. The material shall be rapid dry and specifically designed for corrosion protection. 3M Rubberized Underseal Undercoating 08883 or any equivalent rubberized-bitumen based spray-on undercoating may be used.

D. Polyvinyl Chloride Pipe and Fittings

- 1. Design: All PVC pipe shall comply with either ANSI/AWWA C900 or ANSI/AWWA C905. The minimum pressure class shall be Pressure Class 235.
- 2. Fittings: Where fittings are required, they shall be ductile iron and comply with Paragraph 3901.C.2.
- 3. Joints: Joints for pipe and fittings shall comply with either ANSI/AWWA C900 or ANSI/AWWA C905.
- 4. Restrained Joint Pipe and Fittings:

- a. Restrained joint pipe and fittings shall be per the pipe manufacturer's recommendation. Fused and Certa-Lok are considered restrained joints.
 - b. Retainer glands (e.g., Megalug, Uni-Flange, etc.), and gripper gaskets (e.g., Field-Lok, Fast-Grip, etc.) are not considered a permanent restraint and must be used in conjunction with straddle or thrust blocks.
- 5. Polyethylene Encasement: See Section 3901.C.7 for polyethylene encasement of DI fittings.
- E. Concrete: Concrete shall be a MCIB mix with a design strength of 4500 psi, unless otherwise shown on plans. Mix shall meet MCIB Specifications November 2007 as listed on the Concrete Promotional Group Website www.concretepromotion.com.
- F. Granular Bedding Aggregate Material: See Section 2100.
- G. Backfill: See Section 2100.
- H. Flowable Backfill: Flowable backfill shall consist of Controlled Low Strength Material (CLSM) complying with the requirements in Section 2100,.
- I. Trench Checks: Trench checks shall consist of flowable backfill as specified in Paragraph 3901.H.
- J. Utility Markers:
 - 1. Utility marker tape shall be minimum 2 inches wide, 4-mil thick blue plastic tape with the word "WATER" lettered in permanent black graphics.
 - 2. In addition to utility marker tape, a PVC water main shall have a tracer wire installed along the top of the pipe. The wire shall be insulated, no smaller than 12 gauge, and for underground applications. It shall be detectable using either the inductive or conductive modes using a pipe and cable locator.
 - 3. Splices in wiring shall be made with epoxy/silicon splice connector.
- K. Thrust and Straddle Blocks: Concrete used for thrust and straddle blocks shall be a 4500 psi MCIB mix.
- L. Pipe Encasement: Concrete used for pipe encasement shall be a 4500 psi MCIB mix.
- M. Valves
 - 1. General:
 - a. All valves shall be certified as suitable for contact with drinking water by an accredited certification organization complying with ANSI/NSF Standard 61, Drinking Water Systems Components–Health Effects.

- b. All valves shall have a 2-inch square nut operator.
- c. Direction to open shall be counterclockwise and be marked as such.
- d. Valves on the existing water system or valves that separate newly constructed mains from the existing water system shall be operated by City staff. The Water Utilities Supervisor shall be notified prior to operating any valves.

2. Butterfly Valves

- a. Design: All butterfly valves shall comply with ANSI/AWWA C504 for Class 150B service, as modified herein.
- b. Body: Valve bodies shall be constructed of cast iron ASTM A 126, Class B and comply with AWWA C504 in terms of laying lengths and minimum body shell thickness. Valve ends shall be mechanical joint or flanged as shown on the Drawings and shall comply with AWWA C504.
- c. Disc: Valve discs shall be made from cast iron ASTM A 126, Class B or ASTM A 48, Class 40 for 24-inch and smaller valves. For valves larger than 30 inches, the valve discs shall be built from DI complying with ASTM A 536. Disc shall be furnished with Type 316 stainless steel seating edge to mate with the rubber seat on the body. Discs for valves 20 inches and smaller shall be of an on-center design.
- d. Seat: The valve seat shall be Buna-N rubber located on the valve body. Resilient seats on the valve disc are not acceptable. For 20-inch and smaller valves, the valves shall have bonded seats that meet test procedures outlined in ASTM D 429, Method B. For valves 24 inches and larger, the seat shall be retained in the valve body by mechanical means without use of metal retainers or other devices located in the flow stream.
- e. Shaft: Valve shaft shall be 18-8 Type 304 stainless steel complying with ASTM A 276. Shaft seals shall be standard self-adjusting split V packing. Shaft seals shall be of a design allowing replacement without removing the valve shaft.
- f. Bearings: Valve bearings shall be sleeve-type that are corrosion resistant and self-lubricating.
- g. Actuator: Valve actuators shall be fully grease-packed and have stops in the open/close position. The actuator housing shall be cast or ductile iron. Valve actuator shall be attached to the body with a minimum of three bolts. The actuator shall have a mechanical stop that will withstand an input torque of 450 foot pounds against the stops without damage. The traveling nut shall engage alignment grooves in the housing. The actuator shall have a built-in packing leak bypass to eliminate possible packing leakage into the actuator housing. Actuators for valves 16 inches and larger shall be the link lever type to provide characterized closure and prevent line shock when closing.

- h. Coatings: All internal and external surfaces shall be covered with a polyamide cured epoxy coating applied over a sand blasted “new white metal surface” per SSPC-SP10 to a minimum of 6 mils in compliance with AWWA C550.
 - i. Testing: Each valve shall be factory tested per AWWA C504. If the Drawings call for valves that have been subjected to and passed a one-time pressure test of 192.5 psi prior to delivery (for those areas of the City where the line pressure exceeds 100 psi), those valves shall be clearly marked to that effect. The manufacturer shall provide for testing certification, which shall be given to the Inspector upon delivery of the valves to the site.
 - j. Bolts: Bolts shall comply with ANSI/AWWA C111/A21.11. All bolts shall be coated with FluoroKote #1 or approved equal. After field installation, all bolts shall be coated with an aerosol applied rubberized coating. The material shall be rapid dry and specifically designed for corrosion protection. 3M Rubberized Underseal Undercoating 08883 or any equivalent rubberized-bitumen based spray-on undercoating may be used.
 - k. Refer to the Water Utilities List of Acceptable Manufacturers and Models.
3. Gate Valves
- a. Design: All gate valves shall comply with ANSI/AWWA C509 or AWWA C515 for resilient-seated gate valves, as modified herein. Gate valves shall be designed for underground direct burial service. The minimum design working water pressure shall be 200 psig. All internal parts shall be accessible without removing the body from the water main.
 - b. Body: Valve bodies shall be constructed of cast iron (ASTM A 126, Class B) or DI (ASTM A 536) complying with AWWA C509 or AWWA C515 in terms of minimum body shell thickness. Valve ends shall be mechanical joint or flanged as shown on the Drawings and shall comply with AWWA C509 or AWWA C515.
 - c. Gate/Wedge: The valve gate or wedge shall be fully encapsulated with rubber to create a resilient seat.
 - d. Stem: Valve stem shall be non-rising and made of bronze complying with ASTM B 138 or manganese bronze complying with ASTM B 584. Stem seals shall be the O-ring type, not flat gaskets.
 - e. Coatings: Coating shall be non-toxic and impart no taste to water. All internal and external surfaces shall be covered with a fusion bonded epoxy coating complying with AWWA C550. Although the AWWA standard only refers to interior coatings, the external epoxy coating shall be applied in a manner similar to that used for application of the interior coating. Coating shall be applied prior to assembly such that all exposed external areas—including end connection bolt holes, body-to-bonnet bolt holes, etc.—shall be coated with epoxy.

- f. Bolts: Bolts shall comply with ANSI/AWWA C111/A21.11. All bolts shall be coated with FluoroKote #1 or approved equal. After field installation, all bolts shall be coated with an aerosol applied rubberized coating. The material shall be rapid dry and specifically designed for corrosion protection. 3M Rubberized Underseal Undercoating 08883 or any equivalent rubberized-bitumen based spray-on undercoating may be used.
 - g. Testing: Each valve shall be factory tested per AWWA C509 or AWWA C515.
 - h. Refer to the Water Utilities List of Acceptable Manufacturers and Models.
4. Air Release Valves
- a. Design: These valves shall be combination air valves, performing the functions of both an air release and an air/vacuum valve. All air release valves shall comply with ANSI/AWWA C512.
 - b. Body: Valve bodies shall be constructed of cast iron complying with ASTM A 126, Class B and shall have a working pressure rating of at least 150 psi.
 - c. Connections: Inlets and outlets shall be full size, national standard pipe tapered (NPT) equal to the nominal valve size. The valve shall have two additional NPT connections for the connection of gauges, testing, and draining.
 - d. Seat: Resilient seat shall be Buna-N.
 - e. Orifice Button: The valve shall have an adjustable threaded orifice button.
 - f. Internal Parts: Floats, guide shafts, and bushings shall be constructed of Type 304 stainless steel. Non-metallic floats, linkage, or bushings are not acceptable. Floats shall be unconditionally guaranteed against failure, including pressure surges.
 - g. Coating: The exterior of the valve shall be coated with a universal alkyd primer.
 - h. Refer to the Water Utilities List of Acceptable Manufacturers and Models.
5. Tapping Valves:
- a. Tapping valves shall have the same characteristics as gate valves specified in Paragraph 3901.M.3. of the City of Lee's Summit Standard Specifications. Tapping valve ends shall comply with Section 4.4.1.4.4 of ANSI/AWWA C509.
 - b. A flange x mechanical joint (MJ) gate valve with all characteristics specified in Paragraph 3901.M.3. of the City of Lee's Summit Standard Specifications may be used in lieu of a standard tapping valve if the tapping machine to be used does not have a full-size cutter.

N. Tapping Sleeves

1. Iron body tapping sleeves shall have the following characteristics:
 - a. Design: Tapping sleeves shall comply with MSS SP-111, as modified herein. The minimum working pressure rating shall be 150 psig.
 - b. Tapping sleeves shall be cast iron complying with ASTM A 126, Class B or DI complying with ASTM A 536 and shall be compatible with the tapping valve.
 - c. Coating shall comply with AWWA C550.
 - d. Cast iron tapping sleeves shall have MJ connection x flange end. The flange end shall include a recess to provide positive alignment of the tapping valve. Recess dimensions are per MSS SP-60.
 - e. Bolts: Bolts shall comply with ANSI/AWWA C111/A21.11.
 - f. Refer to the Water Utilities List of Acceptable Manufacturers and Models.
2. Stainless steel tapping sleeves shall have the following characteristics:
 - a. Design: The minimum working pressure rating shall be 150 psig. The height from the flange surface to the pipe centerline shall comply with MSS SP-111. Recess dimensions are per MSS SP-60.
 - b. Top Shell: The top shell shall be 18-8 Type 304 stainless steel, minimum 12 gauge thickness.
 - c. Bottom Shell: The bottom shell shall be 18-8 Type 304 stainless steel, minimum 14 gauge thickness.
 - d. Flange: The flange shall be 18-8 Type 304 stainless steel and shall have a 3/4-inch NPT test port.
 - e. Gasket: The tapping sleeve shall have a full circumferential gasket made of synthetic rubber.
 - f. Refer to the Water Utilities List of Acceptable Manufacturers and Models.

O. Valve Boxes

1. Valve Box Covers: All valve box covers, whether in pavement or grassed areas, shall meet the following requirements:
 - a. Cast iron castings shall conform to the requirements of "Gray Iron Castings," ASTM A48/AASHTO M105, Class 30B.
 - b. Dimension Tolerances:

- i. The dimensions of all castings shall be $\pm 1/8$ inch of the dimensions shown in the Standard Drawings.
 - ii. No casting shall weigh less than 95 percent of the specified weight shown in the Standard Drawings.
 - c. Workmanship and Finish:
 - i. Castings shall be free of casting defects such as porosity, rough surfaces and shrinkage.
 - ii. Surfaces shall be free of fused on sand and shall be smooth.
 - iii. Runners, risers, fins and other cast-on pieces shall be removed.
 - d. Interchangeability: Castings shall be interchangeable with the City's existing valve box lids. These shall be Clay & Bailey Model 2194 or 2195.
 - e. Markings:
 - i. Imported castings shall meet the country-of-origin markings as required in accordance with Title 19, Code of Federal Regulations, Part 134 (19 CFR 134).
 - ii. The word "WATER" shall appear on the cover as shown on the standard details.
2. Valve Boxes:
- a. In Pavement: Valve boxes to be located in pavement (roadways, driveways, sidewalks or shoulders) shall have a screw-type ferrous metal body. Refer to the Water Utilities List of Acceptable Manufacturers and Models.
 - b. In Non-paved Areas: Valve boxes to be located in non-paved areas may be made of ferrous metal, schedule 40 PVC, or of C900 PVC pipe. Valve box shall be cut to finish grade after final site grading is complete. Buried valve boxes shall be uncovered and extended by the Contractor/Developer prior to final acceptance of the Work by the City.
3. All valves with the operating nut greater than 3 feet below finished grade or road surface shall be provided with extension stems to bring the operating nut to within 3 feet of the finished grade. Stem guides shall be provided to keep the valve stem extensions concentric with the valve box.
4. All ferrous metal parts shall be painted with an asphalt varnish.

P. Backflow Prevention Devices

- 1. The current MDNR Approved Backflow Prevention Assemblies list shall be used to select the BFPD.

2. Vaults:

- a. Vaults shall be made of at least MCIB/KCMMB 4000 psi concrete mix. Other materials may be used if approved by the City Engineer.
- b. Steps meeting the requirements for manhole steps (see Paragraph 3500.P.8. of the City of Lee's Summit Standard Specifications) shall be cast into the vault wall in-line with the top opening.
- c. Minimum clearance dimensions shall be as shown in the Standard Drawings.

3. Irrigation Box: Backflow prevention devices shall be installed horizontally.

Q. Fire Hydrants

1. All fire hydrants shall be the traffic model, break-away type, and comply with the current AWWA C502.
2. Hydrants shall have a minimum design working pressure of 150 psig and test pressure of 300 psig.
3. Hydrants shall have two 2½-inch nozzles and one 4½-inch pumper nozzle with national standard fire hose coupling screw thread. Nozzle caps shall be the "nut type" having the same dimensions as the operating nut. Such caps shall be securely chained to the base of the hydrant.
4. The size of the hydrant main opening shall be 5¼ inches.
5. Operating nut shall be 5-sided measuring 1½" from point to flat and include the weather shield.
6. Hydrant shall be furnished with a 6-inch isolation gate valve in accordance with Paragraph 3901.M.3 of the City of Lee's Summit Standard Specifications.
7. Direction to open shall be counterclockwise and be marked as such.
8. Hydrants shall come with an oil reservoir or grease zerk.
9. Hydrants shall be factory painted (baked on enamel) according to the following schedule:

Ownership	Color
City	Optic yellow
Private	Optic yellow with silver bonnet
Private–Yard fire hydrant (i.e., attached to the fire suppression system)	Red

10. Extension Kits

- a. Extension kits shall be supplied by the hydrant manufacturer.
 - b. All extensions shall be factory painted (baked on enamel) and shall match the color of the barrel section as called for in Paragraph 3901.Q.9. above.
- 11. Hydrants shall be furnished with temporary black plastic caps or shall be covered with black plastic bags until the hydrants are available for service.
- 12. Refer to the Water Utilities List of Acceptable Manufacturers and Models.
- R. Service Lines from the Water Main to the Water Meter: Service lines 2 inches in diameter and smaller shall be made of Type K soft copper, complying with ASTM B 88. Service lines greater than 2 inches in diameter shall be DIP or PVC pipe and shall comply with Paragraphs 3901.C. or 3901.D, respectively, of the City of Lee's Summit Standard Specifications, subject to restrictions based on the City's currently-adopted Fire Code.
- S. Casing Pipe
 - 1. Pipe
 - a. The casing pipe shall be made of steel complying with ASTM A 139, grade B, with a minimum yield strength of 35,000 psi.
 - b. The minimum wall thicknesses required are shown in the following table:

Casing Diameter (inch)	Minimum Wall Thickness
10, 12, 14, 16	0.188" (3/16")
18, 20, 22	0.250" (1/4")
24, 26	0.281" (9/32")
28, 30, 32, 34	0.312" (5/16")
36, 38, 40, 48	0.344" (11/32")
 - 2. Spacers: Casing spacer shall be a two-piece shell or band made from T-304 stainless steel of a minimum 14 gauge thickness. The shell/band shall have risers made of 10 gauge T-304 stainless steel and have a PVC liner. The bearing surface (skid or runner) shall be made of an ultra high molecular weight polymer, glass reinforced polyester, or fiberglass reinforced nylon. The shell/band shall be bolted together with T-304 stainless steel bolts. The configuration of the carrier pipe in the casing pipe shall be centered. End seals shall be made by the same manufacturer as the casing spacers and shall use stainless steel bands to hold end seals to pipes.
 - 3. Ends of the Casing Pipe: The ends of the casing pipe shall be closed with one of the following (see the Standard Drawings):
 - a. Manufactured end seal.
 - b. Concrete plug with allowances for water flow.

3902 CONSTRUCTION AND INSTALLATION

A. General

1. Notification

a. Disruption of Water Service:

- i. When a disruption of water service will occur, the Contractor shall notify Water Utilities Operations at least 48 hours in advance to make the necessary arrangements.
- ii. It shall be the Contractor's responsibility to place door hangers on the affected premises at least 24 hours in advance of the disruption. The door hanger shall indicate the date and time of the disruption and its anticipated length.
- iii. Once the work begins, the work shall be continuous (24 hours per day) until completed.

b. The Contractor's work shall be scheduled in a manner to accommodate the schedules of the City and the affected customers.

- i. In the event closing of valves to make a connection will affect a customer who cannot be without service, as approved by the City Engineer, the Contractor shall make provisions to provide temporary service to that customer.
- ii. In the event closing of valves to make a connection will affect a customer who can temporarily be without service, the maximum amount of time the customer may be without service, without Contractor furnished provisions for temporary service, shall be 8 hours.

2. Protection of Existing Water Mains, Sewers, Structures, or Utilities

- a. Where new lines approach, cross, connect to, or run parallel to existing water or sewer mains, the Contractor shall be held completely responsible for protecting, preserving, and otherwise maintaining existing line during construction of new line. Any damage inflicted to water and sanitary sewer mains or structures must be promptly reported to Water Utilities Operations and arrangement made for the repair. Any damage inflicted to storm sewer lines or structures must be reported promptly to the Public Works Operations Division and arrangement made for repair. Any damage inflicted to any other utility must be reported promptly to the respective utility and arrangement made for the repair.
- b. The Contractor shall protect all existing structures, utilities, and work of any kind against damage or interruption of service that may result from the operations of the Contractor. Damage or interruption of service resulting from failure to do so shall be repaired or restored promptly at the expense of the Contractor.
- c. The Contractor shall give reasonable notice to utility companies and to other owners of property when such property is liable to damage or injury could result from the execution of the Work, so that the owners of such utility or property may take precautionary measures.

- d. The Contractor shall be responsible to adjust to finish grade any existing utility/appurtenances (i.e. valves, meter wells, sanitary sewer manhole, storm junction box etc.) that is affected by construction.
- 3. Handling and Storage
 - a. Handle pipe materials and fittings in a manner to assure installation in sound and undamaged condition. Use slings, lifting bags, hooks, and other devices designed to protect pipe, joint elements, and coatings. In handling plastic pipe of 10 feet or more long, a double sling will be required.
 - b. Ship, move, and store with provisions to prevent movement or shock contact with adjacent units.
 - c. Pipe shall be handled in a manner that minimizes the damage to the coating. Damaged coating shall be repaired in a manner complying with the pipe manufacturer's recommendations.
- 4. Inspection of Materials: All pipe, fittings, and accessories shall be examined by the Inspector prior to installation for soundness and specification compliance. Rejected materials shall be marked and removed from the project site, and replaced with approved materials.
- 5. Alignment: Pipe shall be laid to the lines and grades as shown on the approved Engineering Plans.
- 6. Cleaning: All pipe, fittings, and accessories shall be kept clean of foreign matter while being handled or stored. During installation, foreign matter shall not enter the pipe or appurtenances. At the end of each working day, a temporary plug shall be installed at the termination of the pipeline.

B. Water Main Installation

- 1. Installation Standards: All pipes shall be installed in a manner complying with the following standards:
 - a. DIP - ANSI/AWWA C600.
 - b. PVC Pipe - ANSI/AWWA C605.
- 2. Installation
 - a. Governmental Requirements: Water main installation shall comply with applicable local, State, and Federal requirements.
 - b. Trench Dewatering: See Section 2100.
 - c. Drainage Course Crossings: See Section 2100.
 - d. Trench Widths

- i. Minimum Widths: Trench widths pipe clearances shall be not less than those shown in the following table.

TRENCH WIDTHS AND PIPE CLEARANCES (in)			
Nominal Pipe Diameter	Suggested Trench Width ¹	Minimum Pipe Side Clearance ² (Soil/Rock)	Minimum Pipe Bottom Clearance (Soil/Rock)
6	30	6/6	6/6
8	32	6/6	6/6
10	34	6/6	6/6
12	36	6/6	6/6
16	40	6/6	6/6
18	42	6/6	6/6
20	44	7/9	6/9
24	48	7/9	6/9
30	54	8/9	6/9
¹ Measured at the top of the pipeline. ² Measured from the outside face of pipe barrel to inside face of trench.			

- ii. Maximum Widths: Maximum trench widths shall be governed by existing soils, trench type, bedding, and laying conditions. Maximum widths shall not exceed the manufacturer's recommendations.
- iii. Trench Slope: See Section 2100.
- iv. Trench Shields: See Section 2100.
- e. Compacted Fill: See Section 2100.
- f. Pipe Embedment: DIP and PVC pipe shall be bedded in bedding material with a minimum thickness beneath the pipe as specified in Paragraph 3902.B.2.d. Also see Section 2100.
- g. Bedding Installation: See Section 2100.
3. Backfill: See Section 2100.
4. Utility Marker Tape and Tracer Wire: Install utility marker tape above the centerline of each water main. Bury marker tape 18 to 24 inches below finished grade, along the full length of the water main. When tracer wire is required, tracer wire shall be installed along the top of the pipe so that the wire is in relatively continuous contact with the pipe. The wire shall be accessible at every valve box. Marker tape and tracer wire shall be inspected by the public works inspector prior to backfill. All tracer wires

shall be tested before acceptance. Any tracer wire broken during installation shall be repaired by the Contractor.

5. Domestic Service Connections

- a. The City will install a corporation connection at the main for individual, commercial, industrial, and residential service lines that are 2 inches in diameter and less. The Contractor/Developer shall notify Water Utilities Operations 48 hours in advance of requiring a service connection.
- b. Taps: Refer to the Water Utilities List of Acceptable Manufacturers and Models.
 - i. A saddle shall be required when PVC pipe is tapped
 - ii. A direct tap with a tapping machine is required for DIP.
- c. For service lines larger than 2 inches in diameter, a tee shall be cut in with appropriate valving or a tapping sleeve and valve shall be installed. The Contractor/Developer shall notify Water Utilities Operations and the Inspector 48 hours prior to starting this work.
- d. Excavation for service connections shall be provided by the Contractor/Developer as illustrated in the Standard Drawings. The excavation shall be prepared prior to the time scheduled with Water Utilities Operations for the tap.
- e. Installation of meters greater than 2-inch diameter will be specifically approved by the City Engineer.
- f. Excavation shall be adequately protected in accordance with Section 2103 of Lee's Summit Special Provisions. Backfilling shall take place as soon as practicable.

6. Thrust Restraint

- a. All plugs, caps, dead ends, tees, bends and hydrants shall be provided with thrust blocks as shown in the Standard Drawings.
- b. Concrete construction shall comply with ACI 301, Specifications for Structural Concrete.
- c. Concrete shall extend from fitting to undisturbed soil and shall be installed so that all joints are accessible.
- d. Concrete shall be placed and cured for 24 hours prior to energizing the water main.
- e. If adequate soil support cannot be obtained, a mechanical restraining assembly shall be installed as approved by the City Engineer.

7. Pipe Encasement, Straddle Blocks, and Trench Checks

- a. Total or partial encasement of pipe in concrete shall be used where the required safe supporting strength of the pipe cannot be obtained by other bedding methods. Concrete encasement shall also be provided at locations where there exists the possibility that standard bedding may be eroded by currents of water under and around the pipe. Concrete construction shall comply with ACI 301, Specifications for Structural Concrete.
 - b. Concrete encasement shall be constructed at locations indicated and complying with details as shown on the Engineering Plans and in the Standard Drawings. Start and terminate encasement at a pipe joint. Adequately support and block the pipe to maintain position and prevent flotation. Form to dimensions indicated or construct full width of the trench.
 - i. Longitudinal reinforcement shall be continuous.
 - ii. Concrete encasement shall be protected and cured so as to prevent excessive evaporation of moisture or freezing. Backfilling will not be considered as a suitable method of curing the encasement.
 - iii. Backfill trench only after concrete encasement has obtained a minimum of 2000 psi. All backfilling shall be done in accordance with Section 2100.
 - c. Straddle blocks shall be constructed at locations indicated on and comply with details shown on the Engineering Plans and in the Standard Drawings.
 - d. Trench Checks: Trench checks shall be located as shown on the plans. They shall consist of flowable backfill and extend 12 inches below the bottom of the pipe. Length shall be a minimum of 12 inches and width shall be the width of the trench. The height of the trench check shall extend to 12 inches above the top of the pipe.
8. Pipe Laying: All pipe installation shall comply with the pipe manufacturer's recommendations, except as modified herein.
- a. Pipe laying shall not proceed if the trench width as measured at the top of pipe exceeds the maximum allowable trench width. If this occurs, the Contractor shall submit to the Design Engineer and the City Engineer, for approval, a better bedding design for the pipe or pipe of sufficient strength to provide safe supporting strength.
 - b. All pipe and fittings shall be stored and handled with care to prevent damage thereto. Do not use hooks to transport or handle pipe or fittings. Do not drop pipe or fittings.
 - c. Pipe and fittings rejected by the Inspector shall be marked and removed from the project site. All pipe and fittings shall be examined for soundness and specification compliance prior to placement in the trench and rejected pipe or fittings shall not be incorporated into the pipeline. Check the class or pipe strength to be sure proper pipe is installed.

- d. Clean joint contact surfaces prior to jointing. Use lubricants, primers, or adhesives as recommended by the pipe or joint manufacturer. Keep lubricants and applicators clean.
- e. Excavate bell holes for each pipe joint. When jointed, the pipe shall form a true and smooth pipeline.
- f. The alignment of all pipelines shall be true to line and grade. The pipe shall be truly centered into the abutting pipe.
- g. On transmission mains, the pipes and appurtenances shall be truly laid to line and grade throughout, all junctions and other pieces required shall be properly excavated for and laid as shown on the Drawings, and the following tolerances from true horizontal alignment and vertical grade shall be maintained:

Horizontal Alignment:	± 12 inches
Vertical Grade:	± 0.1 feet

Pipe installed but not meeting these tolerances shall be ordered removed and replaced at the Contractor's expense.

- h. The trench shall be excavated to sufficient depth to allow embedment to be placed in the bottom of all trenches. At the pipe joints, the trench shall be excavated to an additional depth so that the bell will not rest on the bottom of the trench, and all the weight of the pipe shall be evenly distributed along the entire length of the barrel of the pipe.
- i. The water main must be made watertight at all points; any leaks or other defects discovered at any time before the final acceptance of the Work shall be immediately repaired or that portion of the water main shall be rebuilt if necessary.
- j. In all cases, full length sticks of pipe shall be used, except in making closures.
- k. Clean interior of all pipe, fittings, and joints prior to installation. To exclude entrance of foreign matter during discontinuance of installation, close open ends of pipe with snug fitting closures. Take reasonable precautions to not let water fill the open trench, and include provisions to prevent pipe flotation. Remove water, sand, mud, and other undesirable backfill materials from trench before removal of end cap.
- l. In forming joints, each length of pipe shall be carefully aligned in such manner as to form an accurate concentric joint, thus providing a uniform circular pipe opening. Each length of pipe shall thrust into the bell and shall be securely held in position until the next length of pipe has been placed.
- m. The pipeline trench excavation shall be dewatered sufficiently to allow pipe joints to be made under dry conditions. No joints shall be made under water.

n. Joints:

- i. Joints shall in general be made complying with the manufacturer's recommendations and as specified herein.
- ii. Clean and lubricate all joint and gasket surfaces with lubricant recommended by pipe manufacturer.
- iii. Care shall be exercised by the Contractor to insure against damage to joint material in storage, handling, or placing operations.
- iv. No damaged joint material shall be permitted to be used and the same shall be removed from the job site.
- v. All pipe joints shall be completed by insuring that the ends of the pipe to be joined are in contact and completely shoved into "home" position.
- o. Pipe shall be cut in a neat workmanlike manner without damage to pipe. Cutting of pipe with a torch is not permitted. Smooth cut by power grinding to remove burrs and sharp edges. Repair the lining as required and approved by the Inspector.
- p. All pipelines shall be plugged at the end of each day's progress. Plugs or other positive methods of sealing shall be utilized at all times to protect any existing system from entrance of stormwater or other foreign matter.
- q. When a water main crosses an existing pipeline (sanitary sewer, storm sewer, service laterals or force mains) and the clearance is less than 18 inches, concrete encasement shall be required in a manner approved by the City's on-site representative.

9. Valves, Fittings, and Hydrants:

- a. Valves, fittings, and hydrants shall be set and jointed to a new pipe in the manner specified for cleaning, laying, and jointing pipe.
- b. Valves, fittings, hydrants, and pipe shall be supported in such a manner that there is no deflection in the valve or fitting-to-pipe joint. Larger valves and fittings may require additional support so that the pipe does not have to support the weight of the valve or fitting. In no case shall hollow pipe be used as a support mechanism.
- c. Valve boxes and lids shall be installed over each valve. The valve box shall be supported in a manner to remain centered and plumb over the operating nut of the valve. The valve box shaft shall not transmit shock or stress to the valve. Valve box covers shall be installed flush with the finish grade, or as directed by the Inspector.
- d. Hydrants:

- i. Hydrants shall be installed as shown in the Standard Drawings.
 - ii. Hydrants shall be installed so that the steamer nozzle is 18 inches above final grade, and the bottom of the break-away coupling is 2 to 6 inches above final grade, as recommended by the hydrant's manufacturer.
 - iii. Hydrants shall stand plumb.
 - iv. The weep holes of the hydrant shall be kept clear and free to drain.
 - v. Refer to AWWA Manual M17 for additional installation guidelines.
10. Removal of Water: The Contractor shall provide dewatering as specified in Section 2103. Damaged pipe or structures of any kind resulting from insufficient dewatering facilities or similar lack of proper conduct of the work shall be replaced by the Contractor at their own expense. No structure or pipes shall be laid in water, and no water shall be allowed to run into or over any concrete work or pipe, or into or through any pipe.
11. Water Main Connections to Existing Main
- a. The Contractor/Developer shall furnish and install all of the fittings necessary for connections between new water mains and existing water mains. The use of tapping sleeves and valves is to be minimized and shall only be allowed where required on approved engineering drawings. The installation of tapping sleeves and valves shall be done while an Inspector is present.
 - i. All tapping sleeves will be required to meet the following air test:
 - < 12-inch, hold 45 psi for 1 minute
 - ≥ 12-inch, hold 60 psi for 1 minute
 - ii. Tapping into existing mains shall be done with no interruption of existing services unless otherwise approved by the City Engineer 48 hours prior to disruption of service.
 - b. Valves on the existing water system or valves that separate newly constructed mains from the existing water system shall be operated by City staff. The Water Utilities Supervisor shall be notified prior to operating any valves.
 - c. Special care should be taken when making a connection to an existing main. No foreign material or contaminants will be permitted to enter the water system.
 - d. Thrust blocks shall be provided at the new connection to provide thrust restraint as shown in the Standard Drawings

12. Abandonment of Water Mains

- a. No existing water mains shall be abandoned prior to contacting Water Utilities Operations at least 48 hours in advance.
- b. Prior to abandonment of a water main, the Contractor shall verify that no existing services will be affected.
- c. If a water main is indicated for abandonment, it shall be abandoned by removal and backfill if required or by plugging each end of the line segment. To plug each end of the line segment, a section of pipe at least 10 feet long shall be cut out of the existing line. The water shall be drained out to the fullest extent practicable, and the ends shall be sealed with a 1-foot thick plug of non-shrink grout sealed with a Portland cement grout.
- d. Location of cut line and plugs shall be shown on the record drawings.
- e. Hydrants (complete) shall be removed and returned to Water Utilities Operations.

13. Abandonment of Service Lines

- a. Water service lines shall be disconnected from the water main when buildings are demolished and there are no re-development plans to reuse the existing tap.
- b. If the water service line is to be reused it shall be compliant with all applicable codes and standards in effect at the time.
- c. Water service lines being disconnected from the water main, shall be disconnected by the Water Utilities Department after the contractor has provided access to the main via an OSHA compliant excavation with proper shoring as necessary. Water Utilities staff reserve the right to not enter any trench determined to be unsafe
- d. The water meter on abandoned service lines shall be removed by the Water Utilities Department.

14. Protection of Water Supplies

- a. There shall be no physical connection between a public or private potable water supply system and a sewer, or an appurtenance thereto, that would permit the passage of any wastewater or polluted water into the potable water supply.
- b. For water mains paralleling or crossing sewer mains, see Paragraph 6901.D.1.c.
- c. Water and sewer mains shall not be placed in the same trench or excavation.

15. Connection of Pipes of Dissimilar Materials: The connection of pipes of different materials shall be made using approved transition couplings, and shall provide a permanent and watertight connection that will withstand the hydrostatic test pressure.

C. Disinfection

1. General

- a. Precautions, methods, procedures and materials for disinfection shall comply with the current AWWA C651.
 - b. Precaution shall be taken to protect the interior of pipes, fittings, and valves against contamination. Pipe shall be handled in such a manner to prevent the entrance of foreign material or water.
 - c. All water mains shall be disinfected and tested. Not more than 4,000 feet of water main shall be installed without disinfecting and testing.
 - d. The Contractor/Developer shall notify the Inspector at least 48 hours prior to commencing disinfection.
 - e. Existing water distribution system valves shall be operated by City staff.
 - f. Samples shall be taken at locations selected by the Inspector but not less than 1 sample shall be collected for every 1,200 feet of pipe, plus 1 sample from each dead end line, and at least 1 set from each branch. If trench water has entered the main, samples shall be collected every 200 feet.
 - g. If the continuous feed method of chlorination is selected, bacteriological samples shall not be taken until the water mains have passed hydrostatic and leakage tests.
2. Filling: After installation, the entire main shall be completely filled with water to eliminate air and be flushed to remove any material that may have entered the main. Flushing velocities shall not be less than 3.0 feet per second.
- a. If the continuous feed method of chlorination is selected, the filling and flushing shall be done prior to chlorination.
 - b. If the tablet method of chlorination is selected, the filling shall be done very slowly (i.e., less than 1 ft/s) and in the presence of the Inspector. The water main shall be flushed after it has been chlorinated.
3. Chlorination: Chlorination shall comply with the procedures given in AWWA C651, as modified below.
- a. The tablet method may only be used under the following conditions:
 - i. The water main to be chlorinated is 12 inches in diameter or less,
 - ii. Calcium hypochlorite granules are used (i.e., not tablets), and
 - iii. The pipes and appurtenances are kept clean and dry during construction.
 - b. The tablet method shall not be used if nonpotable water or foreign materials have entered the mains or if the water temperature is below 5°C (41°F).
 - c. The slug method may only be used with prior permission from the City Engineer.

- d. Cutting into or Repairing Existing Water Mains:
 - i. Disinfection procedures when cutting into or repairing existing water mains shall comply with AWWA C651.
 - ii. This procedure shall only be used if the length of pipe to be disinfected is less than 150 feet, unless otherwise approved by the City Engineer.
- e. A basic flow chart for the chlorination process is given in Figure 3901-1 and is further described below.
 - i. Chlorinate water main and measure chlorine at the ends of the water main and ends of all branches. A minimum of 25 milligrams per liter (mg/l) free chlorine should be detected at each location, or additional chlorination is required until that level is reached.
 - ii. When acceptable chlorine levels are detected at all points, the Contractor/Developer shall operate all valves and hydrants within the newly-constructed section (except for the valve tying the new construction to the City's distribution system) in order to disinfect appurtenances.
 - iii. The chlorinated water shall be retained in the water main for at least 24 hours.
 - iv. If the required minimum residual of 10 mg/l chlorine is not present in all portions of the water main after 24 hours, rechlorinate the water main.
 - v. If the required minimum residual of 10 mg/l chlorine is present in all portions of the water main, flush the water main until chlorine measurements show the water leaving the test main are no higher than that prevailing in the system.
 - vi. Disposal of Heavily-Chlorinated Water: The heavily-chlorinated flush water shall be discharged to a sanitary sewer, or the flush water shall be dechlorinated in a manner complying with AWWA C651, Appendix C. If the flush water is to be discharged to the sanitary sewer, the Contractor/Developer will be charged for the disposal of the quantity of water disposed.
 - vii. Samples shall be taken of water that has stood in the main for at least 16 hours after final flushing has been completed and shall be tested by a state-certified laboratory, as approved by the City, for bacteriological quality complying with "Standard Methods for the Examination of Water and Wastewater." The samples shall meet the MDNR standard.
 - viii. Samples for bacteriological testing shall be taken through a corporation stop and copper tubing.
 - ix. The first set of bacteriological samples will be taken under the direction of the Inspector, who will take this and all subsequent samples to the laboratory.

- x. The laboratory shall be one certified by MDNR for microbiological analyses.
- xi. If the results are acceptable from the first samples (taken on Day 3), a second set of samples will be taken under the direction of the Inspector.
- xii. If the results for the second set of samples (taken on Day 4) are acceptable, the laboratory shall provide a hard copy of the lab results to the Inspector.
- xiii. If the results are not acceptable from the first set of samples, (taken on Day 3) the Contractor shall follow the procedure shown in the flow chart in Figure 3901-1 to flush and/or rechlorinate the water main until acceptable test results are achieved.
- xiv. If the results are not acceptable from the second set of samples, the Contractor shall follow the procedure shown in the flow chart in Figure 3901-1 to re-chlorinate the water main (beginning at Day 1) until acceptable results are achieved.

D. Hydrostatic and Leakage Testing

1. Hydrostatic pressure and leakage testing shall be performed by the Contractor/Developer in the presence of the Inspector and shall comply with current AWWA C600 and C605 procedures for DI and PVC pipe, respectively. The Contractor/Developer shall supply all pipe, tools, and equipment necessary to operate the test.
2. The hydrostatic pressure during testing shall be:
 - a. At least 125 percent of normal operating pressure at the highest elevation of the test section.
 - b. At least 150 percent of normal operating pressure at the lowest elevation of the test section.
 - c. At least 150 psi throughout the test section.
3. The leakage test shall be conducted concurrently with the pressure test. A DIP pipeline is acceptable if the leakage does not exceed the allowable limits as determined by the following formula:

$$L = SD (P)^{1/2} / 148,000$$

where

L = testing allowance (makeup water), gallons per hour

S = length of pipe tested, feet

D = nominal diameter of pipe, inches

P = average test pressure during hydrostatic test, psig

4. A PVC pipeline is acceptable if the leakage does not exceed the allowable limits as determined by the following formula:

$$L = ND (P)^{1/2}/7,400$$

where

L = allowable leakage, gallons per hour

N = number of joints in the length of pipe tested

D = nominal diameter of pipe, inches

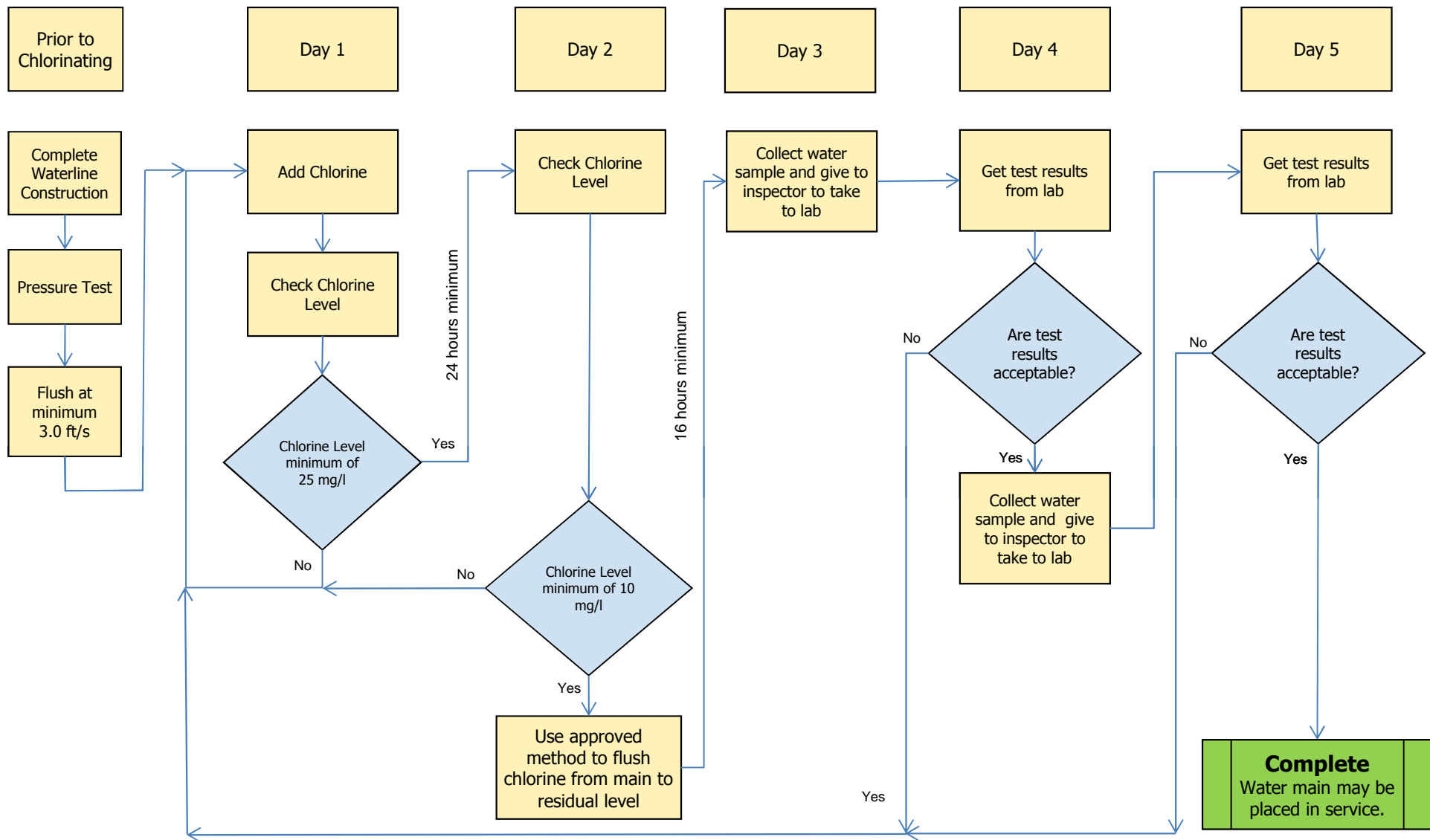
P = average test pressure during leakage test, psi

5. Water mains that fail to meet the test standards shall be repaired and retested, at the expense of the Contractor/Developer, as necessary, until the test requirements are met. Not more than 4,000 feet of main shall be installed without testing.
6. Fire lines shall be hydrostatically tested at not less than 200 psi for 2 hours.

3903 ACCEPTABLE MANUFACTURERS AND MODELS

- A. General: A list of acceptable manufacturers and models for various materials will be maintained by the City Engineer and updated on a regular basis. An approved list of materials can be found on the City's web site www.cityofls.net. Go to Development, then Development Regulations, then Design and Construction Manual.

Figure 3901-1. Chlorination Flow Chart



SECTION 057300 - DECORATIVE METAL RAILINGS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Steel and iron decorative railings.

B. Related Requirements:

1. Section 055213 "Pipe and Tube Railings" for nonornamental railings fabricated from pipes and tubes.

1.2 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.

- 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 items to Project site in time for installation.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS**A. Product Data:**

1. Manufacturer's product lines of decorative metal railings assembled from standard components.
2. Stainless steel cable and cable fittings.
3. Fasteners.
4. Post-installed anchors.
5. Handrail brackets.
6. Shop primer.
7. Intermediate coats and topcoats.
8. Nonshrink, nonmetallic grout.
9. Anchoring cement.
10. Metal finishes.

- B. Shop Drawings: Include plans, elevations, sections, and attachment details.

- C. Samples for Initial Selection: For products involving selection of color, texture, or design.
- D. Samples for Verification: For each type of exposed finish required.
 - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters
 - 2. Fittings, end caps, and brackets.
 - 3. Welded connections.
 - 4. Cable and cable hardware and connections.
 - 5. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and guard infill. Sample need not be full height.
 - a. Show method of connecting and finishing members at intersections.
- E. 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. Mill Certificates: Signed by manufacturers of stainless steel products, certifying that products furnished comply with requirements.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E894 and ASTM E935.
- E. Research Reports: For post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.
- F. Preconstruction test reports.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces of railings 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 railings 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, are to 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.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior railings by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, 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: Same metal and finish as supported rails unless otherwise indicated.
 - 1. Provide cast-metal brackets with flange tapped for concealed anchorage to threaded hanger bolt.

2.3 STEEL AND IRON DECORATIVE RAILINGS

- A. Source Limitations: Obtain steel decorative railing components from single source from single manufacturer.

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- 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. Tubing: ASTM A500/A500M (cold formed) or ASTM A513/A513M, Type 5.
- D. Bars: Hot-rolled, carbon steel complying with ASTM A29/A29M, Grade 1010.
- E. Plates, Shapes, and Bars: ASTM A36/A36M.
- F. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- G. Stainless Steel Cable and Cable Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johnson, C. Sherman, Co., Inc.
 - b. Loos & Co. Inc.
 - c. Ultra-tec; The Cable Connection.
 - 2. Cable: 1-by-19 wire cable made from wire complying with ASTM A492, Type 316,.
 - 3. Cable Diameter: 3/16 inch.
 - 4. Cable Fittings: Connectors of types indicated, fabricated from stainless steel, and with capability to sustain, without failure, a load equal to minimum breaking strength of cable with which they are used.

2.4 FASTENERS

- A. Fastener Materials:
 - 1. Stainless Steel Railing Components: Type 304 stainless steel fasteners.
 - 2. Ungalvanized-Steel Railing Components: Plated-steel fasteners complying with ASTM F1941/F1941M, Class Fe/Zn 5 for electrodeposited zinc coating where concealed; Type 304 stainless steel fasteners where exposed.
 - 3. Finish exposed fasteners to match appearance, including color and texture, of railings.
- B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction and capable of withstanding design loads.
- C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless exposed fasteners are unavoidable.
- D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, in accordance with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.
 - 1. Torque-controlled expansion 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.

2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
3. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593 and nuts, ASTM F594.

2.5 MISCELLANEOUS MATERIALS

- A. Handrail Brackets: Cast-aluminum, center of handrail 2-1/4" inches from wall.
 1. Provide cast-metal brackets with flange tapped for concealed anchorage to threaded hanger bolt.
- B. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
 1. For stainless steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- C. Shop Primers: Provide primers that comply with Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."
 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- D. Intermediate Coats and Topcoats: Provide products that comply with Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."
- E. Epoxy Intermediate Coat: Compatible with primer and topcoat.
- F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- G. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

2.6 FABRICATION

- A. 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.

1. Clearly mark units for reassembly and coordinated installation.
 2. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately.
1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
 2. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- F. Connections: Fabricate railings with welded connections unless otherwise indicated.
- G. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
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 flux immediately.
 4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 welds; ornamental quality with no evidence of a welded joint.
- H. Form changes in direction as follows:
1. As detailed.
- I. Bend members in jigs to produce uniform curvature for each 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 hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.
- 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 or less.
- L. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, handrail brackets, 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 to prevent bracket or fitting rotation and crushing of substrate.
- M. Provide inserts and other anchorage devices for connecting railings to concrete or masonry Work.
1. Fabricate anchorage devices capable of withstanding loads imposed by railings.

2. Coordinate anchorage devices with supporting structure.
- N. For railing posts set in concrete, provide stainless steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.
- O. Stainless Steel Cable Guard Infill: Fabricate cable guard infill assemblies in the shop to field-measured dimensions with fittings machine swaged.
 1. Minimize amount of turnbuckle take-up used for dimensional adjustment, so maximum amount is available for tensioning cable.
 2. Tag cable assemblies and fittings to identify installation locations and orientations for coordinated installation.

2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.8 STEEL AND IRON FINISHES

- A. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, hot-dip galvanize anchors to be embedded in exterior concrete or masonry.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3. SSPC-SP 7/NACE No. 4. requirements indicated below:
 1. Railings Indicated To Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3.
 2. Other Railings: SSPC-SP 7/NACE No. 4.
- C. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1 for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
 1. Shop prime uncoated railings with primers specified in Section 099123 "Interior Painting" unless indicated.
 2. Do not apply primer to galvanized surfaces.

- D. Shop-Painted Finish: Comply with Section 099113 "Exterior Painting." Section 099600 "High-Performance Coatings."
 - 1. Color: As indicated by manufacturer's designations.
- E. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1 for shop painting. Apply at spreading rates recommended by coating manufacturer.
 - 1. Color: Match Architect's sample.

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 have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

- A. Perform cutting, drilling, and fitting required for installing railings.
 - 1. Fit exposed connections together to form tight, hairline joints.
 - 2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
 - 3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
 - 4. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 5. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 - 6. 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.
- B. 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 concealed surfaces of that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- D. 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. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws, using plastic cement filler colored to match finish of railings.
- B. 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.

3.4 ANCHORING POSTS

- A. Use stainless steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Leave anchorage joint exposed with anchoring material flush with adjacent surface.
- D. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For steel railings, weld flanges to posts and bolt to metal-supporting surfaces.

3.5 ATTACHING RAILINGS

- A. Anchor railing ends to concrete and masonry with sleeves concealed within railing ends and anchored to wall construction with anchors and bolts.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends or connected to railing ends, using nonwelded connections.
- C. Attach handrails to walls with wall brackets. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.
 - 1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
 - 2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets 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 wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
4. 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.
5. For steel-framed partitions, fasten brackets directly to steel framing or concealed steel reinforcements using self-tapping screws of size and type required to support structural loads.
6. For steel-framed partitions, fasten brackets with toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.6 REPAIR

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Apply by spray to provide a minimum 2.0-mil dry film thickness.
2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."

3.7 CLEANING

- #### A.
- Clean by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

3.8 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.
- #### B.
- Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 057300

SECTION 061000 - ROUGH CARPENTRY**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Wood products.
2. Wood-preservative-treated lumber.
3. Fire-retardant-treated lumber.
4. Miscellaneous lumber.
5. Plywood backing panels.

1.2 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.
- C. Lumber grading agencies, and abbreviations used to reference them, include the following:
1. NeLMA: Northeastern Lumber Manufacturers' Association.
 2. NLGA: National Lumber Grades Authority.
 3. SPIB: The Southern Pine Inspection Bureau.
 4. WCLIB: West Coast Lumber Inspection Bureau.
 5. WWPAA: Western Wood Products Association.

1.3 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.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency in accordance with ASTM D5664.
 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.4 INFORMATIONAL SUBMITTALS**A. Material Certificates:**

1. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products 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**

- A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber 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. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.

B. Maximum Moisture Content:

1. Boards: 15 percent.
2. Dimension Lumber: 15 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWP A U1, Use categories as follows:

1. UC1: Interior construction not in contact with ground or subject to moisture. Include all rough carpentry.
 - a. Wood, blocking, furring, and similar concealed members in contact with masonry or concrete.
 - b. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 - c. Wood furniture.
 - d. Wood millwork.
2. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
3. After treatment, redry dimension lumber to 19 percent maximum moisture content.

- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that 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 all rough carpentry unless otherwise indicated.

2.3 FIRE-RETARDANT-TREATED LUMBER

- A. General: Where fire-retardant-treated materials are indicated, materials are to 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 in accordance with ASTM E84, 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 beyond the centerline of the burners at any time during the test.
 - 1. Treatment is not to promote corrosion of metal fasteners.
 - 2. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
 - 3. Design Value Adjustment Factors: Treated lumber is to be tested according to ASTM D5664 and design value adjustment factors are to be calculated according to ASTM D6841.
- C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency and other information required by authorities having jurisdiction.
- E. Application: Treat all rough carpentry unless otherwise indicated.

2.4 MISCELLANEOUS LUMBER

- A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Furring.
- B. Concealed Boards: 15 percent maximum moisture content and any of the following species and grades:
 - 1. Mixed southern pine or southern pine; No. 2 grade; SPIB.

2. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWP.
 3. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWP.
 4. Eastern softwoods; No. 2 Common grade; NeLMA.
 5. Northern species; No. 2 Common grade; NLGA.
 6. Western woods; Construction or No. 2 Common grade; WCLIB or WWP.
- C. 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.
- D. 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, C-C Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.6 FASTENERS

- A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.
1. Where rough 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 A153/A153M or ASTM F2329.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 ICC-ES AC58 ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.

2.7 MISCELLANEOUS MATERIALS**PART 3 - EXECUTION****3.1 INSTALLATION**

- A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. 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.
- C. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- D. 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 o.c.
- E. 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.
- F. Comply with AWP A 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.
- G. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).
- H. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

- 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 wood blocking to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.3 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 061600 - SHEATHING**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Wall sheathing.
2. Sheathing joint-and-penetration treatment materials.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for plywood backing panels.
2. Section 072500 "Weather Barriers" for water-resistive barrier applied over wall sheathing.

1.2 PREINSTALLATION MEETINGS**A. Preinstallation Conference: Conduct conference at Project site.**

1. Review air-barrier and water-resistant glass-mat gypsum sheathing requirements and installation, special details, transitions, mockups, air-leakage testing, protection, and work scheduling that covers air-barrier and water-resistant glass-mat gypsum sheathing.

1.3 ACTION SUBMITTALS**A. Product Data:**

1. Wall sheathing.
2. Sheathing joint-and-penetration treatment materials.

B. Product Data Submittals: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

C. Field quality-control reports.**1.4 QUALITY ASSURANCE****A. Testing Agency Qualifications:**

1. 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 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: As tested in accordance with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 WALL SHEATHING

- A. Glass-Mat Gypsum Sheathing, Walls: ASTM C1177/C1177M.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN.
 - b. Georgia-Pacific Gypsum LLC.
 - c. USG Corporation.
 - 2. Type and Thickness: Type X, 5/8 inch thick.
 - 3. Size: 48 by 96 inches for vertical installation.
- B. Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M, Type X, coated fiberglass mat gypsum sheathing with integral weather-resistant barrier and air barrier complying with ASTM E2178.
 - 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.
 - b. USG Corporation.
 - 2. Thickness: 5/8 inch thick.
 - 3. Size: 48 by 96 inches for vertical installation.
 - 4. Edges: Square.

5. Flashing and Transitions Strips: As acceptable to sheathing manufacturer.
6. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference when tested in accordance with ASTM E2178.
7. Vapor Permeance: Minimum 20 perms when tested in accordance with ASTM E96/E96M, Desiccant Method, Procedure A.
8. Sheathing Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. when tested in accordance with ASTM E2357.
9. Fire Propagation Characteristics: Complies with NFPA 285 testing as part of an approved assembly.
10. UV Resistance: Can be exposed to sunlight for 30 days in accordance with manufacturer's written instructions.
11. Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by sheathing manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

C. Cementitious Backer Units, Walls: ASTM C1325, Type A.

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. **Custom Building Products.**
 - b. **FinPan, Inc.**
 - c. **USG Corporation.**
2. Thickness: 5/8 inch.

2.3 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. For wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
 2. For wall sheathing, provide fasteners with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours in accordance with ASTM B117.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.
- E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

- F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
 - 1. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C1002.
 - 2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C954.
- G. Screws for Fastening Composite Nail Base Insulated Roof Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours in accordance with ASTM B117. Provide washers or plates if recommended by sheathing manufacturer.

PART 3 - EXECUTION

3.1 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. Table 2304.10.1, "Fastening Schedule," in the ICC's International Building Code.
 - 2. ICC-ES evaluation report for fastener.
- D. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 INSTALLATION OF GYPSUM SHEATHING

- A. Comply with GA-253 and with manufacturer's written instructions.
 - 1. Fasten gypsum sheathing to wood framing with screws.
 - 2. Fasten gypsum sheathing to cold-formed metal framing with screws.
 - 3. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.

4. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.
 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.
- D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.
 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.
- E. Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing:
 1. Install accessory materials in accordance with sheathing manufacturer's written instructions and details to form a seal with adjacent construction, to seal fasteners, and ensure continuity of air and water barrier.
 - a. Coordinate the installation of sheathing with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 - b. Install transition strip on roofing membrane or base flashing, so that a minimum of 3 inches of coverage is achieved over each substrate.
 2. Connect and seal sheathing material continuously to air barriers specified under other Sections as well as 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.
 3. 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.
 4. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of sheathing material with foam sealant.
 5. Seal top of through-wall flashings to sheathing with an additional 6-inch-wide, transition strip.
 6. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
 7. Repair punctures, voids, and deficient lapped seams in strips and transition strips extending 6 inches beyond repaired areas in strip direction.

SHEATHING

LXT Eastside Development

SECTION 06 16 00

Project #47732472

Permit Set 09/29/22

3.3 INSTALLATION OF CEMENTITIOUS BACKER UNITS

- A. Install panels and treat joints in accordance with ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.4 FIELD QUALITY CONTROL

- A. Testing and Inspecting Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests: As determined by testing agency from among the following tests:
- C. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
- D. Prepare test and inspection reports.

END OF SECTION 061600

SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Plastic-laminate-clad architectural cabinets.
2. Cabinet hardware and accessories.
3. Miscellaneous materials.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.
2. Section 123623.13 "Plastic-Laminate-Clad Countertops."

1.2 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS**A. Product Data:**

1. Plastic-laminate-clad architectural cabinets.
2. Cabinet hardware and accessories.
3. Miscellaneous materials.

B. Product Data Submittals: For each product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

C. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Show large-scale details.

3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 4. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.
 5. Apply AWI Quality Certification Program label to Shop Drawings.
- D. Samples: For each exposed product and for each color and texture specified, in manufacturer's or manufacturer's standard size.
- E. Samples for Verification: For the following:
1. Plastic Laminates: 8 by 10 inches, for each type, color, pattern, and surface finish required.
 - a. Provide one sample applied to core material with specified edge material applied to one edge.
 2. Corner Pieces:
 - a. Cabinet-front frame joints between stiles and rails and at exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
 - b. Miter joints for standing trim.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and Installer.
- B. Product Certificates: For each type of product.
- C. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.6 CLOSEOUT SUBMITTALS

- A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.7 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: 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.
 1. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.
- B. Installer Qualifications: Manufacturer of products.
 1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.9 FIELD CONDITIONS

- A. Environmental Limitations with Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.
- B. Field Measurements: Where cabinets are 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 cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS**2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS**

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.
 - 1. Provide labels and certificates from AWI certification program indicating that woodwork and installation complies with requirements of grades specified.
 - 2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.
- B. Architectural Woodwork Standards Grade: Custom.
- C. Type of Construction: Frameless.
- D. Door and Drawer-Front Style: Flush overlay.
- E. High-Pressure Decorative Laminate: ISO 4586-3, grades as indicated or if not indicated, as required by quality standard.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Formica Corporation.
 - b. Wilsonart LLC.
 - c. Arborite
- F. Exposed Surfaces:
 1. Plastic-Laminate Grade Horizontal Surface: HGS.
 2. Plastic-Laminate Grade Postformed Surface: HGP.
 3. Plastic-Laminate Grade Vertical Surface: HGS.
 4. Edges: Grade HGS.
 5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.
- G. Semiexposed Surfaces:
 1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, ISO 4586-3.
 - a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch minimum thickness, matching laminate in color, pattern, and finish.
 - b. Edges of Thermally Fused Laminate Panel Shelves: PVC or polyester edge banding.
 - c. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, ISO 4586-3, grade to match exposed surface.
 2. Drawer Sides and Backs: Thermally fused laminate panels with PVC or polyester edge banding.
 3. Drawer Bottoms: Thermally fused laminate panels.
- H. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.
- I. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, ISO 4583-3, grade to match exposed surface.
- J. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.
- K. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 1. As indicated by laminate manufacturer's designations.
 2. Match Architect's sample.

3. As selected by Architect from laminate manufacturer's full range in the following categories:
 - a. As selected by Architect.

2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 1. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130, made with binder containing no urea formaldehyde.
 2. Particleboard (Medium Density): ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.
 3. Softwood Plywood: DOC PS 1.
 4. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper, made with adhesive containing no urea formaldehyde.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products in accordance with test method indicated by a qualified testing agency.
 1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials 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 qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.
- B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, 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 beyond the centerline of the burners at any time during the test.
 1. Kiln-dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.

2. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
- C. Fire-Retardant Fiberboard: MDF 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 in accordance with ASTM E84.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following or equal:
 - a. Roseburg.

2.4 CABINET HARDWARE AND ACCESSORIES

- A. Cabinet Hardware: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087100 "Door Hardware."
- B. Butt Hinges: 2-3/4-inch, five-knuckle steel hinges made from 0.095-inch-thick metal, and as follows:
 1. Semiconcealed Hinges for Flush Doors: ANSI/BHMA A156.9, B01361.
 2. Semiconcealed Hinges for Overlay Doors: ANSI/BHMA A156.9, B01521.
- C. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 135 degrees of opening.
- D. Back-Mounted Pulls: ANSI/BHMA A156.9, B02011.
- E. Pulls: Per drawings
- F. Catches: Magnetic catches, ANSI/BHMA A156.9, B03141.
- G. Adjustable Shelf Standards and Supports: ANSI/BHMA A156.9, B04071; with shelf rests, B04081.
- H. Shelf Rests: ANSI/BHMA A156.9, B04013; two-pin metal with shelf hold-down clip.
- I. Drawer Slides: ANSI/BHMA A156.9.
 1. Heavy-Duty (Grade 1HD-100 and Grade 1HD-200): Side mount.
 - a. Type: Full extension.
 - b. Material: Galvanized steel ball bearing slides.
 - c. Motion Feature: Soft close dampener.
 2. General-purpose drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide 75 lb load capacity.
 3. File drawers more than 6 inches high or more than 24 inches wide, provide 100 lb load capacity.
 4. Lateral file drawers more than 6 inches high and more than 24 inches but not more than 30 inches wide, provide 150 lb load capacity.

5. Lateral file drawers more than 6 inches high and more than 30 inches wide, provide 200 lb load capacity.
6. Computer keyboard tray, provide 75 lb load capacity.
- J. Slides for Sliding Glass Doors: ANSI/BHMA A156.9, B07063; aluminum.
- K. Door Locks: ANSI/BHMA A156.11, E07121.
- L. Drawer Locks: ANSI/BHMA A156.11, E07041.
- M. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.
- N. Float Glass for Cabinet Doors: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
 1. Thickness: 4.0 mm.
- O. Tempered Float Glass for Cabinet Doors: ASTM C1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3, 6 mm thick unless otherwise indicated.
 1. Unframed Glass Doors: Seam exposed edges seamed before tempering.
- P. Tempered Float Glass for Cabinet Shelves: ASTM C1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3; with exposed edges seamed before tempering, 6 mm thick.
- Q. Grommets for Cable Passage: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
 1. Color: White.
- R. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.
 1. Dark, Oxidized, Satin Bronze, Oil Rubbed: ANSI/BHMA 613 for bronze base; ANSI/BHMA 640 for steel base; match Architect's sample.
 2. Bright Brass, Clear Coated: ANSI/BHMA 605 for brass base; ANSI/BHMA 632 for steel base.
 3. Bright Brass, Vacuum Coated: ANSI/BHMA 723 for brass base; ANSI/BHMA 729 for zinc-coated-steel base.
 4. Satin Brass, Blackened, Bright Relieved, Clear Coated: ANSI/BHMA 610 for brass base; ANSI/BHMA 636 for steel base.
 5. Satin Chromium Plated: ANSI/BHMA 626 for brass or bronze base; ANSI/BHMA 652 for steel base.
 6. Bright Chromium Plated: ANSI/BHMA 625 for brass or bronze base; ANSI/BHMA 651 for steel base.
 7. Satin Stainless Steel: ANSI/BHMA 630.
- S. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.5 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesive for Bonding Plastic Laminate: Type I, waterproof type as selected by fabricator to comply with requirements.
 - 1. Adhesive for Bonding Edges: Hot-melt adhesive.

2.6 FABRICATION

- A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.
- B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
- D. Install glass to comply with applicable requirements in Section 088000 "Glazing" and in GANA's "Glazing Manual."
 - 1. For glass in frames, secure glass with removable stops.
 - 2. For exposed glass edges, polish and grind smooth.

PART 3 - EXECUTION**3.1 PREPARATION**

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

- A. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.
- B. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.

- C. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.
 - 1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
 - 2. Install cabinets without distortion so doors and drawers fit openings 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.
 - 3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

3.3 FIELD QUALITY CONTROL

- A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.
 - 1. Inspection entity is to prepare and submit report of inspection.

3.4 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION 064116

SECTION 072100 - THERMAL INSULATION**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Extruded polystyrene foam-plastic board insulation.
2. Polyisocyanurate foam-plastic board insulation.
3. Glass-fiber blanket insulation.
4. Sound attenuation Glass-fiber blanket insulation.

B. Related Requirements:

1. Section 075423 "Thermoplastic-Polyolefin (TPO) Roofing" for insulation specified as part of roofing construction.
2. Section 092900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.2 ACTION SUBMITTALS**A. Product Data** For each type of product indicated.**1.3 INFORMATIONAL SUBMITTALS**

- A. **Installer's Certification:** Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.
- B. **Product Test Reports:** For each product, for tests performed by a qualified testing agency.
- C. **Research Reports:** For foam-plastic insulation, from ICC-ES.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than 25 and 450 when tested in accordance with ASTM E84.
- B. Fire-Resistance Ratings: Comply with ASTM E119 or UL 263; testing 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 listings of another qualified testing agency.
- C. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
- D. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.
- E. Thermal-Resistance Value (R-Value): R-value as indicated on Drawings in accordance with ASTM C518.

2.2 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION

- A. Extruded Polystyrene Board Insulation, Type IV: ASTM C578, Type IV, 25-psi minimum compressive strength; unfaced.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DuPont de Nemours, Inc.
 - b. Owens Corning.
 - c. The Dow Chemical Company.

2.3 GLASS-FIBER BLANKET INSULATION

- A. Glass-Fiber Blanket Insulation, Polypropylene-Scrim-Kraft Faced: ASTM C665, Type II (nonreflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier).
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Owens Corning.

- B. Glass-Fiber Blanket Insulation, Kraft Faced: ASTM C665, Type II (nonreflective faced), Class C (faced surface not rated for flame propagation); Category 1 (membrane is a vapor barrier).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. CertainTeed; SAINT-GOBAIN.
- b. Johns Manville; a Berkshire Hathaway company.
- c. Owens Corning.

2.4 SOUND ATTENUATION GLASS-FIBER BLANKET INSULATION

- A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
- C. Provide glass-fiber blanket insulation as follows:
1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
 2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

2.5 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. AGM Industries, Inc.
 - b. Gemco.
2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
- B. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. AGM Industries, Inc.
 - b. Gemco.

- C. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGM Industries, Inc.
 - b. Gemco.

2.6 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
 - 1. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.
 - 2. Polyurethane Pour-In-Place Insulation: Closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84, specifically formulated for pour-in-place applications.
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) Huntsman Building Solutions.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF SLAB INSULATION

- A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
 - 1. If not otherwise indicated, extend insulation a minimum of 36 inches below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
 - 1. If not otherwise indicated, extend insulation a minimum of 24 inches in from exterior walls.

3.4 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
 - 5. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
 - 6. For wood-framed construction, install blankets in accordance with ASTM C1320 and as follows:
 - a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.
 - 7. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.
 - a. Exterior Walls: Set units with facing placed toward interior of construction.
 - b. Interior Walls: Set units with facing placed toward areas of high humidity.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - 1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..
 - 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

- C. Loose-Fill Insulation: Apply in accordance with ASTM C1015 and manufacturer's written instructions.
 - 1. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not compact excessively.
 - 2. For cellulosic-fiber loose-fill insulation, comply with CIMA's Bulletin #2, "Standard Practice for Installing Cellulose Insulation."
- D. Spray-Applied Cellulosic Insulation: Apply spray-applied insulation according to manufacturer's written instructions.
 - 1. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked.
 - 2. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

3.5 INSTALLATION OF CURTAIN-WALL INSULATION

- A. Install board insulation in curtain-wall construction according to curtain-wall manufacturer's written instructions.
 - 1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass.
 - 2. Maintain cavity width of dimension indicated on Drawings between insulation and glass.
 - 3. Install insulation to fit snugly without bowing.

3.6 INSTALLATION OF REFLECTIVE INSULATION

- A. Install sheet reflective insulation in accordance with ASTM C727.
- B. Install sheet radiant barriers in accordance with ASTM C1744.
- C. Install interior radiation control coating system in accordance with ASTM C1321.

3.7 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.
- B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 072500 - WEATHER BARRIERS**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Building wrap.
 - 2. Flexible flashing.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Building wrap.
 - 2. Flexible flashing.
- B. Product Data Submittals: For building wrap, include data on air and water-vapor permeance based on testing in accordance with referenced standards.
- C. Shop Drawings: Show details of building wrap at terminations, openings, and penetrations. Show details of flexible flashing applications.
- D. Sustainable Design Submittals:

1.3 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For water-resistive barrier and flexible flashing, from ICC-ES.

PART 2 - PRODUCTS**2.1 WATER-RESISTIVE BARRIER**

- A. Building Wrap: ASTM E2556/E2556M, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested in accordance with ASTM E84; UV stabilized; and acceptable to authorities having jurisdiction.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Alpha ProTech.
 - b. DuPont de Nemours, Inc.
 - c. Kingspan Insulation LLC.
 - 2. Water-Vapor Permeance: Minimum 75 perms per ASTM E96/E96M, Desiccant Method (Procedure A).

3. Air Permeance: Maximum 0.004 cfm/sq. ft. at 0.3-inch wg when tested in accordance with ASTM E2178.
4. Allowable UV Exposure Time: Not more than 120 days.
5. Flame Propagation Test: Materials and construction to be as tested in accordance with NFPA 285.

2.2 FLEXIBLE FLASHING

- A. Butyl Rubber 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.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Alpha ProTech.
 - b. DuPont de Nemours, Inc.
 - c. Kingspan Insulation LLC.
 2. Flame Propagation Test: Materials and construction to be as tested in accordance with NFPA 285.
- B. Primer for Flexible Flashing: Product recommended in writing by flexible flashing manufacturer for substrate.
- C. Nails and Staples: Product recommended in writing by flexible flashing manufacturer and complying with ASTM F1667.

PART 3 - EXECUTION

3.1 INSTALLATION OF WATER-RESISTIVE BARRIER

- A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.
- B. Cover sheathing with water-resistive barrier as follows:
 1. Cut back barrier 1/2 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.
- C. Building Wrap or Drainage Wrap: Comply with manufacturer's written instructions and warranty requirements.
 1. Seal seams, edges, fasteners, and penetrations with tape.
 2. Extend into jambs of openings and seal corners with tape.

3.2 INSTALLATION OF FLEXIBLE FLASHING

- A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.
 - 1. Prime substrates as recommended by flashing manufacturer.
 - 2. Lap seams and junctures with other materials at least 4 inches except that at flashing flanges of other construction, laps need not exceed flange width.
 - 3. Lap flashing over water-resistive barrier at bottom and sides of openings.
 - 4. Lap water-resistive barrier over flashing at heads of openings.
 - 5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

3.3 INSTALLATION OF DRAINAGE MATERIAL

- A. Install drainage material over building wrap and flashing to comply with manufacturer's written instructions.

END OF SECTION 072500

SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Medium-build air barriers, vapor permeable.

B. Related Requirements:

1. Section 061600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.
2. Section 072500 "Weather Barriers" for weather barriers, including flexible flashing.

1.2 DEFINITIONS

- A. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- B. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.
- C. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

1.3 PREINSTALLATION MEETINGS**A. Preinstallation Conference: Conduct conference at Project site.**

1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.4 ACTION SUBMITTALS**A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.**

1. Medium-build air barriers, vapor permeable.

B. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

3. Include details of interfaces with other materials that form part of air barrier.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer. Include list of ABAA-certified installers and supervisors employed by Installer, who work on Project.
- B. 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 the barrier.
- C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.
- D. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
 1. Installer to be licensed by ABAA in accordance with ABAA's Quality Assurance Program and to employ ABAA-certified installers and supervisors on Project.

1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on field mockups.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- B. Protect stored materials from direct sunlight.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.
 1. Protect substrates from environmental conditions that affect air-barrier performance.
 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS**2.1 SOURCE LIMITATIONS**

- A. Obtain primary air-barrier materials and air-barrier accessories from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction to be capable of performing as a continuous air barrier. Air-barrier assemblies to be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested in accordance with ASTM E2357.
- C. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. pressure difference; ASTM E2178.
- D. Ultimate Elongation: Minimum 250 percent; ASTM D412, Die C.
- E. Adhesion to Substrate: Minimum 16 lbf/sq. in. when tested in accordance with ASTM D4541.
- F. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
- G. UV Resistance: Can be exposed to sunlight for 180 days in accordance with manufacturer's written instructions.

2.3 MEDIUM-BUILD AIR BARRIERS, VAPOR PERMEABLE

- A. Medium-Build, Vapor-Permeable Air Barrier: Synthetic polymer material with an installed dry film thickness, according to manufacturer's written instructions, of 16 to 34 mils over smooth, void-free substrates.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division.
 - b. DuPont de Nemours, Inc.
 - c. Sto Corp.
 - 2. Vapor Permeance: Minimum 5 perms ASTM E96/E96M, Procedure A, Desiccant Method.

2.4 ACCESSORY MATERIALS

- A. Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.
- B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.
- C. Stainless Steel Sheet: ASTM A240/A240M, Type 304, 0.0187 inch thick, and Series 300 stainless steel fasteners.
- D. Preformed Silicone Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pecora Corporation.
 - b. The Dow Chemical Company.
 - c. Tremco Incorporated.

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 substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
 - 3. Verify that substrates are visibly dry and free of moisture.
 - 4. Verify that masonry joints are flush and completely filled with mortar.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate in accordance with manufacturer's written instructions and details. 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 material.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. 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.
- G. 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.
- H. Bridge isolation joints expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement in accordance with manufacturer's written instructions and details.

3.3 INSTALLATION OF ACCESSORIES

- A. Install accessory materials in accordance with air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.
 - 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 - 2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
 - 3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
 - 4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
- B. Connect and seal exterior wall air-barrier material 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.
- C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- D. 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.

- E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply 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. Transition Strip: Roll firmly to enhance adhesion.
 - 2. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.
- F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.
- G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
- H. Seal top of through-wall flashings to air barrier with an additional 6-inch-wide, transition strip.
- I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.4 INSTALLATION OF PRIMARY AIR-BARRIER MATERIAL

- A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier in accordance with air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.
 - 1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
 - 2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
 - 3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.
- B. Medium-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply an increased thickness of air-barrier material in full contact around protrusions such as masonry ties.
 - 1. Vapor-Permeable, Medium-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, applied in two equal coats. Apply additional material as needed to achieve void- and pinhole-free surface, but do not exceed thickness on which required vapor permeability is based.
- C. Do not cover air barrier until it has been tested and inspected by testing agency.
- D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.5 FIELD QUALITY CONTROL

- A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. 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. Air-barrier dry film thickness.
 - 3. Continuous structural support of air-barrier system has been provided.
 - 4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
 - 5. Site conditions for application temperature and dryness of substrates have been maintained.
 - 6. Maximum exposure time of materials to UV deterioration has not been exceeded.
 - 7. Surfaces have been primed, if applicable.
 - 8. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
 - 9. Termination mastic has been applied on cut edges.
 - 10. Strips and transition strips have been firmly adhered to substrate.
 - 11. Compatible materials have been used.
 - 12. Transitions at changes in direction and structural support at gaps have been provided.
 - 13. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
 - 14. All penetrations have been sealed.
- D. Tests: As determined by testing agency from among the following tests:
 - 1. Air-Leakage-Location Testing: Air-barrier assemblies will be tested for evidence of air leakage in accordance with ASTM E1186, chamber pressurization or depressurization with smoke tracers.
 - 2. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate in accordance with ASTM E783.
 - 3. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate in accordance with ASTM D4541 for each 600 sq. ft. of installed air barrier or part thereof.
- E. Air barriers will be considered defective if they do not pass tests and inspections.
 - 1. Apply additional air-barrier material, in accordance with manufacturer's written instructions, where inspection results indicate insufficient thickness.
 - 2. Remove and replace deficient air-barrier components for retesting as specified above.
- F. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

- G. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

- A. Protect air-barrier system from damage during application and remainder of construction period, in accordance with manufacturer's written instructions.
 - 1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials in accordance with 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 in writing by manufacturer of affected construction.
- C. Remove masking materials after installation.

END OF SECTION 072726

SECTION 074213.13 - FORMED METAL WALL PANELS**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
1. Concealed-fastener, lap-seam metal wall panels.
 2. Metal liner panels.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of doors, windows, and louvers.
 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
 6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
 7. Review temporary protection requirements for metal panel assembly during and after installation.
 8. Review of procedures for repair of metal panels damaged after installation.
 9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.3 ACTION SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
1. Exposed-fastener, lap-seam metal wall panels.
 2. Concealed-fastener, lap-seam metal wall panels.
 3. Metal liner panels.
- B. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
 2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied finishes.
1. Include Samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below:
1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For concealed-fastener, lap-seam metal wall panels for tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer with minimum five years of experience.
- B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

1.8 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.9 COORDINATION

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Five years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show 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 Delta E units when tested according to ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Deflection Limits: For wind loads, no greater than 1/240 of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft..
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 2.86 lbf/sq. ft.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 EXPOSED-FASTENER, LAP-SEAM METAL WALL PANELS

- A. Provide factory-formed metal panels designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for weathertight installation.
- B. Tapered-Rib-Profile, Exposed-Fastener Metal Wall Panels MP-1: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Berridge Manufacturing Company.
 - b. Butler Manufacturing Company; a division of BlueScope Buildings North America, Inc.
 - c. CENTRIA, a Nucor Brand.
 - 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

- a. Nominal Thickness: 0.022 inch.
- b. Exterior Finish: Two-coat fluoropolymer.
- c. Surface: Smooth, flat
- d. Color: Per the drawings.

2.3 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

- A. Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. Flush-Profile, Concealed-Fastener Metal Wall Panels MP-2 & MP-3: Formed with vertical panel edges and a flat pan between panel edges; with flush joint between panels.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Berridge Manufacturing Company.
 - b. PAC-CLAD; Petersen; a Carlisle company.
 - c. Butler Manufacturing Company; a division of BlueScope Buildings North America, Inc.
 - 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
 - a. Nominal Thickness: 0.022 inch.
 - b. Exterior Finish: Two-coat fluoropolymer.
 - c. Surface: Smooth, flat
 - d. Color: Per the drawings.
- C. Flush-Profile, Concealed-Fastener Metal Wall Panels MP-4: Formed with horizontal panel edges and a flat pan between panel edges; with flush joint between panels.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Berridge Manufacturing Company.
 - b. PAC-CLAD; Petersen; a Carlisle company.
 - c. Butler Manufacturing Company; a division of BlueScope Buildings North America, Inc.
 - 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
 - a. Nominal Thickness: 0.022 inch.

- b. Exterior Finish: Two-coat fluoropolymer.
 - c. Surface: Smooth, flat
 - d. Color: Per the drawings.
- D. Flush-Profile, Concealed-Fastener Metal Wall Panels MP-5: Formed with vertical panel edges and a flat pan between panel edges; with flush joint between panels.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Berridge Manufacturing Company.
 - b. PAC-CLAD; Petersen; a Carlisle company.
 - c. Butler Manufacturing Company; a division of BlueScope Buildings North America, Inc.
 - 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
 - a. Nominal Thickness: 0.022 inch.
 - b. Exterior Finish: Two-coat fluoropolymer.
 - c. Surface: Stucco
 - d. Color: Per the drawings.

2.4 METAL LINER PANELS

- A. Provide factory-formed metal liner panels designed for interior side walls and field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for a complete installation.
- B. Metal Liner Panels: Solid panels formed with intermediate stiffening ribs symmetrically spaced between panel edges; with a flush joint between panels.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Berridge Manufacturing Company.
 - b. CENTRIA, a Nucor Brand.
 - c. Butler Manufacturing Company; a division of BlueScope Buildings North America, Inc.
 - 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
 - a. Nominal Thickness: 0.022 inch.
 - b. Exterior Finish: Two-coat fluoropolymer.

- c. Color: As selected by Architect from manufacturer's full range.
- 3. Panel Coverage: 36 inches.
- 4. Seam Profile: Flush.
- 5. Seam Height: 1.5 inches.

2.5 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 hot-dip galvanized coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 - 1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
 - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
 - 2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
 - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.6 FABRICATION

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.7 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Steel Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (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.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.3 INSTALLATION OF METAL PANELS

- A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 1. Shim or otherwise plumb substrates receiving metal panels.

2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 3. Install screw fasteners in predrilled holes.
 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 5. Install flashing and trim as metal panel work proceeds.
 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
 2. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
 3. Copper Panels: Use copper, stainless steel, or hardware-bronze fasteners.
 4. Stainless Steel Panels: Use stainless steel fasteners.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
 3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
 5. Flash and seal panels with weather closures at perimeter of all openings.
- E. Watertight Installation:
1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
 2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.
- F. Metal Liner Panels: Install panels on interior side of girts with flush appearance on the inside.

- G. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
- H. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
 - 1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Water-Spray Test: After installation, test area of assembly as directed by Architect for water penetration according to AAMA 501.2.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.
- D. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.
- E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- F. Prepare test and inspection reports.

3.5 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

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- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074213.13

SECTION 074293 - SOFFIT PANELS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Metal soffit panels.

B. Related Requirements:

1. Section 074213.13 "Formed Metal Wall Panels" for lap-seam metal wall panels.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS**A. Product Data:**

1. Metal soffit panels.

B. Product Data Submittals:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

C. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.4 INFORMATIONAL SUBMITTALS**A. Qualification Data:** For Installer.

- B. Product Test Reports: For each product, tests performed by a qualified testing agency.
- C. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.
- 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 mockup of typical roof eave, including fascia, and soffit as shown on Drawings; approximately 4 by full eave width, including attachments 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. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

1.8 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.9 COORDINATION

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

- 1. Failures include, but are not limited to, the following:

- a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.

- 2. Warranty Period: Two years from date of Substantial Completion.

- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show 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 Delta E units when tested according to ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

- 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

- 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Deflection Limits: For wind loads, no greater than 1/240 of the span.

- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft..
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 2.86 lbf/sq. ft..
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METAL SOFFIT PANELS

- A. Provide metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. Metal Soffit Panels: Match profile and material of metal wall panels.
 - 1. Finish: As indicated on Drawings.
- C. Flush-Profile Metal Soffit Panels: Solid panels formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced between panel edges; with flush joint between panels.
 - 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. Berridge Manufacturing Company.
 - b. CENTRIA, a Nucor Brand.
 - c. Dimensional Metals, Inc.
 - 2. Material: Same material, finish, and color as metal fascia panels.
 - 3. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
 - a. Nominal Thickness: 0.022 inch.
 - b. Exterior Finish: Two-coat fluoropolymer.
 - c. Color: Per the drawings.
 - 4. Panel Coverage: 12 inches.

5. Panel Height: 1.0 inch.

2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 hot-dip galvanized coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 1. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
 2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.4 FABRICATION

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal soffit panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Steel Panels and Accessories:
 - 1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (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.
- D. Aluminum Panels and Accessories:
 - 1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (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.

2. Exposed Anodized Finish:
 - a. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 1. Examine framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal panel manufacturer.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.
 1. Soffit Framing: Wire tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.

3.3 INSTALLATION OF METAL SOFFIT PANELS

- A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 1. Shim or otherwise plumb substrates receiving metal panels.
 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 3. Install screw fasteners in predrilled holes.
 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 5. Install flashing and trim as metal panel work proceeds.
 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 7. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
2. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
3. Copper Panels: Use copper, stainless steel, or hardware-bronze fasteners.
4. Stainless Steel Panels: Use stainless steel fasteners.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.**D. Lap-Seam Metal Panels:** Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Apply panels and associated items true to line for neat and weathertight enclosure.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

E. Watertight Installation:**F. Accessory Installation:** Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling, and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074293

SECTION 075423 - THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Thermoplastic polyolefin (TPO) roofing system.
2. Accessory roofing materials.
3. Vapor retarder.
4. Roof insulation.
5. Insulation accessories and cover board.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
2. Section 061600 "Sheathing" for wood-based, structural-use roof deck panels.
3. Section 072100 "Thermal Insulation" for insulation beneath the roof deck.
4. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
5. Section 077100 "Roof Specialties" for roof edge flashings.
6. Section 077129 "Manufactured Roof Expansion Joints" for manufactured roof expansion-joint assemblies.
7. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.2 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D1079 and glossary in NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.3 PREINSTALLATION MEETINGS

- A. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

B. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Thermoplastic polyolefin (TPO) roofing system.
2. Accessory roofing materials.
3. Roof insulation.
4. Insulation accessories and cover board.
5. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane termination details.
3. Flashing details at penetrations.

4. Tapered insulation layout, thickness, and slopes.
 5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
 6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
 7. Tie-in with adjoining air barrier.
- C. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer manufacturer.
- B. Manufacturer Certificates:
1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - a. Submit evidence of compliance with performance requirements.
 2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.
- C. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.
- D. Evaluation Reports: For components of roofing system, from ICC-ES.
- E. Field Test Reports:
1. Concrete internal relative humidity test reports.
 2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.
- F. Field quality-control reports.
- G. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing system to include in maintenance manuals.
- B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.7 QUALITY ASSURANCE

- A. **Manufacturer Qualifications:** A qualified manufacturer that is UL listed or listed in FM Approvals' or RoofNav listed in SPRI's Directory of Roof Assemblies for roofing system identical to that used for this Project.
- B. **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 manufacturer's special warranty.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, 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 roofing system manufacturer. Protect stored liquid material from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. 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.

1.9 FIELD CONDITIONS

- A. **Weather Limitations:** Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.10 WARRANTY

- A. **Special Warranty:** Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, vapor retarder, substrate board, and other components of roofing system.
 - 2. **Warranty Period:** 20 years from date of Substantial Completion.
- B. **Special Project Warranty:** Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of

roofing system such as roof membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, and, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing system and flashings to withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings to remain watertight.
 1. Accelerated Weathering: Roof to withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
 2. Impact Resistance: Roof membrane to resist impact damage when tested according to ASTM D3746, ASTM D4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
- B. Material Compatibility: Roofing materials to be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.
- C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897: Refer to drawings.
- D. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and are listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.
 1. Fire/Windstorm Classification: Class 1A-120.
 2. Hail-Resistance Rating: FM Global Property Loss Prevention Data Sheet 1-34 VSH.
- E. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- F. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.2 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING SYSTEM

- A. TPO Sheet: ASTM D6878/D6878M, internally fabric- or scrim-reinforced, fabric-backed self-adhering TPO sheet.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle Syntec Systems.
 - b. GAF.
 - c. Johns Manville; a Berkshire Hathaway company.
2. Source Limitations: Obtain components for roofing system from roof membrane manufacturer.
3. Thickness: 60 mils, nominal.
4. Exposed Face Color: Gray.

2.3 ACCESSORY ROOFING MATERIALS

- A. General: Accessory materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
 1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 55 mils thick, minimum, of same color as TPO sheet.
- C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.
- D. Roof Vents: As recommended by roof membrane manufacturer.
 1. Size: Not less than 4-inch diameter.
- E. Bonding Adhesive: Manufacturer's standard.
- F. Slip Sheet: Manufacturer's standard, of thickness required for application.
- G. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
- H. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick, prepunched.
- I. Ballast Retaining Bar: Perimeter securement system consisting of a slotted extruded-aluminum retention bar with an integrated compression fastening strip.
 1. Fasteners: 1-1/2-inch stainless steel fasteners with neoprene washers.
- J. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.
- K. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by TPO roof membrane manufacturer.
- B. Extruded-Polystyrene Board Insulation: ASTM C578, Type IV, 1.45-lb/cu. ft. minimum density, 25 psi minimum compressive strength, square edged.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kingspan Insulation LLC.
 - b. Owens Corning.
 - c. The Dow Chemical Company.
 - 2. Thermal Resistance: R-value of 5.0 per 1 inch.
 - 3. Size: 48 by 48 inches.
 - 4. Thickness:
 - a. Base Layer: 1 inches.

2.5 INSULATION ACCESSORIES AND COVER BOARD

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.
- B. Fasteners: Factory-coated steel fasteners with metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- C. Induction-Welding Plates: Minimum 3-inch diameter with recessed center, 0.034-inch thick, aluminum-zinc-alloy-coated steel plates, factory-coated with adhesive formulated for roof membrane, with corresponding corrosion-resistant fasteners.
- D. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
 - 1. Full-spread, spray-applied, low-rise, two-component urethane adhesive.
- E. Glass-Mat Gypsum Cover Board: ASTM C1177/C1177M, water-resistant gypsum board.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN.
 - b. Georgia-Pacific Gypsum LLC.
 - c. USG Corporation.
 - 2. Thickness: 1/4 inch.
 - 3. Surface Finish: Fiberglass facer.

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 roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
 - 2. Verify that wood 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 Section 053100 "Steel Decking."
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 INSTALLATION OF ROOFING, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav listed roof assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning Work on adjoining roofing.
- C. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified under Section 072726 "Fluid-Applied Membrane Air Barriers."

3.4 INSTALLATION OF INSULATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.
- B. Comply with roofing system and roof insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Metal Decking:

1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows and with long joints continuous at right angle to flutes of decking.
 - a. Locate end joints over crests of decking.
 - b. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
 - c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - d. Make joints between adjacent insulation boards not more than 1/4 inch in width.
 - e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
 - 1) Trim insulation so that water flow is unrestricted.
 - f. Fill gaps exceeding 1/4 inch with insulation.
 - g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
 - h. Loosely lay base layer of insulation units over substrate.
 - i. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.
 - 1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
 - 2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.
 - a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
 - b. Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.
 - c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - d. Make joints between adjacent insulation boards not more than 1/4 inch in width.
 - e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
 - 1) Trim insulation so that water flow is unrestricted.
 - f. Fill gaps exceeding 1/4 inch with insulation.
 - g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
 - h. Loosely lay each layer of insulation units over substrate.
 - i. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

- 1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.
- 2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
- 3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.5 INSTALLATION OF COVER BOARDS

- A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.
 1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 2. Cut and fit cover board tight to nailers, projections, and penetrations.
 3. Loosely lay cover board over substrate.
 4. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
 - a. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
 - b. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
- B. Install slip sheet over cover board and beneath roof membrane.
- C. Place plates on insulation in required fastening patterns to achieve FM rating and secure in accordance with manufacturer's instructions.
 1. Install plates and fasteners tight and flat to substrate with no dimpling, and with fastener extending 1 inch minimum into roof deck; do not overdrive fasteners.

3.6 INSTALLATION OF MECHANICALLY FASTENED ROOF MEMBRANE

- A. Mechanically fasten roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
- B. Unroll roof membrane and allow to relax before installing.
- C. For in-splice attachment, install roof membrane with long dimension perpendicular to steel roof deck flutes.
- D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

- E. Mechanically fasten or adhere roof membrane securely at terminations, penetrations, and perimeter of roofing.
- F. Apply roof membrane with side laps shingled with slope of roof deck where possible.
- G. In-Seam Attachment: Secure one edge of TPO sheet using fastening plates or metal battens centered within seam, and mechanically fasten TPO sheet to roof deck.
- H. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and flashing sheet.
 - 2. Verify field strength of seams a minimum of once daily, and repair seam sample areas.
 - 3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.
- I. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.7 INSTALLATION OF INDUCTION-WELDED ROOF MEMBRANE

- A. Unroll roof membrane and allow to relax before installing.
- B. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer, with side laps shingled with slope of roof deck where possible.
- C. Seams: Clean seam areas, overlap roof membrane, and hot-air-weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity.
 - 2. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
 - 3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.
- D. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.
- E. Induction-weld roof membrane to plates in accordance with roofing system manufacturer's written instructions, creating 100 percent bond between underside of membrane and top of plates; a partial bond is unacceptable.
 - 1. Test welds to verify adhesion of roof membrane to top of plates in accordance with membrane manufacturer's instructions.

3.8 INSTALLATION OF BASE FLASHING

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and to inspect substrate conditions, surface preparation, roof membrane application, sheet flashings, protection, and drainage components, and to furnish reports to Architect.
- B. Perform the following tests:
 - 1. Flood Testing: Flood test each roof area for leaks, according to recommendations in ASTM D5957, after completing roofing and flashing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
 - a. Perform tests before overlying construction is placed.
 - b. Flood to an average depth of 2-1/2 inches with a minimum depth of and not exceeding a depth of 4 inches. Maintain 2 inches of clearance from top of base flashing.
 - c. Flood each area for 24 48 72 hours.
 - d. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.
 - 1) Cost of retesting is Contractor's responsibility.
 - e. Testing agency to prepare survey report indicating locations of initial leaks, if any, and final survey report.
- C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.
- D. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.10 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.11 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS _____ of _____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
 - 1. Owner: .
 - 2. Owner Address: .
 - 3. Building Name/Type: .
 - 4. Building Address: .
 - 5. Area of Work: .
 - 6. Acceptance Date: _____.
 - 7. Warranty Period: .
 - 8. Expiration Date: _____.
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period Roofing Installer will, at Roofing Installer's own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
 - 1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
 - a. lightning;

- 3.12 peak gust wind speed exceeding" SUBSTRATE BOARD
- a. : Per the drawings.
 - b. fire;
 - c. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
 - d. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
 - e. vapor condensation on bottom of roofing; and
 - f. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
 3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
 4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
 5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
 6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
 7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

B. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

LXT Eastside Development

SECTION 07 54 23

Project #47732472

Permit Set 09/29/22

END OF SECTION 075423

SECTION 076200 - SHEET METAL FLASHING AND TRIM**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Roof-drainage sheet metal fabrications.
2. Low-slope roof sheet metal fabrications.
3. Wall sheet metal fabrications.
4. Miscellaneous sheet metal fabrications.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 075423 Thermoplastic-Polyolefin (TPO) Roofing for roofing installation of sheet metal flashing and trim integral with roofing.
3. Section 074213.13 - Formed Metal Wall Panels for sheet metal flashing and trim integral with metal wall panels.
4. Section 077100 "Roof Specialties" for manufactured copings, roof-edge specialties, roof-edge drainage systems, and counterflashings.
5. Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.

1.2 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.3 PREINSTALLATION MEETINGS**A. Preinstallation Conference: Conduct conference at Project site.**

1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.4 ACTION SUBMITTALS**A. Product Data:**

1. Roof-drainage sheet metal fabrications.
2. Low-slope roof sheet metal fabrications.
3. Steep-slope roof sheet metal fabrications.
4. Wall sheet metal fabrications.
5. Miscellaneous sheet metal fabrications.

B. Product Data Submittals:

1. Underlayment materials.
2. Elastomeric sealant.
3. Butyl sealant.
4. Epoxy seam sealer.

C. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of roof-penetration flashing.
8. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
9. Include details of special conditions.
10. Include details of connections to adjoining work.
11. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.

D. Samples: For each exposed product and for each color and texture specified, 12 inches long by actual width.**1.5 INFORMATIONAL SUBMITTALS****A. Qualification Data: For fabricator.****B. Product Certificates: For each type of coping and roof edge flashing that is ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved.****C. Product Test Reports: For each product, for tests performed by a qualified testing agency.****D. Evaluation Reports: For copings and roof edge flashing, from ICC-ES showing compliance with ANSI/SPRI/FM 4435/ES-1.**

- E. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.
- B. Special warranty.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: 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.
 - 1. For copings and roof edge flashings that are ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved, shop is to be listed as able to fabricate required details as tested and approved.

1.8 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.
 - 1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
 - 2. Protect stored sheet metal flashing and trim from contact with water.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.9 WARRANTY

- A. Special Warranty on Finishes: 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 Delta E units when tested in accordance with ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to 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 are not to rattle, leak, or loosen, and are to remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. SPRI Wind Design Standard: Manufacture and install copings & roof edge flashings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:
 - 1. Design Pressure: As indicated on Drawings.
- D. FM Approvals Listing: Manufacture and install copings & roof edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with name of fabricator and design approved by FM Approvals.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

- A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Metallic-Coated Steel Sheet: aluminum-zinc alloy-coated steel sheet in accordance with ASTM A792/A792M, Class AZ50 coating designation, Grade 40; prepainted by coil-coating process to comply with ASTM A755/A755M.
 - 1. Surface: Smooth, flat.
 - 2. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (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.
 - 3. Color: Per the drawings.

4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

2.3 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.
- B. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over 220 deg F; and complying with physical requirements of ASTM D226/D226M for Type I and Type II felts.
 1. Source Limitations: Obtain underlayment from single source from single manufacturer.
- C. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle WIP Products; a brand of Carlisle Construction Materials.
 - b. Henry Company; a Carlisle company.
 - c. Owens Corning.
 2. Source Limitations: Obtain underlayment from single source from single manufacturer.
 3. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.
- D. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.

2.4 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.

- b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
- 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
- 3. Fasteners for Zinc-Coated (Galvanized) or Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329/F2329M.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- D. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

2.5 FABRICATION, GENERAL

- A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
 - 1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 - 2. 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.
 - 3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
 - 4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 - 5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances:
 - 1. 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 indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

- D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.
- G. Seams:
 - 1. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 2. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
- H. Do not use graphite pencils to mark metal surfaces.

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters:
 - 1. Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required.
 - 2. Fabricate in minimum 96-inch-long sections.
 - 3. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard, but with thickness not less than twice the gutter thickness Insert dimension.
 - 4. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.
 - 5. Gutter Profile: Style B in accordance with cited sheet metal standard.
 - 6. Expansion Joints: Butt type with cover plate.
 - 7. Gutters with Girth 26 to 30 Inches (660 to 760 mm): Fabricate from the following materials:
 - a. Galvanized Steel: 0.040 inch thick.
- B. Downspouts: Fabricate rectangular downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors.
 - 1. Fabricated Hanger Style: Fig. 1-35B in accordance with SMACNA's "Architectural Sheet Metal Manual."
 - 2. Fabricate from the following materials:
 - a. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.

- C. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch-wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof. Fabricate from the following materials:
 - 1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.
- D. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape required, complete with outlet tubes, exterior flange trim,. Fabricate from the following materials:
 - 1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.
- E. Splash Pans: Fabricate to dimensions and shape required and from the following materials:
 - 1. Aluminum: 0.040 inch thick.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof Edge Flashing (Gravel Stop) and Fascia Cap: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long sections. Furnish with 6-inch-wide, joint cover plates. Shop fabricate interior and exterior corners.
 - 1. Joint Style: Butted with expansion space and 6-inch-wide, concealed backup plate.
 - 2. Fabricate from the following materials:
 - a. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.
- B. Copings: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-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, fasten and seal watertight. Shop fabricate interior and exterior corners.
 - 1. Coping Profile: Fig. 3-4A in accordance with SMACNA's "Architectural Sheet Metal Manual."
 - 2. Joint Style: Butted with expansion space and 6-inch-wide, concealed backup plate.
 - 3. Fabricate from the following materials:
 - a. Aluminum-Zinc Alloy-Coated Steel: 0.040 inch thick.
- C. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
 - 1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.
- D. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
 - 1. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.
- E. Flashing Receivers: Fabricate from the following materials:
 - 1. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.
- F. Roof-Penetration Flashing: Fabricate from the following materials:
 - 1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

2.8 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12-foot-long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch-high, end dams. Fabricate from the following materials:
 - 1. Stainless Steel: 0.0156 inch thick.
- B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch-high, end dams. Fabricate from the following materials:
 - 1. Stainless Steel: 0.0156 inch thick.

2.9 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Equipment Support Flashing: Fabricate from the following materials:
 - 1. Stainless Steel: 0.0188 inch thick.
- B. Overhead-Piping Safety Pans: Fabricate from the following materials:
 - 1. Stainless Steel: 0.0250 inch thick.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, 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.
 - 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF UNDERLAYMENT

- A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim.
 - 1. Install in shingle fashion to shed water.
 - 2. Lap joints not less than 2 inches.

- B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, in accordance with manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.
 - 1. Lap horizontal joints not less than 4 inches.
 - 2. Lap end joints not less than 12 inches.
- C. Install slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.
 - 1. Install in shingle fashion to shed water.
 - 2. Lapp joints not less than 4 inches.

3.3 INSTALLATION, GENERAL

- A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
 - 1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of sealant.
 - 3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
 - 5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
 - 6. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 - 7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
 - 8. Do not field cut sheet metal flashing and trim by torch.
 - 9. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
 - 1. Coat concealed side of uncoated-aluminum sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
 - 1. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.

2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
- D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
 1. Use sealant-filled joints unless otherwise indicated.
 - a. Embed hooked flanges of joint members not less than 1 inch into sealant.
 - b. Form joints to completely conceal sealant.
 - c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
 - d. Adjust setting proportionately for installation at higher ambient temperatures.
 - 1) Do not install sealant-type joints at temperatures below 40 deg F.
 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.4 INSTALLATION OF ROOF-DRAINAGE SYSTEM

- A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Hanging Gutters:
 1. Join sections with riveted and soldered joints.
 2. Provide for thermal expansion.
 3. Attach gutters at eave or fascia to firmly anchor them in position.
 4. Provide end closures and seal watertight with sealant.
 5. Slope to downspouts.
 6. Fasten gutter spacers to front and back of gutter.
 7. Anchor and loosely lock back edge of gutter to continuous eave or apron flashing.
 8. Anchor gutter with gutter brackets straps spaced not more than 36 inches apart to roof deck unless otherwise indicated, and loosely lock to front gutter bead.
 9. Install gutter with expansion joints at locations indicated on Drawings, but not exceeding, 50 feet apart. Install expansion-joint caps.
- C. Downspouts:
 1. Join sections with 1-1/2-inch telescoping joints.
 2. Provide hangers with fasteners designed to hold downspouts securely to walls.
 3. Locate hangers at top and bottom and at approximately 60 inches o.c.

4. Connect downspouts to underground drainage system.

D. Splash Pans:

1. Install where downspouts discharge on low-slope roofs.
2. Set in elastomeric sealant compatible with the substrate.

E. Parapet Scuppers:

1. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
2. Anchor scupper closure trim flange to exterior wall and seal with elastomeric sealant to scupper.
3. Loosely lock front edge of scupper with conductor head.
4. Seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.

F. Conductor Heads: Anchor securely to wall, with elevation of conductor head rim at minimum of 1 inch below scupper discharge.

G. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated on Drawings. Lap joints minimum of 4 inches in direction of water flow.

3.5 INSTALLATION OF ROOF FLASHINGS

A. Install sheet metal flashing and trim to comply with performance requirements and cited sheet metal standard.

1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.

C. Copings:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated.
 - a. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch centers.
 - b. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch centers.

3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.
- D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless steel draw band and tighten.
- E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.
 1. Extend counterflashing 4 inches over base flashing.
 2. Lap counterflashing joints minimum of 4 inches.
 3. Secure in waterproof manner by means of snap-in installation and sealant or lead wedges and sealant or interlocking folded seam or blind rivets and sealant unless otherwise indicated.
- F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.6 INSTALLATION OF WALL FLASHINGS

- A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.

3.7 INSTALLATION OF MISCELLANEOUS FLASHING

- A. Equipment Support Flashing:
 1. Coordinate installation of equipment support flashing with installation of roofing and equipment.
 2. Weld or seal flashing with elastomeric sealant to equipment support member.
- B. Overhead-Piping Safety Pans:
 1. Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings.
 2. Pipe and install drain line to plumbing waste or drainage system.

3.8 INSTALLATION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.9 CLEANING

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean off excess sealants.

3.10 PROTECTION

- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.
- C. Maintain sheet metal flashing and trim in clean condition during construction.
- D. 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, as determined by Architect.

END OF SECTION 076200

SECTION 077253 - SNOW GUARDS**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Rail-type, seam-mounted snow guards.

1.2 ACTION SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 1. Rail-type, seam-mounted snow guards.
- B. Shop Drawings: Include roof plans showing layouts and attachment details of snow guards.
 - 1. Include details of rail-type snow guards.
- C. Samples:
 - 1. Rail-Type Snow Guards: Bracket, 12-inch-long rail, and installation hardware.
 - a. For units with factory-applied finishes, submit manufacturer's standard color selections.
- D. Delegated Design Submittals: For snow guards, include analysis reports signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Include calculation of number and location of snow guards.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that the engineer is licensed in the state in which the Project is located.
- B. Product Test Reports: For each type of snow guard, for tests performed by a qualified testing agency, indicating load at failure of attachment to roof system identical to roof system used on this Project.

1.4 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit adhesive-mounted snow guards to be installed, and adhesive cured, according to adhesive manufacturer's written instructions.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design snow guards, including attachment to roofing material and roof deck, as applicable for attachment method, based on the following:
1. Roof snow load.
 2. Snow drifting
 3. Roof slope.
 4. Roof type.
 5. Roof dimensions.
 6. Roofing substrate type and thickness.
 7. Snow guard type.
 8. Snow guard fastening method and strength.
 9. Snow guard spacing.
 10. Coefficient of Friction Between Snow and Roof Surface: 0.
 11. Factor of Safety: 2.
- B. Performance Requirements: Provide snow guards that withstand exposure to weather and resist thermally induced movement without failure, rattling, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- C. Structural Performance: Snow guards to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
1. Snow Loads: As indicated on Drawings.

2.2 RAIL-TYPE SNOW GUARDS

- A. Rail-Type, Seam-Mounted Snow Guards:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Alpine SnowGuards.
 - b. IceBlox Inc.
 - c. Rocky Mountain Snow Guards, Inc.
 - d. Approved equal
 2. Description: Snow guard rails fabricated from metal pipes, bars, or extrusions, anchored to brackets and equipped with one rail.
 3. Brackets and Baseplate: ASTM B209 aluminum; mill finished or ASTM B209 aluminum; clear anodized.
 4. Bars: ASTM B221 aluminum; mill finish or ASTM B221 aluminum, clear anodized.

- a. Profile: Round or Square.
- 5. Seam Clamps: ASTM B221 aluminum extrusion or ASTM B85/B85M aluminum casting with stainless steel set screws incorporating round nonpenetrating point; designed for use with applicable roofing system to which clamp is attached.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, snow guard attachment, and other conditions affecting performance of the Work.
 - 1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install snow guards according to manufacturer's written instructions.
 - 1. Space rows as recommended by manufacturer.
- B. Attachment for Standing-Seam Metal Roofing:
 - 1. Do not use fasteners that will penetrate metal roofing or fastening methods that void metal roofing finish warranty.
 - 2. Rail-Type, Seam-Mounted Snow Guards:
 - a. Install brackets to vertical ribs in straight rows.
 - b. Secure with stainless steel set screws, incorporating round nonpenetrating point, on same side of standing seam.
 - c. Torque set screw in accordance with manufacturer's written instructions.
 - d. Install cross members to brackets.
- C. Attachment for Exposed Fastened Metal Roofing:
 - 1. Do not use fasteners that will void metal roofing finish warranty.
 - 2. Rail-Type, Flat-Mounted Snow Guards:
 - a. Install brackets in straight rows.
 - b. Mechanically fasten to metal roofing, using sealant and mechanical fasteners identical to those used to secure metal roofing to substrate.
 - c. Install cross members to brackets.

SNOW GUARDS

LXT Eastside Development

SECTION 07 72 53

Project #47732472

Permit Set 09/29/22

END OF SECTION 077253

SECTION 078443 - JOINT FIRESTOPPING**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Joints in or between fire-resistance-rated construction.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies.
2. Section 092216 "Non-Structural Metal Framing" for firestop tracks for metal-framed partition heads.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS**A. Product Data:**

1. Joints in or between fire-resistance-rated construction.

- B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly developed in accordance with current International Firestop Council (IFC) guidelines.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

- B. Listed System Designs: For each joint firestopping system, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Approvals according to FM Approvals 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS**2.1 SOURCE LIMITATIONS**

- A. Obtain joint firestop systems for each type of joint opening indicated from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Joint firestop systems installed with products bearing the classification marking of a qualified product certification agency in accordance with Listed System Designs published by a qualified testing agency.

- 1) UL in its online directory "Product iQ."

2.3 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems must accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
 1. Joint firestopping systems that are compatible with one another, with the substrates forming openings, and with penetrating items, if any.
 2. Provide products that, upon curing, do not re-emulsify, dissolve, leach, breakdown, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture.
 3. Provide firestop products that do not contain ethylene glycol.
- B. Intumescent Gypsum Wall Framing Gaskets (Applied to Steel Tracks, Runners, and Studs prior to Framing Installation): Provide products with fire, smoke, and acoustical ratings that allow movement up to 100 percent compression and/or extension in accordance with UL 2079 or ASTM E1966; have an L Rating less than 1 cfm/ft. in accordance with UL 2079; and a minimum Sound Transmission Class (STC) rating of 56 in accordance with ASTM E90 or ASTM C919.
- C. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 or UL 2079.
 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. 3M Building and Construction.
 - b. Hilti, Inc.
 - c. Tremco Incorporated.
 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- D. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.

2.4 ACCESSORIES

- A. Provide components of joint firestopping systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing joint firestopping systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Apply a suitable bond-breaker to prevent three-sided adhesion in applications where this condition occurs, such as the intersection of a gypsum wall to floor or roof assembly where the joint is backed by a steel ceiling runner or track.

3.3 INSTALLATION

- A. General: Install joint firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install elastomeric fill materials for joint firestopping systems by proven techniques to produce the following results:
 - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.

2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 ft. from end of wall and at intervals not exceeding 30 ft..
- B. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Designation of applicable testing agency.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections in accordance with ASTM E2393.
- B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.
- C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or

deteriorated joint firestopping systems immediately and install new materials to produce joint firestopping systems complying with specified requirements.

3.7 JOINT FIRESTOPPING SYSTEM SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's online directory "Product iQ" under product Category XHBN or Category XHDG.
- B. Wall-to-Wall, Joint Firestopping Systems: .
 - 1. UL-Classified Systems: WW-D S- 0000-0999.
 - 2. Assembly Ratings: 1 hour and 2 hours.
 - 3. Nominal Joint Width: As indicated.
 - 4. Movement Capabilities: Class I – 50 percent compression or extension.
- C. Floor-to-Wall, Joint Firestopping Systems: .
 - 1. UL-Classified Systems: FW- S- 0000-0999.
 - 2. Assembly Rating: 1 hour and 2 hours.
 - 3. Nominal Joint Width: As indicated.
- D. Head-of-Wall, Fire-Resistive Joint Firestopping Systems: .
 - 1. UL-Classified Systems: HW- S-Insert four-digit number 0000-0999.
 - 2. Assembly Rating: 1 hour 2 hours.
 - 3. Nominal Joint Width: As indicated.
 - 4. Movement Capabilities: Class I - 50 percent compression or extension.

END OF SECTION 078443

SECTION 079200 - JOINT SEALANTS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.

1.2 ACTION SUBMITTALS**A. Product Data:**

1. Joint-sealants.
2. Joint sealant backing materials.

B. Samples for Initial Selection: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.**C. Samples for Verification:** For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.**D. Joint-Sealant Schedule:** Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.3 QUALITY ASSURANCE**A. Qualifications:**

1. Installers: Authorized representative who is trained and approved by manufacturer.

1.4 FIELD CONDITIONS**A. Do not proceed with installation of joint sealants under the following conditions:**

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
2. When joint substrates are wet.

3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.5 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 2. Disintegration of joint substrates from causes exceeding design specifications.
 3. Mechanical damage caused by individuals, tools, or other outside agents.
 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain joint sealants from single manufacturer for each sealant type.

2.2 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adfast Corp.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.
 - c. Pecora Corporation.
 - d. Sika Corporation.
- B. Silicone, Acid Curing, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant: ASTM C920, Type S, Grade NS, Class 25, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adfast Corp.
 - b. Pecora Corporation.
 - c. Sika Corporation.
 - d. The Dow Chemical Company.
- C. Silicone, S, NS, 50, T, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Uses T and NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Soudal USA.
 - b. The Dow Chemical Company.
- D. Silicone, S, P, 100/50, T, NT: Single-component, pourable, plus 100 percent and minus 50 percent movement capability traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 100/50, Uses T and NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pecora Corporation.
 - b. Sika Corporation.

2.4 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested in accordance with ASTM C1248.

- B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adfast Corp.
 - b. Pecora Corporation.
 - c. Sika Corporation.
- C. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adfast Corp.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.
 - c. Pecora Corporation.
 - d. Sika Corporation.
 - e. The Dow Chemical Company.

2.5 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adfast Corp.
 - b. Alcot Plastics Ltd.
 - c. Construction Foam Products; a division of Nomaco, Inc.
 - d. Master Builders Solutions.
- B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.6 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 joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to 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 performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions 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 porous joint substrate surfaces by brushing, grinding, 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 after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

- a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. 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 or primer 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 written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.

2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.

3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing 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 and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT-SEALANT SCHEDULE

- A. Interior joints in vertical surfaces and horizontal nontraffic surfaces JS-1:
 1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Tile control and expansion joints.
 - c. Vertical joints on exposed surfaces of walls and partitions.
 2. Joint Sealant: Silicone, S, NS, 50, NT.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement JS-2:
 1. Joint Locations:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors windows.
 2. Joint Sealant: Silicone, S, NS, 50, NT
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.

B. Related Requirements:

1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.2 DEFINITIONS

- A. Minimum Thickness:** Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.3 COORDINATION

- A.** Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B.** Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 ACTION SUBMITTALS**A. Product Data:**

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.

C. Shop Drawings: Include the following:

1. Elevations of each door type.
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 electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.

- D. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For door inspector.
1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
 2. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.
 3. Submit copy of DHI Fire and Egress Door Assembly Inspector (FDAI) certificate.
- B. Product Test Reports: For each type of fire-rated hollow-metal door and frame assembly and thermally rated door assemblies for tests performed by a qualified testing agency indicating compliance with performance requirements.
- C. Oversize Construction Certification: For assemblies required to be fire-rated and exceeding limitations of labeled assemblies.
- D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.7 QUALITY ASSURANCE

- A. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies is to meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.
- B. Egress Door Inspector Qualifications: Inspector for field quality-control inspections of egress door assemblies is to meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 1. Provide additional protection to prevent damage to factory-finished units.
- B. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 HOLLOW METAL DOORS AND FRAMES

- 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. Ceco Door; AADG, Inc.; ASSA ABLOY.
 2. Curries, AADG, Inc.; ASSA ABLOY Group.
 3. Steelcraft; Allegion plc.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
 1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.
 2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
- B. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing in accordance with NFPA 257 or UL 9.
- C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.50 deg Btu/F x h x sq. ft. 0.40 deg Btu/F x h x sq. ft. 0.38 deg Btu/F x h x sq. ft. Insert U-factor when tested in accordance with ASTM C1363 or ASTM E1423.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B..
 - 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule on Drawings.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Uncoated steel sheet, minimum thickness of 0.042 inch.
 - d. Edge Construction: Model 1, Full Flush.
 - e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
 - f. Core: Manufacturer's standard.
 - g. Fire-Rated Core: Manufacturer's standard vertical steel stiffener core for fire-rated doors.
 - 2. Frames:
 - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
 - b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
 - c. Construction: Knocked down.
 - 3. Exposed Finish: Prime.

2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B..
 - 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule on Drawings.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch, with minimum A40 coating.
 - d. Edge Construction: Model 1, Full Flush.
 - e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
 - f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
 - g. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
 - h. Core: Manufacturer's standard.

- i. Fire-Rated Core: Manufacturer's standard vertical steel stiffener with insulation core for fire-rated doors.
2. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
 - b. Construction: Knocked down.
3. Exposed Finish: Prime Factory.

2.5 BORROWED LITES

- A. Fabricate of uncoated steel sheet, minimum thickness of 0.053 inch.
- B. Construction: Knocked down.
- C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.
- D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.6 HOLLOW-METAL PANELS

- A. Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.

2.7 FRAME ANCHORS

- A. Jamb Anchors:
 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
 3. Postinstalled Expansion Anchor: Minimum 3/8-inch-diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at top of underlayment.

- D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

2.8 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
- G. Glazing: Comply with requirements in Section 088000 "Glazing."

2.9 FABRICATION

- A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
 - 1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding, or by rigid mechanical anchors.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. Door Silencers: Except on weather-stripped frames, 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.
- B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling,

and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule on Drawings, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

C. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.
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. Provide loose stops and moldings on inside of hollow-metal doors and frames.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
5. Provide stops for installation 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.

2.10 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11, NAAMM-HMMA 840.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - b. Install frames with removable stops located on secure side of opening.
 2. Fire-Rated Openings: Install frames in accordance with NFPA 80.
 3. Floor Anchors: Secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 4. Solidly pack mineral-fiber insulation inside frames.
 5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
 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. Installation Tolerances: Adjust hollow-metal frames 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 and adjust hollow-metal doors accurately in frames, within clearances specified below.
1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8, NAAMM-HMMA 841 and NAAMM-HMMA guide specification indicated.
 2. Fire-Rated Doors: Install doors with clearances in accordance with NFPA 80.
 3. Smoke-Control Doors: Install doors in accordance with NFPA 105.
- D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

- A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
 2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 REPAIR

- A. 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.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint in accordance with manufacturer's written instructions.
- C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Solid-core five-ply flush wood veneer-faced doors and transom panels for transparent finish.
2. Light frames

B. Related Requirements:

1. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.2 ACTION SUBMITTALS**A. Product Data:**

1. Solid-core five-ply flush wood veneer-faced doors for transparent finish.

B. Product Data Submittals: For each product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Door trim for openings.
5. Factory-machining criteria.
6. Factory- finishing specifications.

C. Sustainable Design Submittals:**D. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:**

1. Door schedule indicating door location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Details of frame for each frame type, including dimensions and profile.
4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
5. Dimensions and locations of blocking for hardware attachment.
6. Dimensions and locations of mortises and holes for hardware.
7. Clearances and undercuts.
8. Doors to be factory finished and application requirements.
9. Apply AWI Quality Certification WI Certified Compliance Program label to Shop Drawings.

E. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For door inspector.

1. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.

B. Field quality-control reports.

C. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Special warranties.

B. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

C. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.5 QUALITY ASSURANCE

A. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.

B. Egress Door Inspector Qualifications: Inspector for field quality-control inspections of egress door assemblies complies with qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on bottom rail with opening number used on Shop Drawings.

D. Do not deliver doors until building interior environmental conditions are maintained to meet Manufacturer's requirements for relative humidity.

E. Do not place other items on top of stored doors.

F. Do not drag doors across one another or across other surfaces.

- G. Handle doors using clean gloves.
- H. Protect doors in place as necessary to prevent scratches, dents, and other damage.

1.7 FIELD CONDITIONS

A. Environmental Limitations:

- 1. Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.
- 2. Do not deliver or install doors until building is enclosed and weathertight, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during remainder of construction period.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

- 1. Failures include, but are not limited to, the following:
 - a. Delamination of veneer.
 - b. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
 - c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
- 2. Warranty also includes installation and finishing that may be required due to repair or replacement of defective doors.
- 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain flush wood doors from single manufacturer.

2.2 FLUSH WOOD DOORS AND FRAMES, GENERAL

A. Quality Standard: In addition to requirements specified, comply with AWI/AWMAC/WT's "Architectural Woodwork Standards."

- 1. Provide labels and certificates from AWI certification program indicating that doors comply with requirements of grades specified.

2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with the Contract Documents in addition to those of the referenced quality standard.

2.3 SOLID-CORE FIVE-PLY FLUSH WOOD VENEER-FACED DOORS AND TRANSOM PANELS FOR TRANSPARENT FINISH

A. Interior Doors, Solid-Core Five-Ply Veneer-Faced:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Algoma
 - b. Marshfield
 - c. Eggers
2. Performance Grade: ANSI/WDMA I.S. 1A Heavy Duty & Standard Duty.
3. Performance Grade by Location:
 - a. ANSI/WDMA I.S. 1A Extra Heavy Duty: Classrooms public toilets janitor's closets assembly spaces.
 - b. ANSI/WDMA I.S. 1A Standard Duty: Closets (not including janitor's closets).
4. ANSI/WDMA I.S. 1A Quality Grade: Premium.
5. Architectural Woodwork Standards Quality Grade: Premium.
6. Faces: Single-ply wood veneer not less than 1/50 inch thick.
 - a. Species: Cherry.
 - b. Cut: Plain sliced (flat sliced).
 - c. Match between Veneer Leaves: Book match.
 - d. Assembly of Veneer Leaves on Door Faces: running match.
 - e. Pair and Set Match: Provide for doors hung in same opening.
 - f. Room Match:
 - 1) Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 10 feet or more.
 - 2) Provide door faces of compatible color and grain within each separate room or area of building.
7. Exposed Vertical and Top Edges:
 - a. Same species as faces
 - 1) Vertical edge: 1-3/8 inch hardwood to match face veneer.
 - 2) Top and bottom edges: 1-1/8 inch hardwood or composite lumber. No particleboard allowed.
8. Core for Non-Fire-Rated Doors:
 - a. ANSI A208.1, Grade LD-1 particleboard.
 - 1) Blocking: Provide wood blocking in particleboard-core doors as follows:

- a) 5-inch top-rail blocking, in doors indicated to have closers.
 - b) 5-inch bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
 - c) 5-inch midrail blocking, in doors indicated to have exit devices.
- 2) Provide doors with glued-wood-stave or WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices in Section 087100 "Door Hardware."
- b. Glued wood stave.
 - c. WDMA I.S. 10 structural composite lumber.
 - 1) Screw Withdrawal, Door Face: 550 lbf.
 - 2) Screw Withdrawal, Vertical Door Edge: 550 lbf.
 - d. Either glued wood stave or WDMA I.S. 10 structural composite lumber.
9. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.4 LIGHT FRAMES AND LOUVERS

- A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.
- 1. Wood Species: Same species as door faces.
 - 2. Profile: Flush rectangular beads Recessed tapered beads Recessed tapered beads with exposed banding Lipped tapered beads Manufacturer's standard shape.

2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated.
- 1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 - 2. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied.
- 1. Locate hardware to comply with DHI-WDHS-3.
 - 2. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
 - 3. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- C. Openings: Factory cut and trim openings through doors.
- 1. Light Openings: Trim openings with moldings of material and profile indicated.

2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

2.6 FACTORY PRIMING

2.7 FACTORY FINISHING

- A. Comply with referenced quality standard for factory finishing.
 1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 2. Finish faces, all four edges, edges of cutouts, and mortises.
 3. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors.
- C. Factory finish doors that are indicated on Drawings to receive transparent finish.
- D. Factory finish doors where indicated in schedules or on Drawings as factory finished.
- E. Transparent Finish:
 1. Architectural Woodwork Standards Grade: Premium.
 - a. System-5, Varnish, Conversion.
 - b. System-9, UV Curable, Acrylated Epoxy, Polyester or Urethane.
 - c. System-10, UV Curable, Water Based.
 - d. System-11, Polyurethane, Catalyzed.
 2. ANSI/WDMA I.S. 1A Grade: Premium.
 - a. TR-4 Conversion Varnish.
 - b. TR-6 Catalyzed Polyurethane.
 - c. TR-8 UV Cured Acrylated Polyester/Urethane.
 3. Staining: As selected by Architect from manufacturer's full range.
 4. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
 1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 2. Reject doors with defects.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- C. Install frames level, plumb, true, and straight.
1. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
 2. Anchor frames to anchors or blocking built in or directly attached to substrates.
 - a. Secure with countersunk, concealed fasteners and blind nailing.
 - b. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
 - 1) For factory-finished items, use filler matching finish of items being installed.
- D. Job-Fitted Doors:
1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
 - a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.
 2. Machine doors for hardware.
 3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 4. Clearances:
 - a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
 - b. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
 - c. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
 5. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
- E. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- F. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 FIELD QUALITY CONTROL

- A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
 - 1. Provide inspection of installed Work through AWI's Quality Certification Program, certifying that wood doors and frames, including installation, comply with requirements of AWI/AWMCA/WT's "Architectural Woodwork Standards" for the specified grade.
 - 2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
 - 3. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 083113 - ACCESS DOORS AND FRAMES**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Access doors and frames.

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for heating and air-conditioning duct access doors.

1.2 ACTION SUBMITTALS**A. Product Data:** For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Product Schedule: For access doors and frames.**1.3 INFORMATIONAL SUBMITTALS****PART 2 - PRODUCTS****2.1 ACCESS DOORS AND FRAMES****A. Recessed Access Doors with Concealed Flanges:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Babcock-Davis.
 - b. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
 - c. Nystrom, Inc.
2. Description: Door face recessed 5/8 inch for gypsum board infill; with concealed flange for gypsum board installation and concealed hinge.
3. Optional Features: Piano hinges.
4. Locations: Ceiling.
5. Door Size: Per the drawings.
6. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage, factory primed.
7. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch, 16 gage, factory primed.

8. Latch and Lock: Cam latch, screwdriver operated.

2.2 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.
- D. Frame Anchors: Same material as door face.
- E. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.3 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
 2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded-metal lath and exposed casing bead welded to perimeter of frames.
- D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling. Provide access sleeves for each latch operator and install in holes cut through finish.
- E. Latch and Lock Hardware:
 1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.

2.4 FINISHES

- 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.
- D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
 - 2. Bright, Cold-Rolled, Unpolished Finish: ASTM A480/A480M No. 2B.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine substrates 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 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 FIELD QUALITY CONTROL

- A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 083113

SECTION 083323 - OVERHEAD COILING DOORS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Fire-rated service doors.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports, door-opening framing, corner guards, and bollards.
2. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for finish painting of factory-primed doors.

1.2 ACTION SUBMITTALS**A. Product Data:** For each type and size of overhead coiling door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
3. Include description of automatic-closing device and testing and resetting instructions.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
5. Show locations of controls, locking devices, and other accessories.
6. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS**A. Qualification Data:** For Installer.

1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
2. Submit copy of DHI Fire and Egress Door Assembly Inspector (FDAI) certificate.

- B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Special warranty.
- B. Maintenance Data: For overhead coiling doors to include in maintenance manuals.
- C. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
 - 1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
- B. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies is to meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
 - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of doors 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 MANUFACTURERS

- A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
 - 1. Obtain operators and controls from overhead coiling-door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Complying with NFPA 80; listed and labeled by qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B.
- B. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:
 - 1. Design Wind Load: As indicated on Drawings.
 - 2. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
 - 3. Operability under Wind Load: Design overhead coiling doors to remain operable under design wind load, acting inward and outward.

2.3 FIRE-RATED DOOR ASSEMBLY

- A. Fire-Rated Insulated Service Door: Overhead fire-rated coiling door formed with curtain of interlocking metal slats.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cookson; a CornellCookson company.
 - b. Cornell; a CornellCookson company.
 - c. Overhead Door Corporation.
 - d. Wayne Dalton; a division of Overhead Door Corporation.
- B. Operation Cycles: Door components and operators capable of operating for not less than 100,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
 - 1. Include tamperproof cycle counter.
- C. Fire Rating: Per the drawings.
- D. Air Infiltration: Maximum rate of 1.0 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E283 or DASMA 105.
- E. STC Rating: 27.
- F. Insulated Door Curtain R-Value: 4.5 deg F x h x sq. ft./Btu.
- G. Insulated Door Assembly U-Factor: 0.90 Btu/deg F x h x sq. ft..
- H. Door Curtain Material: Galvanized steel.
- I. Door Curtain Slats: Flat profile slats of center-to-center height.
 - 1. Insulated-Slat Interior Facing: Metal.

- J. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from hot-dip galvanized steel and finished to match door.
- K. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- L. Hood: Match curtain material and finish.
 - 1. Shape: Round.
 - 2. Mounting: As indicated on Drawings.
- M. Locking Devices: Equip door with locking device assembly and chain lock keeper.
 - 1. Locking Device Assembly: Single-jamb side locking bars, operable from.
- N. Electric Door Operator:
 - 1. Usage Classification: Medium duty, up to 12 cycles per hour and up to 50 cycles per day.
 - 2. Operator Location: Wall.
 - 3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 ft. or lower.
 - 4. Motor Exposure: Interior.
 - 5. Motor Electrical Characteristics:
 - a. Horsepower: 1 hp.
 - b. Voltage: 115 V ac, single phase, 60 Hz.
 - 6. Emergency Manual Operation: Chain type.
 - 7. Obstruction-Detection Device: Automatic pneumatic sensor edge on bottom bar.
 - a. Sensor Edge Bulb Color: Black.
 - 8. Control Station(s): Interior mounted.
 - 9. Other Equipment: Audible and visual signals.
- O. Curtain Accessories: Equip door with smoke seals, automatic-closing device,.
- P. Door Finish:
 - 1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
 - 2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.4 MATERIALS, GENERAL

- 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.

2.5 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. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural-steel sheet; complying with ASTM A653/A653M, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch; and as required.
 - 2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84 or UL 723. Enclose insulation completely within slat faces.
 - 3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch.
- B. 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.

2.6 HOODS

- 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. Galvanized Steel: Nominal 0.028-inch-thick, hot-dip galvanized-steel sheet with G90 zinc coating, complying with ASTM A653/A653M.
 - 2. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.

2.7 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
- B. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.8 CURTAIN ACCESSORIES

- A. Smoke Seals: Equip each fire-rated door with replaceable smoke-seal perimeter gaskets or brushes for smoke and draft control as required for door listing and labeling by a qualified testing agency.

- B. Astragal for Interior Doors: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.
- C. Automatic-Closing Device: Equip each fire-rated door with an automatic-closing device or holder-release mechanism and governor unit complying with NFPA 80 and an easily tested and reset release mechanism. Testing for manually operated doors allows resetting by opening the door without retensioning the counterbalance mechanism. Automatic-closing device is to be designed for activation by the following:
 - 1. Replaceable fusible links with temperature rise and melting point of 165 deg F deg C) interconnected and mounted on both sides of door opening.
 - 2. Manufacturer's standard UL-labeled smoke detector and door-holder-release devices.
 - 3. Manufacturer's standard UL-labeled heat detector and door-holder-release devices.
 - 4. Building fire-detection, smoke-detection, and -alarm systems.

2.9 COUNTERBALANCE 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. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.
- C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
 - 1. Fire-Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic-closing device operates.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.10 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
 - 1. Comply with NFPA 70.

2. 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. Door Operator Location(s): Operator location indicated for each door.
 1. Wall Mounted: Operator is mounted to the inside front wall on the left or right side of door and connected to door drive shaft with drive chain and sprockets. Side room is required for this type of mounting. Wall-mounted operator can also be mounted above or below shaft; if above shaft, headroom is required.
- D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each door assembly.
 1. Electrical Characteristics: Minimum as indicated for each door assembly. 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.
 2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 3. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
- E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- F. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For fire-rated doors, activation delays closing.
 1. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
 - a. Self-Monitoring Type: Four-wire-configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.
- G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."
 1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
- H. 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.
- I. 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.

- J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
- K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with the accessibility standard.

2.11 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 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.

2.12 STEEL AND GALVANIZED-STEEL FINISHES

- A. 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.

PART 3 - EXECUTION

3.1 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.

3.2 INSTALLATION, GENERAL

- 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, controls, 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 the accessibility standard.

- D. Fire-Rated Doors: Install according to NFPA 80.
- E. Power-Operated Doors: Install according to UL 325.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and to furnish reports to Architect.
- B. Perform the following tests and inspections:
 - 1. Test door release, closing, and alarm operations when activated by smoke detector or building's fire-alarm system. Test manual operation of closed door. Reset door-closing mechanism after successful test.
 - 2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

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. After electrical circuitry has been energized, operate doors to confirm proper motor rotation and door performance.
 - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.5 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 tight fit around entire perimeter.

3.6 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service includes three months' full maintenance by skilled employees of coiling-door Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies are to be manufacturer's authorized replacement parts and supplies.
 - 1. Perform maintenance, including emergency callback service, during normal working hours.

3.7 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

PART 1 - GENERAL**1.1 SUMMARY****A. Section Includes:**

1. Exterior horizontal rolling steel hangar doors.
2. Basis of design Product: Subject to compliance with requirements, provide by Spec-Dor. or comparable product to be approved by the architect.

B. Related Requirements:

1. Section 081113- "Hollow Metal Doors and Frames" for hollow-metal doors and frames.
2. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.
3. Section 08 45 23 "Fiberglass-Sandwich-Panel Assemblies" for framed translucent light panel system.
4. Section 13 34 19 "Metal Building Systems" for pre-engineered metal building system.

C. Scope of the Work: The work shall consist of the supply of ONE (1) electrically operated, hangar door system. The finished opening size shall be 160 ft x 28ft high. The motorized door system shall consist of EIGHT (8) bottom rolling door blades on FOUR (4) tracks running the full width of the opening. Each end section shall be independently motorized. The door system be able to render 3/4 the opening on either side or middle.

D. DESIGN CRITERIA: Important the quotation is based on design criteria shown

1. Roof deflection, downward: 6 inches
2. Roof deflection, upward: 6 inches
3. Lintel deflection inward 1 inch
4. Door deflection: L/120- of the span
5. Wind load: ASCE 7-16 Cat II exp C
6. Maximum girt spacing 60 inches
7. Exterior siding 3 inch max./ by others
8. Interior siding 1 inch max./ by others

1.2 REFERENCES

- A. 1-American Gear Manufacturer's Association(AGMA)
- B. 2-American Institute of Steel Construction (AISC)
- C. 3-M011 - Steel Construction Manual
- D. 5-American Society of Civil Engineers (ASCE)
- E. 6-Minimum Design Loads for Buildings and Other Structures (7-88)
- F. 7-American Society for Testing Materials (ASTM)

- G. 8-Structural Steel A36/A36M
- H. 9-Steel, Carbon, Cold-Rolled Sheet Commercial Quality (A366)
- I. 13-Steel, Carbon, Hot-Rolled Sheet and Strip Commercial Quality (A569)
- J. 14-High Strength Low Alloy Columbian-Vanadium Steel of Structural Quality (A572 /A 572M)
- K. 15-High Strength Low Alloy Structural Steel with 50KSI (345MPa)Minimum Yield Point to 4 Inch Thick
- L. 16-National Electrical Manufacturers association (NEMA)
- M. 17-Industrial Controls and System (ICS)
- N. 18-National Fire Protection Association (NFPA)
- O. 19-National Electrical Code (NEC)
- P. 20-Official codes, rules and regulations, adopted by the applicable state.
- Q. underwriters Laboratories (UL)
- R. 22-Accessories to meet OSHA regulations. (Toe Guards, Audio and visual warning “Unit in Motion”)

1.3 ACTION SUBMITTALS

- A. Product Data: Provide the following.
 - 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
 - 3. Include description of automatic-closing device and testing and resetting instructions.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include plans, elevations, sections, and mounting details as details of the door's connection to the building.
 - 2. Track layout, girt spacing/locations, weatherstripping details, cladding and flashing details, drive components layout.
 - 3. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 4. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 - 5. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
 - 6. Show locations of controls, locking devices, and other accessories.
 - 7. Include diagrams for power, signal, and control wiring, include.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Manufacture and Installer.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Special warranty.
- B. Maintenance Data: Submit operation and maintenance manuals for systems that provide basic data relating to the design, operation, and maintenance of the door and its related systems.
- C. the electrical distribution system
- D. provide basic data relating to the design, operation, and maintenance of
- E. the electrical distribution system
- F. The door manufacturer will submit maintenance manuals to the owners complete with mill test certificates for all structural steel, rails, and bolting materials

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
- B. Hangar door manufacturer shall have at least 10 years of proven, continuous experience in designing and manufacturing hangar doors.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.
 - 1. The hangar door structure including the bottom wheels and top rollers shall carry a warranty for a period of three years. All electrical components and miscellaneous hardware will carry a two year warranty.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Source Limitations: Obtain hangar doors from single source from single manufacturer.
 - 1. Obtain operators and controls from hangar door manufacturer.

- B. Door design: The door will be designed for maximum thermal efficiency and safety. Door section shall be designed not to exceed the maximum permissible deflection when the full specified wind load is applied on the door's exposed surface. The door's drive system and hardware components shall be designed to operate under the maximum specified wind load with a minimum service factor of 1.5.

2.2 DOOR CONSTRUCTION AND FINISHING

- A. Door sections: The door frames shall be fabricated from new structural steel profiles. The design shall comply with AISC 335 standards. The door section shall be designed not to exceed the specified deflection and to withstand 1-1/2 times the nominal windload without exceeding the permissible stresses. The door sections shall be suitable braced with structural members to resist lateral loaded equaling the sections weight. Light cold formed members with tension rod bracings will not be acceptable.
- B. Framing for Man Doors: Manufacturer shall design the door structure with a sub-frame to receive a man door(s) and frame(s). The sub-frames shall be the same thickness as the girts. Interlock switches shall be provided to prevent the hangar door section from operation if the man door is open.
- C. Framing for Windows: If windows are required in the door, the structural framing of the door shall be designed to provide sub-frame for the insertion of windows. The window sub-frames shall be the same depth as the girts.
- D. Door sheeting/insulation: The exterior door surface shall be clad per the drawings. The interior of the door to be covered with liner panel the same as the walls of the hangar the full height of the door. The corner flashings shall follow the door manufacturers details. All siding cladding and flashings, shall be supplied and installed by PEMB. The door will be insulated to the same R value as the exterior walls of the hangar.
- E. Weatherstripping: The interface between each section shall be weatherstripped using one 1/8" thick rubber membrane with metal strip.
- F. Bottom Brush weatherstripping: The door shall be weatherstripped, using one 9 mm thick x 50 mm wide nylon brush and a polyester reinforced urethane rubber as an air barrier. The seal is to be held in place with a 100 mm wide aluminum retainer. The 100 mm wide aluminum retainers shall be supplied with wide slotted holes centered at 228 mm ready to receive removable fasteners for easy field adjustment and long service life.
- G. Towing hooks: The door will be supplied with flush mounted towing hook receptacle situated at each end of the door section.
- H. Shop painting: All metal shall be prepared conforming to SSPC 25. The shop painting of the door sections, top guides, and bottom rails shall consist of 1 coats of zinc rich primer for a total DFT of 3mils.
- I. Building Frame: Coordinate with structural steel building frame provider to provide, perpendicular members at approximately 10'-0" o/c, to receive top door guides. Perpendicular members by building manufacturer. Coordinate with the PEMB that the perpendicular members will be at the proper elevation and within the tolerance specified for the bottom rails.

2.3 HARDWARE

- A. Door wheels: The door shall be equipped with completely concealed wheels assuring complete safety. The door wheels shall be machined from alloy steel and heat treated to Brinnell 280 to 320. The wheels shall be double flanged and CNC machined to SPEC-DOR's self centering profile which closely fits the contour of the ground rails. The wheels shall be of sufficient diameter and capacity to carry the wind and door load according to A.S.C.E. Class C regulations. The wheels shall be removable without taking the section from its position on the rail. Wheel diameter shall be not less than 12 inch.
- B. Door wheel bearings: The wheel shall be equipped with sealed cartridge bearings. The size of the bearings shall be calculated based on a service life of not less than 500hrs. Bearing loads shall be calculated based on maximum design windload and the section's dead load with cladding and hardware. Bearing life under with no windload is almost infinite.
- C. Door Wheel Axles: The door axles shall be sized based on 1-1/2 time design windload and the section's dead load with cladding and hardware. The axle material shall conform to AISI 1045 ground and polished. The axle shall be equipped with grease fitting for the wheel bearings.
- D. Sill tracks: The rail size shall be suitable for the design loads or a minimum of 30lbs ASCE rails. The sill tracks shall be complete with leveling bolts. The sill track installation and wedge anchors are by the general contractor and in accordance with the hangar door manufacturer's drawings.
- E. Sill track flashings: Continuous heavy 12 gauge galvanized steel angle flashings are to be provided on both sides of each rail providing a flush surface and level crossing for the aircraft. Faster installation. No concrete grouting and framing.
- F. Rail Drainage pits: Drain pits shall be provided to collect water from the rail gutters and divert it into the building's drainage system. The drain pits shall have removable, chequered plate covers and shall be hot dip Spelter galvanized. The drain pits are factory set into the rails and are equipped with a min 3" dia pipe outlet.
- G. Sill track flashings: Continuous heavy 12 gauge galvanized steel angle flashings are to be provided on both sides of each rail providing a flush surface and level crossing for the aircraft. Faster installation. No concrete grouting and framing.
- H. Provision for Heating: Provide galvanized conduits to be embedded with the bottom of each rail in such a manner the electric heating cables can be installed. Design the system to meet the industry standards for required watt density for track snow melt.
- I. Heating Cables: Provide runs of heating cables complete with control panel and therostatic controls.
- J. Top guides: The top guides shall extend full travel of the sections. The guides shall be fabricated from structural steel members conforming to ASTM A36. The top guides shall be designed to withstand a minimum load of 1.5 kpa., without exceeding the specified deflection or permissible stresses. The guides shall be designed to accommodate downward and upward roof deflection as specified in section 1.2.
- K. Floating top guide rollers: The door shall have steel roller to guide the door and transmit all horizontal loads from the door to the building structure without interference with the operation of the doors. The top rollers should be designed to freely operate within the allowable parameters of

roof deflection and shall not allow the doors to flutter more than 10mm. The rollers shall be fitted with permanently lubricated and sealed, radial bearings and oilite bushings for vertical movement. The rollers shall be easily removable for servicing. Minimum roller diameter shall be not less than 150 mm in diameter.

- L. Bogeys: Bogeys shall be built as a continuous beam designed to transfer all vertical and horizontal loads to the wheels. The bogey shall be shop predrilled, ready to receive the door section(s). The bogeys shall have door wheels accurately shop set, ready for rail mounting.
- M. Drive base: The drive base(s) shall be rigidly factory set onto the bottom bogey to operate without deflection or torsional rotation. The base shall be provided with a machined sliding base plates allowing the drive chain to be easily tensioned by an adjustment screw. The system shall be designed for easy adjustment requiring only wrenched and no lifting of the drive motor. The base design shall be such that removal of the drive wheel will not require the removal of the drive motor and reducer. Slotted holes as a means of adjustment shall not be allowed.
- N. Protective drive cover: Access to the drive gear shall be protected by a steel screen covers. The covers shall have a steel frame with an exterior 1.5mm thick expanded metal screen.
- O. Door stop bumpers: End stops are to be provided to de-accelerate the door sections to a stop, without damage, in the event of a control failure. They are to prevent the possibility of the door sections running off the end of the rails. The end stops shall be designed using calibrated elastomers bumpers based on the maximum mass of the door, traveling at the design speed with the motors off. The bumpers shall be welded to a 10mm steel plate securely anchored in the concrete and welded to the bottom rails. Weldment design shall incorporate the maximum calculated bumper force plus an additional 25% in their design.

2.4 DOOR DRIVE GEAR

- A. General layout: Each door section will be independently motorized. The drive gear shall be designed to provide maximum safety to the user and hangar personnel. The drive gear shall consist of a high ratio, helical bevel gear reducer coupled to high efficiency electric motor with electromagnetic brake. The gear reducer shall drive a door wheel through hardened steel sprockets via a steel roller chain. The drive gear shall be designed to operate the door at a speed of not less than 12 inches/sec.
- B. Gear reducers: The gear reducer shall be a high quality helical bevel gear reducer. The all steel gearing and high efficiency design makes this reducer impossible to damage, even during manual towing. The gear reducer will be sized with a service factor of 1.5 according to AGMA standards. The loads shall be calculated based on the design operational windload and the section's dead load with cladding and hardware. The reducer oil shall be AGMA #7.
- C. Motors: The motor shall be a totally enclosed fan cooled unit with IEC design. The motor shall be rated to an IP54 environmental protection. The operating voltage shall be 480V-3 PH-60 HZ, (verify voltage). The motors shall be of sufficient size to drive the door with all applicable load. The motors mounted bellow 457mm off the floor shall be explosion proof type NEMA 7 or CEMA 9. Motors will not be less than 2hp

- D. Brakes: The brake will be a fail safe, spring set, high speed DC solenoid operated disk brake. The brake shall be integral to the motor and shall share a single common shaft with no couplings. The brake shall have a manual release. The brake will be sized to stop the door in 100 mm.
- E. Interlock on Brake Release: An electrical interlock is to be installed on the brake release handle such that the door is disabled if the brake is released.
- F. Roller chains: The roller chains shall be high quality stainless steel roller chain with conforming to ANSI 29.3. The chain shall be designed to handle the reducer's torque with a safety factor of 5.
- G. Sprockets: The sprockets shall be high quality steel sprockets with hardened teeth.

2.5 DOOR DRIVE GEAR

- A. General layout: The door will have a control panel mounted on the inner face of the motorized door section. One pushbutton station consisting of an "open" and "closed" pushbutton will be located on the control panel face. Limit switches shall stop the door in the extreme left and extreme right sides of the opening. The controls shall provide for the normal running of the door blades in either direction. The operator shall walk with the door while holding the pushbutton.
- B. Sliding Doors Control panel: The door mounted control panel shall be a NEMA 4/12 waterproof enclosure, of adequate size to contain the necessary controls. The control panel will have an LED power on light, a key switch to prevent unauthorized use, and a main power disconnect switch with locking handle.
- C. Pendant pushbutton station: Provide a pendant pushbutton station suspended near the leading edge and trailing edge of each section. The pendant shall have arrows indicating the desired door direction. The pendant will have protective metal holder to prevent the accidental operation.
- D. End of travel limit switches: The limit switches shall be electric switches. The switches shall be supplied with adjustable mounted brackets and actuating targets. The limit switch shall be NEMA 4 rated or IP56 waterproof.
- E. VSD Variable frequency Drive: "Soft start & Soft stop" All motors shall be controlled by a variable speed drive suitably sized for the drive unit. The unit will be capable of starting the door without harsh mechanical shock as well as de-accelerate the door for precise stopping. The door will slow to 1/3 normal door speed during the last 24 inches of travel in either the fully open or fully closed position. The unit should be sized for operation at full motor load.
- F. Dynamic Braking Module: In conjunction with the VSD, a dynamic braking module shall be provided to have precise control of stopping distances. The module shall ramp the door speed to a stop in a controlled manner without wheel skidding or harsh shock to the structure.
- G. PLC- Programmable logic controller: All controls shall be governed by a programmable logic controller. The controller shall have sufficient I/Os inputs and outputs to perform the door logic as well as a few spares for future expansion.
- H. Warning horn indicating "door in motion": A 100 db warning horn shall be mounted on the inside face of the motorized door section. The horn shall be activated when the door is in operation.

- I. Visual warning beacon. A flashing beacon shall be mounded on the inside face of the motorized door section. The beacon shall be activated when the door is in operation.
- J. Safety Edge: The leading edge and trailing edge of each motorized door section shall be equipped with an electrical safety edge. When the edge is contacted, the door shall stop and the forward motion disabled. The door can be backed away from the obstruction when the edge is contacted.
- K. Power Line: The power line shall be a multi conductor weather proof duct system. The system shall be supplied complete with junction boxes, strain relief fitting, and trolley arms.

PART 3 - INSTALLATION AND EXECUTION

3.1 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.

3.2 INSTALLATION, GENERAL

- A. Install hangar 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 doors controls at the mounting locations indicated per the drawings.

3.3 WIRING

- A. Wire and wiring shall be installed in rigid water tight steel conduit placed inconspicuously on the surface of the door. The conduits should be installed in neat straight runs following the structural features of the door. Wire, and conduits to be supplied and installed by electrical contractor. All material shall be U.L. approved and all wiring shall be installed in strict accordance with all local regulations. Conduits, wire and wiring by electrical contractor.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and to furnish reports to Architect.
- B. Perform the following tests and inspections:
 - 1. Test door release, closing, and alarm operations. Test manual operation of door. Reset door-closing mechanism after successful test.

- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.5 STARTUP SERVICE

- A. Engage an authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. After electrical circuitry has been energized, operate doors to confirm proper motor rotation and door performance.
 - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.6 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

3.7 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service includes three months' full maintenance by skilled employees of coiling-door Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies are to be manufacturer's authorized replacement parts and supplies.
 - 1. Perform maintenance, including emergency callback service, during normal working hours.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hangar doors and to adjust and operate .

END OF SECTION 08 24 16

SECTION 083613 - SECTIONAL DOORS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Sectional-door assemblies.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.
2. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for finish painting of factory-primed steel doors.
3. Section 111200 "Parking Control Equipment" for parking control equipment interlocked to sectional doors.

1.2 ACTION SUBMITTALS**A. Product Data:** For each type and size of sectional door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
2. For power-operated doors, include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings: For each installation and for components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard size.**1.3 INFORMATIONAL SUBMITTALS****A. Qualification Data:** For Installer.**B. Sample Warranties:** For manufacturer's warranty and finish warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sectional doors to include in maintenance manuals.
- B. Manufacturer's warranty.
- C. Finish warranty.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Failure of components or operators before reaching required number of operation cycles.
 - c. Faulty operation of hardware.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
 - e. Delamination of exterior or interior facing materials.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS**2.1 MANUFACTURERS, GENERAL**

- A. Source Limitations: Obtain sectional doors from single source from single manufacturer.
 - 1. Obtain operators and controls from sectional door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Provide sectional doors that comply with performance requirements specified without failure from defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.
- B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
 - 1. Design Wind Load: As indicated on Drawings.
 - 2. Testing: In accordance with ASTM E330/E330M.
 - 3. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components.
 - a. Deflection of door sections in horizontal position (open) shall not exceed 1/120 of door width.
 - b. Deflection of horizontal track assembly shall not exceed 1/240 of door height.
 - 4. Operability under Wind Load: Design sectional doors to remain operable under design wind load, acting inward and outward.

2.3 SECTIONAL-DOOR ASSEMBLY

- A. Steel Sectional Door: Provide sectional door formed with hinged sections and fabricated so that finished door assembly is rigid and aligned with tight hairline joints; free of warp, twist, and deformation; and complies with requirements in DASMA 102.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Overhead Door Corporation.
 - b. Raynor Garage Doors.
 - c. Windsor Door.
- B. Operation Cycles: Door components and operators capable of operating for not less than 100,000 operation cycles. One operation cycle is complete when door is opened from closed position to the open position and returned to closed position.
- C. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. when tested in accordance with ASTM E283 or DASMA 105.
- D. U-Value: 0.052 Btu/sq. ft. x h x deg F.
- E. Steel Door Sections: ASTM A653/A653M, zinc-coated (galvanized), cold-rolled, commercial steel sheet with G60 zinc coating.
 - 1. Door-Section Thickness: 1-3/8 inches.
 - 2. Section Faces:
 - a. Thermal-Break Construction: Provide sections with continuous thermal-break construction separating the exterior and interior faces of door.

- b. Exterior Face: Fabricated from single sheets, not more than 24 inches high; with horizontal meeting edges rolled to continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove, weather- and pinch-resistant seals and reinforcing flange return.
 - 1) Steel Sheet Thickness: 0.019-inch nominal coated thickness.
 - 2) Surface: Manufacturer's standard, flat.
- c. Interior Face: Enclose insulation completely within steel exterior facing and interior facing material, with no exposed insulation. Provide the following interior-facing material:
 - 1) Zinc-Coated (Galvanized) Steel Sheet: With minimum nominal coated thickness of dimension recommended in writing by manufacturer to comply with performance requirements.
- 3. End Stiles: Enclose open ends of sections with channel end stiles formed from galvanized-steel sheet not less than 0.040-inch nominal coated thickness and welded to door section.
- 4. Intermediate Stiles: Provide intermediate stiles formed from not less than 0.040-inch-thick galvanized-steel sheet, cut to door section profile, and welded in place. Space stiles not more than 48 inches apart.
- 5. Section Reinforcing: Horizontal and diagonal reinforcement as required to stiffen door and for wind loading. Provide galvanized-steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place.
 - a. Bottom Section: Reinforce section with a continuous channel or angle conforming to bottom-section profile and allowing installation of astragal (weatherseal).
 - b. Hardware Locations: Provide reinforcement for hardware attachment.
- 6. Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard insulation of type indicated below:
 - a. Board Insulation: Polystyrene or polyurethane, secured to exterior face sheet.
 - b. Foamed-in-Place Insulation: Polyurethane, foamed in place to completely fill interior of section and pressure bonded to face sheets to prevent delamination under wind load.
 - c. Fire-Resistance Characteristics: Maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, in accordance with ASTM E84.
- F. Track: Manufacturer's standard, galvanized-steel, standard-lift track system. Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides.
 - 1. Material: Galvanized steel, ASTM A653/A653M, minimum G60 zinc coating.
 - 2. Size: 3 inches wide.
 - 3. Track Reinforcement and Supports: Provide galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches apart for door-drop safety device.

- a. Vertical Track: Incline vertical track to ensure weathertight closure at jambs. Provide intermittent jamb brackets attached to track and wall.
 - b. Horizontal Track: Provide continuous reinforcing angle from curve in track to end of track, attached to track and supported at points by laterally braced attachments to overhead structural members.
- G. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom top and jambs of door. Provide combination bottom weatherseal and sensor edge for bottom seal.
- H. Hardware: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless steel, or other corrosion-resistant fasteners, to suit door type.
 - 1. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch nominal coated thickness at each end stile and at each intermediate stile, in accordance with manufacturer's written recommendations for door size.
 - a. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible.
 - b. Provide double-end hinges where required for doors more than 16 ft. wide unless otherwise recommended by door manufacturer in writing.
 - 2. Rollers: Heavy-duty rollers with steel ball bearings in case-hardened steel races, mounted to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Match roller-tire diameter to track width.
 - a. Roller-Tire Material: Manufacturer's standard.
- I. Locking Device:
 - 1. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from inside only.
 - 2. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.
- J. Counterbalance Mechanism:
 - 1. Torsion Spring: Adjustable-tension torsion springs complying with requirements of DASMA 102 for number of operation cycles indicated, mounted on torsion shaft.
 - 2. Cable Drums and Shaft for Doors: Cast-aluminum cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised.
 - a. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft.
 - b. Provide one additional midpoint bracket for shafts up to 16 ft. long and two additional brackets at one-third points to support shafts more than 16 ft. long unless closer spacing is recommended in writing by door manufacturer.
 - 3. Cables: Galvanized-steel, multistrand, lifting cables with cable safety factor of at least 5 to 1.

4. Cable Safety Device: Include a spring-loaded steel or bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if lifting cable breaks.
 5. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.
 6. Bumper: Provide spring bumper at each horizontal track to cushion door at end of opening operation.
- K. Electric Door Operator: Electric door operator assembly of size and capacity recommended by door manufacturer for door and operation cycles specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
1. Comply with NFPA 70.
 2. 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.
 3. Safety: Listed in accordance with UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 ft. or lower.
 4. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
 5. Operator Type: Manufacturer's standard for door requirements.
 6. Motor: Reversible-type with controller (disconnect switch) for interior, clean, and dry motor exposure. Use adjustable motor-mounting bases for belt-driven operators.
 - a. Motor Size: As required 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.
 - b. Electrical Characteristics:
 - 1) Phase: Single phase Polyphase.
 - 2) Volts: 115 V.
 7. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
 8. Obstruction Detection: Automatic external entrapment protection consisting of automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.
 - a. Monitored Entrapment Protection: Electric sensor edge on bottom section designed to interface with door-operator control circuit to detect damage to or disconnection of sensor and complying with requirements in UL 325.
 9. Control Station: Surface mounted, three-position (open, close, and stop) two-position (open and close) control.
 - a. Operation: Push button.
 - b. Interior-Mounted Unit: Full-guarded, surface-mounted, standard-duty, weatherproof-type, NEMA ICS 6, Type 4 enclosure.

10. Emergency Manual Operation: Chain type designed so required force for door operation does not exceed 25 lbf.
 11. Emergency Operation Disconnect Device: 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.
 12. Motor Removal: Design operator so motor can be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
- L. Metal Finish: Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
1. 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.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 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. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; in accordance with manufacturer's written instructions.
- B. Tracks:
 1. Fasten vertical track assembly to opening jambs and framing with fasteners spaced not more than 24 inches apart.
 2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.
- C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Power-Operated Doors: Install in accordance with UL 325.

3.3 STARTUP SERVICES

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks in accordance with manufacturer's written instructions.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 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 doors and seals to provide weather-resistant fit around entire perimeter.
- D. Touchup Painting Galvanized Material: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A780/A780M.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION 083613

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Aluminum-framed entrance and storefront systems.

1.2 ACTION SUBMITTALS**A. Product Data:**

1. Aluminum-framed entrance and storefront systems.

B. Product Data Submittals: For each product.

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories.

C. Shop Drawings:

1. Plans, elevations, sections, full-size details, and attachments to other work.
2. Details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
3. Full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed entrance and storefront systems, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.
4. Connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
5. Point-to-point wiring diagrams showing the following:
 - a. Power requirements for each electrically operated door hardware.
 - b. Location and types of switches, signal device, conduit sizes, and number and size of wires.
6. Signed and sealed by the qualified professional engineer responsible for their preparation.

D. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.

- E. 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, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

1.3 INFORMATIONAL SUBMITTALS

- A. Energy Performance Certificates: For aluminum-framed entrance and storefront systems, accessories, and components, from manufacturer.
 - 1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront system.
- B. Product Test Reports: For aluminum-framed entrance and storefront systems, for tests performed by a qualified testing agency.
- C. Test and Evaluation Reports:
 - 1. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Source Quality-Control Submittals:
 - 1. Source quality-control reports.
- E. Qualification Statements:
 - 1. For Installer and field testing agency.
- F. Sample Warranties: For aluminum-framed entrance and storefront systems.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For aluminum-framed entrance and storefront systems.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Fabricator of products.
 - 2. Entity that employs installers and supervisors who are trained and approved by manufacturer.
 - 3. Authorized representative who is trained and approved by manufacturer.
 - 4. Entity that is certified under the North American Contractor Certification Program (NACC) and that employs installers and supervisors who are trained and approved by manufacturer and who are certified under the Architectural Glass and Metal Technician (AGMT) certification program.

- B. Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated and acceptable to Owner and Architect.
- C. Egress Door Inspector Qualifications:
 - 1. Inspector for field quality-control inspections of egress door assemblies to comply with qualifications set forth in NFPA 101, Ch. 7 "Means of Egress," Section "Means of Egress Components," Article "Inspection of Door Openings."
 - 2. Inspector for field quality-control inspections of egress door assemblies to be certified under DHI's certification program as a Fire and Egress Door Assembly Inspector (FDAI) or a Certified Fire and Egress Door Assembly Inspector (CFDAI).
- D. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. 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.
 - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.6 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace components of aluminum-framed entrance and storefront systems that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including, but not limited to, excessive deflection.
 - b. Noise or vibration created by wind and thermal and structural movements.
 - c. Deterioration of metals and other materials beyond normal weathering.
 - d. Water penetration through fixed glazing and framing areas.
 - e. Failure of operating components.
 - 2. Warranty Period: 10 Insert number years from date of Substantial Completion.
- B. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.
 - 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D 4214.
 - c. Cracking, peeling, or chipping.
 - 2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS**2.1 SOURCE LIMITATIONS**

- A. Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrance and storefront systems representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Aluminum-framed entrance and storefront systems to withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 - 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- B. Structural Loads:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
- C. Deflection of Framing Members Supporting Glass: At design wind load, as follows:
 - 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of 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.
 - 2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.
 - a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.
 - 3. Cantilever Deflection: Limited to $2L/175$ at unsupported cantilevers.
- D. Structural: Test in accordance with ASTM E330/E330M as follows:
 - 1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.

2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 Insert number percent of span.
 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- E. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
- F. Water Penetration under Dynamic Pressure: Test in accordance with AAMA 501.1 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
 2. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.
- G. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:
1. Thermal Transmittance (U-factor):
 - a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.41 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
 - b. Entrance Doors: U-factor of not more than 0.68 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
 2. Solar Heat-Gain Coefficient (SHGC):
 - a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.35 as determined in accordance with NFRC 200.
 - b. Entrance Doors: SHGC of not more than 0.40 as determined in accordance with NFRC 200.
 3. Air Leakage:
 - a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft. when tested in accordance with ASTM E283.
 - b. Entrance Doors: Air leakage of not more than 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..
 4. Condensation Resistance Factor (CRF):
 - a. Fixed Glazing and Framing Areas: CRF for the system of not less than 55 as determined in accordance with AAMA 1503.

- b. Entrance Doors: CRF of not less than 63 as determined in accordance with AAMA 1503.
- H. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
 - 2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested in accordance with AAMA 501.5.
 - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
 - b. Low Exterior Ambient-Air Temperature: 0 deg F.
 - c. Interior Ambient-Air Temperature: 75 deg F.
- I. Structural-Sealant Joints:
 - 1. Designed to carry gravity loads of glazing.
- J. Structural Sealant: ASTM C1184. Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed, aluminum-framed entrance and storefront systems without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant to occur before adhesive failure.
 - 1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
 - 2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate, because sealant-to-substrate bond strength exceeds sealant's internal strength.

2.3 ALUMINUM-FRAMED ENTRANCE AND STOREFRONT SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. EFCO Corporation.
 - 2. Kawneer Company, Inc.; Arconic Corporation.
 - 3. OldCastle BuildingEnvelope (OBE).
 - 4. Tubelite Inc.
- B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 - 1. Exterior Framing Construction: Thermally broken.
 - 2. Interior Vestibule Framing Construction: Nonthermal.
 - 3. Glazing System: Retained mechanically with gaskets on four sides.
 - 4. Glazing Plane: Front.
 - 5. Finish: Clear anodic finish.
 - 6. Fabrication Method: Field-fabricated stick system.

7. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 8. Steel Reinforcement: As required by manufacturer.
- C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.4 ENTRANCE DOOR SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. EFCO Corporation.
 2. Kawneer Company, Inc.; Arconic Corporation.
 3. OldCastle BuildingEnvelope (OBE).
 4. Tubelite Inc.
- B. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic 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: Wide stile; 5-inch nominal width.
 3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.
 4. Finish: Match adjacent storefront framing finish.

2.5 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."
- B. 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 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.
- C. Continuous-Gear Hinges: BHMA A156.26.
- D. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing in accordance with UL 305.
- E. Cylinders:
1. As specified in Section 087100 "Door Hardware."
 2. BHMA A156.5, Grade 1.
 - a. Keying: Master key system. Permanently inscribe each key with a visual key control number and include notation "DO NOT DUPLICATE" to be furnished by Owner.
- F. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
- G. Operating Trim: BHMA A156.6.
- H. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.
- I. Concealed Overhead Holders and Stops: BHMA A156.8, Grade 1.
- J. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.
- K. Weather Stripping: Manufacturer's standard replaceable components.
1. Compression Type: Made of ASTM D2000 molded neoprene or ASTM D2287 molded PVC.
 2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
- L. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

- M. Thresholds: BHMA A156.21 raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch.

2.6 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

2.7 MATERIALS

- A. Sheet and Plate: ASTM B209.
- B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.
- C. Structural Profiles: ASTM B308/B308M.
- D. Steel Reinforcement:
 - 1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
 - 2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
 - 3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
- E. Steel Reinforcement Primer: 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 in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

2.8 ACCESSORIES

- A. 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.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
 - 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.
- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

- D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil thickness per coat.
- E. Rigid PVC filler.

2.9 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. 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. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Provisions for field replacement of glazing from interior.
 - 6. 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. Storefront Framing: Fabricate components for assembly using shear-block system screw-spline system head-and-sill-receptor system with shear blocks at intermediate horizontal members Insert system.
- F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
 - 1. At interior and exterior doors, provide compression weather stripping at fixed stops.
- G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
 - 1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
 - 2. At exterior doors, provide weather sweeps applied to door bottoms.
- H. 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.
- I. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.10 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine areas, 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 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE AND STOREFRONT SYSTEMS

- A. Comply with manufacturer's written instructions.
- B. Do not install damaged components.
- C. Fit joints to produce hairline joints free of burrs and distortion.
- D. Rigidly secure nonmovement joints.
- E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- F. Seal perimeter and other joints watertight unless otherwise indicated.
- G. Metal Protection:
 - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
 - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- H. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.
- I. Install joint filler behind sealant as recommended by sealant manufacturer.
- J. Install components plumb and true in alignment with established lines and grades.
- K. Install entrance 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 in accordance with entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

L. Install glazing as specified in Section 088000 "Glazing."

3.3 ERECTION TOLERANCES

A. Install aluminum-framed entrance and storefront systems to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
 - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
 - c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests.

B. Tests: Perform the following tests on representative areas of aluminum-framed entrance and storefront systems.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect to be tested in accordance with AAMA 501.2 and to not evidence water penetration.
 - a. Perform a minimum of two tests in areas as directed by Architect.
2. Air Leakage: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..
 - a. Perform a minimum of two **<Insert number>** tests in areas as directed by Architect.
3. Water Penetration: ASTM E1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and to not evidence water penetration.

- C. Inspection Agency: Engage a qualified inspector to perform inspections.
- D. Inspections:
 - 1. Egress Door Inspections: Inspect each aluminum-framed entrance door equipped with panic hardware, located in an exit enclosure, electrically controlled, and equipped with special locking arrangements, in accordance with NFPA 101, Ch. 7 "Means of Egress," Section "Means of Egress Components," Article "Inspection of Door Openings."
- E. Aluminum-framed entrance and storefront systems will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

3.5 MAINTENANCE SERVICE

- A. Entrance Door Hardware Maintenance:
 - 1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
 - 2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Use parts and supplies that are the same as those used in the manufacture and installation of original equipment.

END OF SECTION 084113

SECTION 084229.23 - SLIDING AUTOMATIC ENTRANCES**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes: Sliding automatic entrances.

1.2 DEFINITIONS

- A. AAADM: American Association of Automatic Door Manufacturers.
- B. Activation Device: A control that, when actuated, sends an electrical signal to the door operator to open the door.
- C. Safety Device: A control that, to avoid injury, prevents a door from opening or closing.
- D. For automatic door terminology, refer to BHMA A156.10 for definitions of terms.

1.3 COORDINATION

- A. Templates: Distribute for doors, frames, and other work specified to be factory prepared for installing automatic entrances.
- B. Coordinate hardware with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish. Coordinate hardware for automatic entrances with hardware required for rest of Project.
- C. Electrical System Roughing-in: Coordinate layout and installation of automatic entrances with connections to power supplies and access-control system.
- D. System Integration: Integrate sliding automatic entrances with other systems as required for a complete working installation.
 - 1. Provide electrical interface control capability for activation of sliding automatic entrances by security access system on doors with electric locking.
 - 2. Provide electrical interface to deactivate door operators on activation of fire alarm system.
 - 3. Provide electrical interface to allow for remote monitoring of automatic entrance door panel status.

1.4 ACTION SUBMITTALS

- A. Product Data: Sliding automatic entrances.
- B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for automatic entrances.
 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- C. Sustainable Design Submittals:
- D. Shop Drawings: For sliding automatic entrances.
1. Include plans, elevations, sections, hardware mounting heights, and attachment details.
 2. 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.
 4. Indicate locations of activation and safety devices.
 5. Include hardware schedule and indicate hardware types, functions, quantities, and locations.
- E. Samples for Initial Selection: For units with factory-applied color finishes.
1. Include Samples of hardware and accessories involving color or finish selection.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of automatic entrance.
- C. Sample Warranties: For manufacturer's special warranties.
- 1.6 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For automatic entrances, safety devices, and control systems to include in operation and maintenance manuals.
- 1.7 QUALITY ASSURANCE
- A. Manufacturer Qualifications: A manufacturer with Company Certificate issued by AAADM indicating that manufacturer has a Certified Inspector on staff.
- B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project.
1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
- C. Certified Inspector Qualifications: Certified by AAADM.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of automatic entrances that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Faulty operation of operators, controls, and hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.
 - 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested in accordance with ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS**2.1 SOURCE LIMITATIONS**

- A. Obtain sliding automatic entrances from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Power-Operated Door Standard: BHMA A156.10.
- 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.
- C. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design automatic entrances.
- D. Structural Performance: Automatic entrances to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated in accordance with ASCE/SEI 7.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- F. Operating Temperature Range: Automatic entrances to operate within minus 20 to plus 122 deg F.
- G. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:
 1. Thermal Transmittance (U-Factor):
 - a. Entrance Doors: U-factor of not more than 0.63 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
 2. Solar Heat-Gain Coefficient (SHGC):
 - a. Entrance Doors: SHGC of not more than 0.35 as determined in accordance with NFRC 200.
 3. Air Leakage:
 - a. Power-Operated Sliding Doors: Air leakage of not more than 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..
 4. Condensation Resistance Factor (CRF):
 - a. Entrance Doors: CRF of not less than 57 as determined in accordance with AAMA 1503.
- H. Opening Force:
 1. Power-Operated Doors: Not more than 50 lbf required to manually set door in motion if power fails, and not more than 15 lbf required to open door to minimum required width.
 2. Breakaway Device for Power-Operated Doors: Not more than 50 lbf required for a breakaway door or panel to open.
- I. Entrapment-Prevention Force:
 1. Power-Operated Sliding Doors: Not more than 30 lbf required to prevent stopped door from closing.

2.3 SLIDING AUTOMATIC ENTRANCES

- A. General: Provide manufacturer's standard automatic entrances, including doors, sidelites, framing, headers, carrier assemblies, roller tracks, door operators, controls, and accessories required for a complete installation.
- B. Sliding, Power-Operated Automatic Entrances Insert drawing designation:
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. ASSA ABLOY Entrance Systems; ASSA ABLOY.

- b. STANLEY Access Technologies LLC; STANLEY Security Solutions, Inc.
 - c. Dormakaba USA Inc.
2. Configuration, Biparting-Sliding: Biparting-sliding doors with two sliding leaves sidelites on each side.
- a. Traffic Pattern: Two way.
 - b. Emergency Breakaway Capability: Sliding leaves only.
 - c. Mounting: Between jambs.
3. Operator Features:
- a. Power opening and closing.
 - b. Drive System: Chain or belt.
 - c. Adjustable opening and closing speeds.
 - d. Adjustable hold-open time between zero and 30 seconds.
 - e. Obstruction recycle.
 - f. On-off/hold-open switch to control electric power to operator.
4. Sliding-Door Carrier Assemblies and Overhead Roller Tracks: Carrier assembly that allows vertical adjustment; consisting of nylon- or delrin-covered, ball-bearing-center steel wheels operating on a continuous roller track, or ball-bearing-center steel wheels operating on a nylon- or delrin-covered, continuous roller track. Support doors from carrier assembly by cantilever and pivot assembly.
- a. Rollers: Minimum of two ball-bearing roller wheels and two antirise rollers for each active leaf.
5. Sliding-Door Threshold: Threshold members and bottom-guide-track system with stainless steel, ball-bearing-center roller wheels.
- a. Configuration, Threshold: Saddle-type threshold across door opening and recessed guide-track system at sidelites.
 - b. Configuration, No Threshold: No threshold across door opening and surface-mounted guide-track system at sidelites.
6. Controls: Activation and safety devices in accordance with BHMA standards.
- a. Activation Device, Motion Sensor: Mounted on each side of door header to detect pedestrians in activating zone and to open door.
 - b. Safety Device, Photoelectric Beams: Two photoelectric beams mounted in sidelite jambs on each side of door to detect pedestrians in presence zone and to prevent door from closing.
 - c. Safety Device, Presence Sensor Under Door Header and Photoelectric Beams: Presence sensor mounted to underside of door header and two photoelectric beams mounted in sidelite jambs on one side of the door to detect pedestrians in presence zone and to prevent door from closing.
 - d. Safety Device, Presence Sensor on Sides of Door Header and Photoelectric Beams: Presence sensor mounted on each side of door header and two photoelectric beams mounted in sidelite jambs on one side of the door to detect pedestrians in presence zone and to prevent door from closing.

7. Finish: Finish framing, door(s), and header with Class I, clear anodic finish.

2.4 ENTRANCE COMPONENTS

- A. Framing Members: Extruded aluminum, minimum 0.125 inch thick and reinforced as required to support imposed loads.
 1. Nominal Size: 1-3/4 by 4-1/2 inches.
 2. Extruded Glazing Stops and Applied Trim: Minimum 0.062-inch wall thickness.
- B. Stile and Rail Doors: 1-3/4-inch-thick, glazed doors with minimum 0.125-inch-thick, extruded-aluminum tubular stile and rail members. Mechanically fasten corners with reinforcing brackets that are welded, or incorporate concealed tie-rods that span full length of top and bottom rails.
 1. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
 2. Stile Design: Wide stile, more than 4-inch nominal width.
- C. Headers: Fabricated from minimum 0.125-inch-thick extruded aluminum and extending full width of automatic entrance units to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.
 1. Mounting: Concealed, with one side of header flush with framing.
 2. Capacity: Capable of supporting doors of up to 175 lb per leaf over spans of up to 14 feet without intermediate supports.
 - a. Provide sag rods for spans exceeding 14 feet.
- D. Brackets and Reinforcements: High-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- E. Signage: As required by cited BHMA standard.
 1. Application Process: Door manufacturer's standard process.
 2. Provide sign materials with instructions for field application after glazing is installed.

2.5 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 1. Extrusions: ASTM B221.
 2. Sheet: ASTM B209.
- B. Steel Reinforcement: Reinforcement with corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Use surface preparation methods in accordance with recommendations in SSPC-SP COM and prepare surfaces in accordance with applicable SSPC standard.

- C. Glazing: As specified in Section 088000 "Glazing."
- D. Sealants and Joint Fillers: As specified in Section 079200 "Joint Sealants."
- E. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout; complying with ASTM C1107/C1107M; of consistency suitable for application.
- F. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- G. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.6 DOOR OPERATORS AND CONTROLS

- A. General: Provide operators and controls, which include activation and safety devices, in accordance with BHMA standards, for condition of exposure, and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated.
- B. Door Operators: Provide door operators of size recommended by manufacturer for door size, weight, and movement.
 - 1. Door Operator Performance: Door operators to open and close doors and maintain them in fully closed position when subjected to Project's design wind loads.
 - 2. Electromechanical Operators: Concealed, self-contained, overhead units powered by fractional-horsepower, permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor; with solid-state microprocessor controller; complying with UL 325; and with manual operation with power off.
- C. Motion Sensors: Self-contained, K-band-frequency, microwave-scanner units; fully enclosed by their plastic housings; adjustable to provide detection-field sizes and functions required by BHMA A156.10.
 - 1. Provide capability for switching between bi- and unidirectional detection.
 - 2. For one-way traffic, sensor on egress side to not be active when doors are fully closed.
- D. Presence Sensors: Self-contained, active-infrared scanner units; adjustable to provide detection-field sizes and functions required by BHMA A156.10. Sensors remain active at all times.
- E. Photoelectric Beams: Pulsed infrared, sender-receiver assembly for recessed mounting. Beams to not be active when doors are fully closed.
- F. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

2.7 HARDWARE

- A. General: Provide units in sizes and types recommended by automatic entrance and hardware manufacturers for entrances and uses indicated. Finish exposed parts to match door finish.

- B. Breakaway Device for Power-Operated Doors: Device that allows door to swing out in direction of egress to full 90 degrees from any operating position. Maximum force to open door to be as stipulated in "Performance Requirements" Article. Interrupt powered operation of door operator while in breakaway mode.
 - 1. Include one adjustable detent device mounted at the top of each breakaway panel to control breakaway force.
 - a. Panel Closer: Factory-installed concealed hydraulic door closer.
 - b. Limit Arms: Limit swing to 90 degrees, spring loaded with adjustable friction damping.
- C. Access-Control Locking: Electrically controlled device mounted in header that automatically locks sliding door in closed position, preventing door panels from sliding manually. Provide fail- safe operation if power fails.
 - 1. Power Interruption: Lock to be disengaged, allowing doors to slide manually.
 - 2. Means of Egress: Vertical rod exit device.
 - 3. Include locking devices for sidelites to prevent manual breakout.
- D. Weather Stripping: Replaceable components.
 - 1. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

2.8 FABRICATION

- A. General: Factory fabricate automatic entrance components to designs, sizes, and thicknesses indicated and to comply with indicated standards.
 - 1. Form aluminum shapes before finishing.
 - 2. 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.
 - 3. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match framing.
 - a. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
 - b. Reinforce members as required to receive fastener threads.
 - 4. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
- B. Framing: Provide automatic entrances as prefabricated assemblies. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site.
 - 1. Fabricate tubular and channel frame assemblies with welded or mechanical joints. Provide subframes and reinforcement as required for a complete system to support required loads.

2. Perform fabrication operations in manner that prevents damage to exposed finish surfaces.
 3. Form profiles that are sharp, straight, and free of defects or deformations.
 4. Provide components with concealed fasteners and anchor and connection devices.
 5. Fabricate components with accurately fitted joints, with ends coped or mitered to produce hairline joints free of burrs and distortion.
 6. Fabricate exterior components to drain water passing joints, condensation occurring within framing members, and moisture migrating within system to exterior. Provide anchorage and alignment brackets for concealed support of assembly from building structure.
 7. Allow for thermal expansion of exterior units.
- C. Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.
- D. Door Operators: Factory fabricated and installed in headers, including adjusting and testing.
- E. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated, in accordance with NGA's "GANA Glazing Manual."
- F. Hardware: Factory install hardware to greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site. Cut, drill, and tap for factory-installed hardware before applying finishes.
1. Provide sliding-type weather stripping, mortised into door, at perimeter of doors.
- G. Controls:
1. General: Factory install activation and safety devices in doors and headers as required by BHMA A156.10 for type of door and direction of travel.
 2. Install photoelectric beams in vertical jambs of sidelites, with dimension above finished floor as follows:
 - a. Top Beam: 48 inches.
 - b. Bottom Beam: 24 inches.

2.9 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. 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.

2.10 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of automatic entrances.
- B. Examine roughing-in for electrical systems to verify actual locations of power connections before automatic entrance installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install automatic entrances in accordance with manufacturer's written instructions and cited BHMA A156.10 for direction of pedestrian travel, including signage, controls, wiring, and connection to the building's power supply.
 - 1. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.
 - 2. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
 - 3. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous coating.
- B. Entrances: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.
 - 1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
 - 2. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.
 - 3. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within system to exterior.
 - 4. Level recesses for recessed thresholds using nonshrink grout.
- C. Door Operators: Connect door operators to electrical power distribution system.
- D. Access-Control Devices: Connect access-control devices to access-control system, as specified in Section 281300 "Access Control Software and Database Management."
- E. Controls: Install and adjust activation and safety devices in accordance with manufacturer's written instructions and cited BHMA standard for direction of pedestrian travel. Connect

control wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

- F. Glazing: Install glazing as specified in Section 088000 "Glazing."
- G. Sealants: Comply with requirements specified in Section 079200 "Joint Sealants" to provide weathertight installation.
 - 1. Set thresholds, bottom-guide-track system, framing members and flashings in full sealant bed.
 - 2. Seal perimeter of framing members with sealant.
- H. Signage: Apply signage on both sides of each door, as required by cited BHMA standard for direction of pedestrian travel.
- I. Wiring within Automatic Entrance Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's written limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 FIELD QUALITY CONTROL

- A. Certified Inspector: Engage a Certified Inspector to test and inspect components, assemblies, and installations, including connections.
- B. Perform the following tests and inspections:
 - 1. Test and inspect each automatic entrance, using AAADM inspection forms, to determine compliance of installed systems with applicable BHMA standards.
- C. Automatic entrances will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust hardware, moving parts, door operators, and controls to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.
 - 1. Adjust exterior doors for tight closure.
- B. Readjust door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).
- 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 two visits to Project during other-than-normal occupancy hours for this purpose.

3.5 CLEANING

- A. Clean glass and metal surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Repair damaged finish to match original finish.
 - 1. Comply with requirements in Section 088000 "Glazing" for cleaning and maintaining glass.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain automatic entrances.

END OF SECTION 084229.23

SECTION 084523 - FIBERGLASS-SANDWICH-PANEL ASSEMBLIES**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes aluminum-framed assemblies incorporating fiberglass-sandwich panels as follows:

1. Wall assemblies.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

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 aluminum components of panel assemblies.

- B. Shop Drawings: For panel assemblies.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include details of provisions for assembly expansion and contraction and for draining moisture within the assembly to the exterior.

- C. Samples: In manufacturer's standard size.

1. For each type of fiberglass-sandwich panel.
2. For each type of exposed finish for framing members.

- D. Fabrication Samples: Of each framing system intersection and adjacent panels, made from 12-inch lengths of full-size framing members and showing details of the following:

1. Joinery.
2. Anchorage.
3. Expansion provisions.
4. Fiberglass-sandwich panels.
5. Flashing and drainage.

- E. Delegated Design Submittals: For panel 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.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer manufacturer.
- B. Product Test Reports: For each fiberglass-sandwich-panel assembly, for tests performed by a qualified testing agency.
- C. Evaluation Reports: For fiberglass-sandwich-panel assemblies from ICC-ES.
- D. Field quality-control reports.
- E. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For panel assemblies to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: For fiberglass-sandwich panels, a qualified manufacturer whose facilities, processes, and products are monitored by an independent, accredited quality-control agency for compliance with applicable requirements in ICC-ES AC04 or ICC-ES AC177.
- B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of panel assemblies that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - c. Water leakage.
 - 2. Warranty Period: Five years from date of Substantial Completion.
- B. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace fiberglass-sandwich panels that exhibit defects in materials or workmanship within specified warranty period.
 - 1. Defects include, but are not limited to, the following:
 - a. Fiberbloom.
 - b. Delamination of coating, if any, from exterior face sheet.
 - c. Color change exceeding requirements.
 - d. Delamination of panel face sheets from panel cores.

2. Warranty Period: 10 years from date of Substantial Completion.
- C. Special Aluminum-Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
 1. Failures include, but are not limited to, checking, crazing, peeling, chalking, and fading of finishes.
 2. Warranty Period: 20 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 fiberglass-sandwich-panel assemblies.
- B. Structural Loads: As indicated on Drawings.
- C. Deflection Limits:
 1. Vertical Panel Assemblies: Limited to 1/120 of clear span for each assembly component.
 2. Overhead Panel Assemblies: Limited to 1/180 of clear span for each assembly component.
- D. Structural-Test Performance: Provide panel assemblies tested in accordance with ASTM E330, as follows:
 1. When tested at positive and negative wind-load design pressures, assemblies do not show evidence of deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not show evidence of material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- E. Water Penetration under Static Pressure: Provide panel assemblies that do not evidence water penetration through fixed glazing and framing areas when tested in accordance with ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
- F. Water Penetration under Dynamic Pressure: Provide panel assemblies that do not evidence water leakage through fixed glazing and framing areas when tested in accordance with AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
 1. Maximum Water Leakage: No uncontrolled water penetrating aluminum-framed systems or water appearing on systems' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water that is controlled by flashing

and gutters and drained to the exterior, or water that cannot damage adjacent materials or finishes.

- G. Thermal Movements: Allow for thermal movements from ambient- and surface-temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- H. Energy Performance: Provide panel assemblies with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 - 1. Thermal Transmittance (U-Factor): Fixed glazing and framing areas to have U-factor of not more than 0.80 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
 - 2. Solar Heat Gain Coefficient (SHGC): Fixed glazing and framing areas to have a SHGC of no greater than 0.6 as determined in accordance with NFRC 200.
 - 3. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.30 cfm/sq. ft. of fixed wall area as determined in accordance with ASTM E283 at a minimum static-air-pressure differential of 1.57 lbf/sq. ft..

2.2 FIBERGLASS-SANDWICH-PANEL ASSEMBLIES

- A. Fiberglass-Sandwich-Panel Assemblies: Translucent assemblies that are supported by aluminum framing and glazed with fiberglass-sandwich panels.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kalwall Corporation.
 - b. Major Industries, Inc.

2.3 FIBERGLASS-SANDWICH PANELS

- A. Fiberglass-Sandwich Panels: Uniformly colored, translucent, thermoset, fiberglass-reinforced-polymer face sheets bonded to both sides of a grid core.
- B. Panel Thickness: 4 inches **or** 2 ¾".
- C. Grid Core: Mechanically interlocked, extruded-aluminum I-beams, ~~with a minimum flange width of 7/16 inch.~~
 - 1. Extruded Aluminum: ASTM B221, in alloy and temper recommended in writing by manufacturer.
 - 2. I-Beam Construction: Thermally broken, extruded aluminum.
 - 3. Grid Pattern: Inline rectangle, nominal 12 by 24 inches.
- D. Exterior Face Sheet:
 - 1. Thickness: 0.070 inch.
 - 2. Color: As selected by Architect from manufacturer's full range.

3. Protective Weathering Surface: Manufacturer's standard.
- E. Interior Face Sheet:
 1. Thickness: 0.045 inch.
 2. Color: As selected by Architect from manufacturer's full range.
- F. Fiberglass-Sandwich-Panel Adhesive: Manufacturer's standard for permanent adhesion of facings to cores.
- G. Panel Strength:
 1. Standard panels shall deflect no more than 1.9" at 30 PSF in 10'-0" span without a supporting frame by ASTM E 72.
 2. Panel Support Strength: Capable of supporting, without failure, a 300-lbf concentrated load when applied to a 3-inch-diameter disk in accordance with ASTM E661.
- H. Panel Performance:
 1. Self-Ignition Temperature: 650 deg F or more in accordance with ASTM D1929.
 2. Smoke-Developed Index: 450 or less in accordance with ASTM E84, or 75 or less in accordance with ASTM D2843.
 3. Combustibility Classification: Class CC1 based on testing in accordance with ASTM D635.
 4. Interior Finish Classification: Class A based on testing in accordance with ASTM E84.
 5. Color Change: Not more than 3.0 units Delta E, when measured in accordance with ASTM D2244, after outdoor weathering compliant with procedures in ASTM D1435.
 - a. Outdoor Weathering Conditions: Sixty months in southern Florida.
 6. Impact Resistance: No fracture or tear at impact of 60 ft. x lbf by a 3-1/4-inch-diameter, 5-lb freefalling ball in accordance with UL 972 test procedure.
 7. Haze Factor: Greater than 90 percent when tested in accordance with ASTM D1003.

2.4 ALUMINUM FRAMING SYSTEMS

- A. Components: Manufacturer's standard extruded-aluminum members of thickness required and reinforced as required to support imposed loads.
 1. Construction: Thermally broken, extruded aluminum.
- B. Aluminum: Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.
 1. Sheet and Plate: ASTM B209.
 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.
 3. Extruded Structural Pipe and Tubes: ASTM B429/B429M.
 4. Structural Profiles: ASTM B308/B308M.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning skylight components.

- D. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, and nonbleeding fasteners and accessories; compatible with adjacent materials.
 - 1. At closures, retaining caps, or battens, use ASTM A193/A193M, 300 series stainless steel screws.
 - 2. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - 3. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended in writing by manufacturer.
- E. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.
- F. Anchor Bolts: ASTM A307, Grade A, galvanized steel.
- G. Concealed Flashing: Corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- H. Exposed Flashing and Closures: Aluminum sheet not less than 0.040 inch thick, finished to match framing.
- I. Framing Gaskets: Manufacturer's standard.
- J. Frame-System Sealants: As recommended in writing by manufacturer.
- K. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.5 ALUMINUM CLAMPTITE INSTALLATION SYSTEM

- A. **Aluminum clampite installation system:**
 - 1. **2¾" Thermal Strut System-Flat Thermally Broken closure system: Thermal barrier shall consist of polyamide thermal strut construction with multi-directional glass fiber reinforcing. Aluminum components shall be mechanically crimped into cross knurled cavities. Poured and de-bridged thermal break is not acceptable.**
- B. **Sealing tape: Manufacturer's standard, pre-applied to aluminum clampite installation system at the factory under controlled conditions.**
- C. **Fasteners: 300 series stainless steel screws for aluminum clampite installation system, excluding final fasteners to the building.**
- D. **Finish:**
 - 1. **Manufacturer's factory paint applied finish, which meets the performance requirements of AAMA 2604. Color to be selected from manufacturer's standards.**

2.6 FABRICATION**A. Frame System Fabrication:**

1. Fabricate components that, when assembled, have the following characteristics:
 - a. Profiles that are sharp, straight, and free of defects or deformations.
 - b. Accurately fitted joints with ends coped or mitered.
 - c. Internal guttering systems or other means to drain water passing through joints, and moisture migrating within assembly to exterior.
2. Fabricate sill closures with weep holes and for installation as continuous component.
3. Reinforce components as required to receive fastener threads.

B. Panel Fabrication: Factory assemble and seal panels.

1. Laminate face sheets to grid core under a controlled process using heat and pressure to produce straight adhesive bonding lines that cover width of core members and that have sharp edges.
 - a. White spots indicating lack of bond at intersections of grid-core members are limited in number to four for every 40 sq. ft. of panel and limited in diameter to 3/64 inch.
2. Fabricate with grid pattern that is symmetrical about centerlines of each panel.
3. Fabricate panel to allow condensation within panel to escape.
4. Reinforce panel corners.

2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
- B. 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: As selected by Architect from full range of industry colors and color densities.

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 INSTALLATION

- A. General: Comply with manufacturer's written instructions.
 - 1. Do not install damaged components.
 - 2. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
 - 3. Rigidly secure nonmovement joints.
 - 4. Install anchors with separators and isolators to prevent metal corrosion, electrolytic deterioration, and immobilization of moving joints.
 - 5. Seal joints watertight unless otherwise indicated.
- B. Metal Protection: Where aluminum components will contact dissimilar materials, protect against galvanic action by painting contact surfaces with corrosion-resistant coating or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.
- C. Install components plumb and true in alignment with established lines and elevations.
- D. Skylight Assemblies: Install continuous aluminum sill closures with weatherproof expansion joints and locked and sealed corners. Locate weep holes at rafters. Install components to drain water passing through joints and moisture migrating within assembly to exterior.
- E. Erection Tolerances: Install panel assemblies to comply with the following maximum tolerances:
 - 1. Alignment: Limit offset from true alignment to 1/32 inch where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than 3 inches; otherwise, limit offset to 1/8 inch.
 - 2. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet, but no greater than 1/2 inch over total length.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
 - 1. Water-Spray Test: Before installation of interior finishes has begun, panel assemblies to be tested in accordance with AAMA 501.2 and to not show evidence of water penetration.
 - 2. Water Penetration under Static Pressure: Before installation of interior finishes has begun, areas to be tested in accordance with ASTM E1105.
 - a. Test Procedures: Test under uniform and cyclic static-air pressure.
 - b. Static-Air-Pressure Difference: 0.67 times the pressure specified for laboratory testing according to ASTM E331.
 - c. Water Penetration: None.
- B. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.

FIBERGLASS SANDWICH PANEL ASSEMBLIES**SECTION 08 45 23**

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- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

END OF SECTION 084523

SECTION 087100 - DOOR HARDWARE**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. Mechanical door hardware for the following:
 - a. Swinging doors.
 - 2. Cylinders for door hardware specified in other Sections.
 - 3. Electrified door hardware.

- B. Related Sections:

- 1. Section 081113 "Hollow Metal Doors and Frames" for astragals provided as part of labeled fire-rated assemblies.
 - 2. Section 081216 "Aluminum Frames" for door silencers provided as part of aluminum frames.
 - 3. Section 081416 "Flush Wood Doors" for integral intumescent seals provided as part of labeled fire-rated assemblies.
 - 4. Section 081416 "Flush Wood Doors" for provided as part of labeled fire-rated assemblies.
 - 5. Section 102600 "Wall and Door Protection" for plastic door protection units that match wall protection units.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

- B. Other Action Submittals:

- 1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - a. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door

hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.

- b. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.
 - c. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
 - d. Content: Include the following information:
 - 1) Identification number, location, hand, fire rating, size, and material of each door and frame.
 - 2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - 3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - 4) Fastenings and other pertinent information.
 - 5) Explanation of abbreviations, symbols, and codes contained in schedule.
 - 6) Mounting locations for door hardware.
 - 7) List of related door devices specified in other Sections for each door and frame.
2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Architectural Hardware Consultant.
- B. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- C. Warranty: Special warranty specified in this Section.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

1.6 QUALITY ASSURANCE

- A. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as follows:
 1. For door hardware, an Architectural Hardware Consultant (AHC).

- B. Source Limitations: Obtain each type of door hardware from a single manufacturer.
- C. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.
- D. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
 - 1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.
- E. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- F. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.
 - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
 - 2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
 - b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
 - 4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.
- G. Keying Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." In addition to Owner, Contractor, and Architect, conference participants shall also include Installer's Architectural Hardware Consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
 - 1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - 2. Preliminary key system schematic diagram.
 - 3. Requirements for key control system.
 - 4. Requirements for access control.
 - 5. Address for delivery of keys.
- H. 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. Inspect and discuss preparatory work performed by other trades.
3. Review sequence of operation for each type of electrified door hardware.
4. Review required testing, inspecting, and certifying procedures.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- D. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.8 COORDINATION

- A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- B. Electrical System Roughing-in: Coordinate layout and installation of electrified door hardware with connections to power supplies, fire alarm system and detection devices, access control system, security system, and building control system, as applicable.
- C. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 2. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.

- a. Exit Devices: Two years from date of Substantial Completion.
- b. Manual Closers: 10 years from date of Substantial Completion.

1.10 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Provide parts and supplies that are the same as those used in the manufacture and installation of original products.

1.11 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.
 - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.
 - 2. References to BHMA Designations: Provide products complying with these designations and requirements for description, quality, and function.

1.12 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Baldwin Hardware Corporation.
 - b. Bommer Industries, Inc.
 - c. IVES Hardware; an Allegion company.

1.13 CONTINUOUS HINGES

- A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch- (3.0-mm-) thick, hinge leaves with minimum overall width of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.
- B. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bommer Industries, Inc.
 - b. IVES Hardware; an Allegion company.
 - c. Select Products Limited.

1.14 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 - 1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.
 - 2. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.
- C. Lock Backset: 2-3/4 inches (70 mm), unless otherwise indicated.
- D. Lock Trim:
 - 1. Operating Device: Lever with escutcheons (roses). Lever style to match existing locks.
- E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
 - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
- F. Bored Locks: BHMA A156.2; Grade 1; Series 4000.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following.
 - a. Schlage Commercial Lock Division; an Allegion company. No substitutions.
- G. Mortise Locks: BHMA A156.13; Grade 1; stamped steel case with steel or brass parts; Series 1000.
 - 1. Manufacturers: Subject to compliance with requirements provide products by the following.

- a. Schlage Commercial Lock Division; an Allegion company. No substitutions.
2. Additional Requirements:
 - a. Where specified, provide locks with indicator. Indicator window shall measure a minimum 2 inch x 1/2 inch with 180 degree visibility. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.
 - b. Provide trim to match existing locksets.
 - c. Tornado Applications: Provide multipoint lockset assembly UL approved to FEMA 361 guidelines. Must be used with tested and approved door and frame system.

1.15 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: BHMA A156.3.

1. Manufacturers: Subject to compliance with requirements, provide products by the following.
 - a. Von Duprin; an Allegion company. No substitutions.
2. Additional Requirements:
 - a. Exit devices shall incorporate a fluid damper or other device that eliminates noise associated with exit device operation. Touchpad shall extend a minimum of one half of the door width, but not the full length of the exit device rail. End-cap will have two-point attachment to door.
 - b. Removable mullions shall be a 2-inch by 3-inch steel tube. All mullions shall be of a type that can be removed by use of a keyed cylinder, which is self-locking when reinstalled. All mullions to be powder coated, provide custom color mullions where specified to match door/frame.
 - c. Non-fire-rated exit devices shall have cylinder dogging, provide special dogging (SD) in device head where specified.
 - d. All exit devices into educational spaces to have classroom security (-2SI) function allowing trim to be locked/unlocked from inside.
 - e. Tornado Applications: Provide assembly UL approved to FEMA 361 guidelines for outswing single or pair doors. Must be used with tested and approved door and frame system.
 - f. Provide electrical options as scheduled.

1.16 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.

1. Manufacturers: Subject to compliance with requirements provide products by the following.
 - a. Schlage Commercial Lock Division; an Allegion company unless another key system exists.

- B. Standard Lock Cylinders: BHMA A156.5; Grade 1; permanent cores that are removable (where specified); face finished to match lockset.

1.17 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.

- 1. Existing System:

- a. Master key or grand master key locks to Owner's existing system. Exterior doors shall have Schlage Primus cylinders, interior cylinders shall be Everest restricted. Hardware Supplier to verify proper key system.
 - 1) All exterior doors to be supplied with temporary cores.

- B. Keys: Brass.

- 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

- a. Notation: "DO NOT DUPLICATE."

- 2. Quantity: In addition to one extra key blank for each lock, provide the following:

- a. Cylinder Change Keys: Three.
 - b. Master Keys: Five.

1.18 OPERATING TRIM

- A. Operating Trim: BHMA A156.6; brass, unless otherwise indicated.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. IVES Hardware; an Allegion company.
 - b. Rockwood Manufacturing Company.
 - c. Trimco.

1.19 ACCESSORIES FOR PAIRS OF DOORS

- A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release; and with internal override.

- B. Astragals: BHMA A156.22.

1.20 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
1. Manufacturers: Subject to compliance with requirements provide products by the following.
 - a. LCN Closers; an Allegion company. No substitutions.
 2. Additional Requirements:
 - a. All Closers UL Certified to be in compliance with UBC 7.2 and UL 10C.
 - b. Provide closers with a solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
 - c. Closers shall have certification by an independent testing laboratory of 10,000,000 cycles without failure.
 - d. Closers with pressure relief valves will not be acceptable.
 - e. Through bolt all closer units, using sex bolt fasteners.
 - f. Closer cylinders, arms, adapter plates, and metal covers shall have a powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or shall have special rust inhibitor (SRI).
 - g. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

1.21 MECHANICAL STOPS AND HOLDERS

- A. Wall- and Floor-Mounted Stops: BHMA A156.16; polished cast brass, bronze, or aluminum base metal.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. IVES Hardware; an Allegion company.
 - b. Rockwood Manufacturing Company.
 - c. Trimco.

1.22 ELECTROMAGNETIC STOPS AND HOLDERS

- A. Electromagnetic Door Holders: BHMA A156.15, Grade 1; wall-mounted electromagnetic single unit with strike plate attached to swinging door; coordinated with fire detectors and interface with fire alarm system for labeled fire-rated door assemblies.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. LCN Closers; an Allegion company.

1.23 OVERHEAD STOPS AND HOLDERS

A. Overhead Stops and Holders: BHMA A156.8.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Architectural Builders Hardware Mfg., Inc.
 - b. Glynn-Johnson; an Allegion company.
 - c. Rockwood Manufacturing Company.

1.24 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

- 1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
 - a. National Guard Products.
 - b. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
 - c. Zero Companies.

1.25 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

- 1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
 - a. IVES Hardware; an Allegion company.
 - b. Rockwood Manufacturing Company.
 - c. Trimco.

1.26 AUXILIARY DOOR HARDWARE

A. Auxiliary Hardware: BHMA A156.16.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. IVES Hardware; an Allegion company.
 - b. Hager Companies.
 - c. Rockwood Manufacturing Company.
 - d. Trimco.

1.27 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.
 - 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
 - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 - 2. Fire-Rated Applications:
 - a. Wood or Machine Screws: For the following:
 - 1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
 - 2) Strike plates to frames.
 - 3) Closers to doors and frames.
 - b. Steel Through Bolts: For the following unless door blocking is provided:
 - 1) Surface hinges to doors.
 - 2) Closers to doors and frames.
 - 3) Surface-mounted exit devices.
 - 3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
 - 4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
 - 5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

1.28 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

- B. Protect mechanical finishes on exposed surfaces from damage by applying a 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 the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 2 - EXECUTION

2.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

2.2 PREPARATION

- A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."

2.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards. Self-tapping screws are not an acceptable means of installation.

- C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as indicated in keying schedule or directed by Owner.
 - 2. Furnish permanent high security cores to Owner for installation.
- E. Thresholds: Set thresholds for doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- F. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- G. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame. Where gasketing is soffit mounted install prior to any soffit mounted hardware to ensure continuous perimeter seal.
- H. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- I. Door Bottoms: Apply to bottom of door, forming seal with threshold or floor when door is closed.

2.4 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

2.5 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

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2.6 DEMONSTRATION

- A. Contractor to instruct owner's personnel to adjust, operate, and maintain door hardware and door hardware finishes.

2.7 DOOR HARDWARE SCHEDULE

- A. The hardware sets listed below 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.

HARDWARE SET: 01

DOOR NUMBER:

126-C

126-D

126-E

127-A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW NRP	630	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-99-NL-CON 24 VDC	626	VON
1	EA	RIM HOUSING	20-079	626	SCH
1	EA	FSIC PERM. CORE	23-030 EV29 T	626	SCH
1	EA	FSIC CONSTR. CORE	23-030 ICX	ORG	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	103A-223	A	ZER
2	EA	WIRE HARNESS	CON X LENGTH REQ'D		SCH
1	EA	DOOR CONTACT	7764	628	SCE
1	EA	POWER SUPPLY	BY SECURITY SYSTEM INTEGRATOR		B/O
1	EA	DOOR CALL STATION	BY SECURITY SYSTEM INTEGRATOR		
1	EA	CARD READER	BY SECURITY SYSTEM INTEGRATOR		
1	EA	WEATHERSTRIP	BY DOOR/FRAME MANUFACTURER		B/O
1	EA	WIRING DIAGRAM	BY SECURITY SYSTEM INTEGRATOR		

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. ACCESS VIA VALID CARD READ. PANIC MAY BE DOGGED (MADE PUSH/PULL) ELECTRONICALLY. OUTSIDE ADA ACTUATOR ONLY OPERABLE WHEN DOOR IS DOGGED OR AFTER VALID CARD READ, INSIDE ACTUATOR ALWAYS OPERABLE. ALWAYS FREE EGRESS.

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HARDWARE SET: 02

DOOR NUMBER:

114-B

121-A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONTINUOUS HINGE	BY SPECIAL-LITE		SPE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-99-EO-CON 24 VDC	626	VON
1	EA	90 DEG OFFSET PULL	8190HD 10"	630	IVE
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	PA MOUNTING PLATE	4040XP-18PA (IF REQ'D)	689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 (IF REQ'D)	689	LCN
1	EA	FLOOR STOP	FS444	626	IVE
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	ADJUSTABLE DOOR SWEEP	BY SPECIAL-LITE		SPE
1	EA	THRESHOLD	103A-223	A	ZER
2	EA	WIRE HARNESS	CON X LENGTH REQ'D		SCH
1	EA	DOOR CONTACT	7764	628	SCE
1	EA	POWER SUPPLY	BY SECURITY SYSTEM INTEGRATOR		B/O
1	EA	CARD READER	BY SECURITY SYSTEM INTEGRATOR		
1	EA	WEATHERSTRIP	BY DOOR/FRAME MANUFACTURER		B/O
1	EA	WIRING DIAGRAM	BY SECURITY SYSTEM INTEGRATOR		

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PANIC MAY BE DOGGED (MADE PUSH/PULL) ELECTRONICALLY. WHEN LOCKED, ENTRY BY CARD READER. ALWAYS FREE EGRESS.

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HARDWARE SET: 03

DOOR NUMBER:

126-A 126-B 126-G

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW NRP	630	IVE
1	EA	PANIC HARDWARE	99-EO	626	VON
1	EA	ACCESSORY	LESS DOGGING PLATE	626	VON
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	SET	GASKETING	429AA-S	AA	ZER
1	EA	DOOR SWEEP	8197AA	AA	ZER
1	EA	THRESHOLD	103A-223	A	ZER
1	EA	DOOR CONTACT	679-05 HM/WD AS REQ'D	BLK	SCE
1	EA	MOTION SENSOR	SCANII 12/24 VDC	WHT	SCE
1	EA	WIRING DIAGRAM	BY SECURITY SYSTEM INTEGRATOR		

OPERATION: DOOR CONTACT MONITORS DOOR POSITION.

NOTE: INSTALL WEATHERSTRIP AT FRAME HEAD FIRST, THEN INSTALL CLOSER PA BRACKET ON WEATHERSTRIP.

HARDWARE SET: 04

DOOR NUMBER:

118-A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW	652	IVE
1	EA	FIRE EXIT HARDWARE	99-L-F-06	626	VON
1	EA	RIM HOUSING	20-079	626	SCH
1	EA	FSIC PERM. CORE	23-030 EV29 T	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223	A	ZER

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HARDWARE SET: 05

DOOR NUMBER:

104-B

204-A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW	652	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-99-L-NL-06-CON 24 VDC	626	VON
1	EA	RIM HOUSING	20-079	626	SCH
1	EA	FSIC PERM. CORE	23-030 EV29 T	626	SCH
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA (AT RATED DOORS)	BK	ZER
1	EA	DOOR CONTACT	679-05 HM/WD AS REQ'D	BLK	SCE
1	EA	POWER SUPPLY	BY SECURITY SYSTEM INTEGRATOR		B/O
1	EA	CARD READER	BY SECURITY SYSTEM INTEGRATOR		

HARDWARE SET: 06

DOOR NUMBER:

115-A

119-A

209-A

222-A

223-A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW	652	IVE
1	EA	STOREROOM LOCK	ND80P6D RHO	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

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HARDWARE SET: 07

DOOR NUMBER:

111-A 117-A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW	652	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	EU STOREROOM LOCK	ND80P6DEU RHO RX CON 12V/24V DC	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223	A	ZER
1	EA	DOOR CONTACT	679-05 HM/WD AS REQ'D	BLK	SCE
1	EA	POWER SUPPLY	BY SECURITY SYSTEM INTEGRATOR		B/O
1	EA	CARD READER	BY SECURITY SYSTEM INTEGRATOR		

HARDWARE SET: 08

DOOR NUMBER:

116-A 221-A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW	652	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	EU STOREROOM LOCK	ND80P6DEU RHO RX CON 12V/24V DC	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA (AT RATED DOORS)	BK	ZER
1	EA	DOOR CONTACT	679-05 HM/WD AS REQ'D	BLK	SCE
1	EA	POWER SUPPLY	BY SECURITY SYSTEM INTEGRATOR		B/O
1	EA	CARD READER	BY SECURITY SYSTEM INTEGRATOR		

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HARDWARE SET: 09

DOOR NUMBER:

215-A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW	652	IVE
1	EA	STOREROOM LOCK	ND80P6D RHO	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA (AT RATED DOORS)	BK	ZER
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE SET: 10

DOOR NUMBER:

220-A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050J 06A 09-544 L283-711	626	SCH
1	EA	FSIC PERM. CORE	23-030 EV29 T	626	SCH
1	EA	SURFACE CLOSER	4040XP HCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

HARDWARE SET: 11

DOOR NUMBER:

127-F

216-A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW	652	IVE
1	EA	CLASSROOM LOCK	ND70P6D RHO	626	SCH
1	EA	SURFACE CLOSER	4040XP	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

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HARDWARE SET: 12

DOOR NUMBER:

121-B

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW	652	IVE
1	EA	DBL CYL COMM LOCK	ND72P6 RHO XN12-002	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223	A	ZER

HARDWARE SET: 13

DOOR NUMBER:

113-A

114-A

125-A

205-A

211-A

212-A

219-A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW	652	IVE
1	EA	ENTRANCE LOCK	ND53P6D RHO	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

NOTE: PROVIDE FLOOR STOP IN LIEU OF WALL STOP WHERE REQUIRED.

HARDWARE SET: 14

DOOR NUMBER:

123-A

208-A

210-A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW	652	IVE
1	EA	OFFICE W/SIM RETRACT	L9056J 06A L583-363 L283-722	626	SCH
1	EA	FSIC PERM. CORE	23-030 EV29 T	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

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HARDWARE SET: 15

DOOR NUMBER:

105-A 106-A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	224XY	628	IVE
1	EA	CLASSROOM SEC W/DB	L9457J 06A	626	SCH
2	EA	FSIC PERM. CORE	23-030 EV29 T	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE SET: 16

DOOR NUMBER:

217-A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW	652	IVE
1	EA	PASSAGE SET	ND10S RHO	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE SET: 17

DOOR NUMBER:

100-A 100-B 110-A 110-B

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	MORTISE HOUSING	26-064	626	SCH
1	EA	FSIC PERM. CORE	23-030 EV29 T	626	SCH
1	EA	LOCAL CONTROL SWITCH	BY DOOR MANUFACTURER		

NOTE: BALANCE OF HARDWARE BY DOOR SYSTEM MANUFACTURER. VERIFY CYLINDER TYPE/QUANTITY REQUIRED WITH DOOR MANUFACTURER.

HARDWARE SET: 18

DOOR NUMBER:

121-C 126-F 127-B 127-C 127-D 127-E

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
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NOTE: ALL HARDWARE BY DOOR MANUFACTURER

END OF SECTION 087100

SECTION 088000 - GLAZING**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Glass products.
2. Insulating glass.
3. Glazing sealants.
4. Glazing tapes.
5. Miscellaneous glazing materials.

B. Related Requirements:

1. Section 088300 "Mirrors."
2. Section 088813 "Fire-Rated Glazing."
3. Section 088853 "Security Glazing."

1.2 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

1.3 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.4 PREINSTALLATION MEETINGS**A. 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.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
- C. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch lengths. Install sealant Samples between two strips of material representative in color of adjoining framing system.
- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer manufacturers of fabricated glass units.
- B. Product Certificates: For glass.
- C. Product Test Reports: For fabricated glass and glazing sealants, for tests performed by a qualified testing agency.
 - 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- D. Preconstruction adhesion and compatibility test report.
- E. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

- A. Fabricated-Glass Manufacturer Qualifications: A qualified manufacturer of fabricated glass units who is approved by primary glass manufacturer.
- B. Installer Qualifications: A qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors and who employs glazing technicians certified under the Architectural Glass and Metal Technician (AGMT) certification program.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials in accordance with 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 instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.9 FIELD 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 are below 40 deg F.

1.10 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- C. Manufacturer's Special Warranty for Heat-Soaked Tempered Glass: Manufacturer agrees to replace heat-soaked tempered glass units that spontaneously break due to nickel sulfide (NiS) inclusions at a rate exceeding 0.3 percent (3/1000) within specified warranty period. Coverage for any other cause is excluded.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Source Limitations for Glass: Obtain tinted and coated glass from single source from single manufacturer.
- B. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:
 - 1. Design Wind Pressures: As indicated on Drawings.
 - a. Wind Design Data: As indicated on Drawings.
 - 2. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
 - 3. Thermal Loads: Design glazing to resist thermal stress breakage induced by differential temperature conditions and limited air circulation within individual glass lites and insulated glazing units.
- C. Windborne-Debris-Impact Resistance: Exterior glazing shall pass ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 4 for basic protection.
 - 1. Large-Missile Test: For glazing located within 30 feet of grade.
 - 2. Small-Missile Test: For glazing located between 30 feet and 60 feet above grade.
- D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 - 1. For monolithic-glass lites, properties are based on units with lites 12 mm.
 - 2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.

3. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x deg F.
4. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.
5. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 1. NGA Publications: "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 is indicated, permanently mark glazing with certification label of the SGCC. 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 the IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.
 1. Minimum Glass Thickness for Exterior Lites: 6 mm.
 2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGC Glass Company North America, Inc.
 - b. Cardinal Glass Industries, Inc.
 - c. Guardian Glass LLC.

- d. Pilkington North America; NSG Group.
 - e. Saint-Gobain Glass Corp.
 - f. Vitro Architectural Glass.
- B. Tinted Annealed Float Glass: ASTM C1036, Type I, Class 2 (tinted), Quality-Q3.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGC Glass Company North America, Inc.
 - b. Guardian Glass LLC.
 - c. Pilkington North America; NSG Group.
 - d. Saint-Gobain Glass Corp.
 - e. Vitro Architectural Glass.
- C. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- D. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- E. Reflective- and Low-E-Coated Vision Glass: ASTM C1376.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cardinal Glass Industries, Inc.
 - b. Guardian Glass LLC.
 - c. Pilkington North America; NSG Group.
 - d. Saint-Gobain Glass Corp.
 - e. Vitro Architectural Glass.

2.5 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.
 - 1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
 - 2. Perimeter Spacer: Manufacturer's standard spacer material and construction.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Saint-Gobain Glass Corp.
- 2) Technoform Glass Insulation North America.
- 3) Thermix; a brand of Ensinger USA.

3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.6 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by 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:
 1. EPDM or Silicone with Shore A durometer hardness of 85, plus or minus 5.
 2. Type recommended in writing by sealant or glass manufacturer.
- D. Spacers:
 1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
 2. Type recommended in writing by sealant or glass manufacturer.
- E. Edge Blocks:
 1. EPDM or Silicone with Shore A durometer hardness per manufacturer's written instructions.
 2. Type recommended in writing by sealant or glass manufacturer.
- F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.7 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.
 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

- 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.
 - 3. Minimum required face and edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 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. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. 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.

- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch-minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. 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 in accordance with requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. 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 in writing by gasket manufacturer.

3.4 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 in writing 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 in writing by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.5 CLEANING AND PROTECTION

- A. Immediately after installation, remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. 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.
 - 1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces 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.

3.6 MONOLITHIC GLASS SCHEDULE

- A. Clear Glass Type: Full tempered float glass.
 - 1. Minimum Thickness: 12 mm.
 - 2. Safety glazing required.

3.7 INSULATING GLASS SCHEDULE

- A. Low-E-Coated, Tinted Insulating Glass Type:
 - 1. Basis-of-Design Product: Solarban 60 Solargray.
 - 2. Overall Unit Thickness: 1 inch.
 - 3. Minimum Thickness of Each Glass Lite: 6 mm.
 - 4. Outdoor Lite: Tinted annealed (Fully Tempered when required) float glass.
 - 5. Tint Color: Gray.
 - 6. Interspace Content: Argon.
 - 7. Indoor Lite: Clear annealed (Fully tempered where required) float glass.
 - 8. Low-E Coating: Sputtered on second surface.
 - 9. Winter Nighttime U-Factor: .29 maximum.
 - 10. Summer Daytime U-Factor: .27 maximum.
 - 11. Visible Light Transmittance: 70 percent minimum.
 - 12. SGHC: .45 maximum.
 - 13. Safety glazing required.

END OF SECTION 088000

SECTION 088300 - MIRRORS**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes: Silvered flat glass mirrors.
- B. Related Requirements:
 - 1. Section 102800 "Toilet, Bath, and Laundry Accessories" for metal-framed mirrors.

1.2 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.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of mirror.
- C. Preconstruction Test Reports: From mirror manufacturer indicating that mirror mastic was tested for compatibility and adhesion with mirror backing and substrates on which mirrors are installed.
- D. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For mirrors to include in maintenance manuals.

1.5 QUALITY ASSURANCE**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Protect mirrors in accordance with 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.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS**2.1 SOURCE LIMITATIONS**

- 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - 1. Gilded Mirrors, Inc.
 - 2. National Glass Industries, Inc.
 - 3. Walker Glass Co., Ltd.

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- B. Mirrors, General: ASTM C1503; manufactured using copper-free, low-lead mirror coating process.
- C. Tempered Glass Mirrors: Mirror Glazing Quality for blemish requirements and complying with ASTM C1048 for Kind FT, Condition A, tempered float glass before silver coating is applied; clear.
 - 1. Nominal Thickness: 4.0 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.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C.R. Laurence Co., Inc.; CRH Americas, Inc.
 - b. Liquid Nails; PPG Industries, Inc.
 - c. Pecora Corporation.
- 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. Aluminum J-Channel Bottom and Side Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch in height, respectively, and a thickness of not less than 0.04 inch.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Andscot Company, Inc.
 - 2) C.R. Laurence Co., Inc.; CRH Americas, Inc.
 - 3) Stylmark, Inc.

2. Aluminum J-Channel Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch in height, respectively, and a thickness of not less than 0.04 inch.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Andscot Company, Inc.
 - 2) C.R. Laurence Co., Inc.; CRH Americas, Inc.
 - 3) Stylmark, Inc.
 3. Finish: Clear bright anodized.
- B. Aluminum J-Channels and Cleat: 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. Aluminum J-Channel and Cleat, Bottom and Side Trim: J-channels formed with front leg and back leg not less than 5/16 and 3/4 inch in height, respectively.
 2. Aluminum J-Channel and Cleat, Top Trim: Formed with front leg with a height matching bottom trim and back leg designed to fit into the pocket created by wall-mounted aluminum cleat.
 3. Finish: Clear bright anodized.
- C. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
- D. 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. Shop fabricate mirrors 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.

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 National Glass Association (NGA) publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
 - 1. NGA Publications: "Laminated Glazing Reference Manual," "Glazing Manual" and "Installation Techniques Designed to Prolong the Life of Flat Glass Mirrors."
- B. Provide a minimum airspace of 1/8 inch 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: Provide setting blocks 1/8 inch thick by 4 inches long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch wide by 3/8 inch long at bottom channel.
 - 2. Aluminum J-Channels and Cleat: Fasten J-channel directly to wall and attach top trim to continuous cleat fastened directly to wall.
 - 3. Mirror Clips: Place a felt or plastic pad between mirror and each clip to prevent spalling of mirror edges. Locate clips so they are symmetrically placed and evenly spaced.
 - 4. Install mastic as follows:
 - a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.

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- 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 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 and NGA's publication "Proper Procedures for Cleaning Flat Glass Mirrors."

END OF SECTION 088300

SECTION 088813 - FIRE-RATED GLAZING**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Fire-resistance-rated glazing.

1.2 DEFINITIONS

- A. Fire-Resistance-Rated Glazing: Glazing that prevents spread of fire and smoke and radiant heat and complies with requirements for rated walls and rated openings; capable of blocking radiant heat
- B. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- C. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.

1.3 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product; 12 inches square.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and glass testing agency.
- B. Product Certificates: For each type of glass and glazing product.
- C. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the NGA's Certified Glass Installer Program.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install fire-resistant glazing until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature conditions at occupancy levels during remainder of construction period.

1.9 WARRANTY

- A. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

- 1. Warranty Period: Five years from date of Substantial Completion.

- B. Manufacturer's Special Warranty for Tempered Glazing Units with Clear Intumescent Interlayer: Manufacturer agrees to replace units that deteriorate within specified warranty period. Deterioration of tempered glazing units with clear intumescent interlayer is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning glass contrary to manufacturer's written instructions. Evidence of failure is air bubbles within units, or obstruction of vision by contamination or deterioration of intumescent interlayer.

- 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS**2.1 SOURCE LIMITATIONS**

- A. Glass: For each glass type, obtain from single source from single manufacturer.
- B. Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; deterioration of glazing materials; or other defects in construction.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organization below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or manufacturer. Label shall indicate manufacturer's name, type of glass, glass thickness, and safety glazing standard with which glass complies.

2.4 GLASS PRODUCTS

- A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
 - 1. Construction: Laminate glass with polyvinyl butyral interlayer unless fire-protection or fire-resistance rating is based on another product.
 - 2. Interlayer Thickness: Provide thickness as needed to comply with requirements.
 - 3. Interlayer Color: Clear unless otherwise indicated.

2.5 FIRE-RESISTANCE-RATED GLAZING

- A. General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-resistance ratings indicated, based on testing in accordance with ASTM E119 or UL 263.
- B. Fire-Resistance-Rated Glazing Labeling: Permanently mark fire-resistance-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, that glazing is approved for use in walls, and fire-resistance rating in minutes.
- C. Fire-Resistance-Rated Framing and Doors: Fire-resistance-rated glazing with 60-, 90-, and 120-minute ratings requires framing and doors from glass supplier, tested as an assembly complying with ASTM E119 or UL 263.
- D. Fire-Resistance-Rated Laminated Glass with Intumescent Interlayers: Laminated glass made from multiple plies of uncoated, clear float glass; with intumescent interlayers; complying with 16 CFR 1201, Category II.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. McGrory Glass, Inc.
 - b. Pilkington North America; NSG Group.
 - c. Vetrotech Saint-Gobain.
- E. Fire-Resistance-Rated Tempered Glazing Units with Clear Intumescent Interlayer: Glazing units made from two or more lites of uncoated, fully tempered, clear float glass; with a perimeter edge seal enclosing a cavity filled with optically clear, intumescent polymer; complying with 16 CFR 1201, Category II.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. SAFTI FIRST Fire Rated Glazing Solutions.

2.6 GLAZING ACCESSORIES

- A. Provide glazing gaskets, glazing sealants, glazing tapes, setting blocks, spacers, edge blocks, and other glazing accessories that are compatible with glazing products and each other and are approved by testing agencies that listed and labeled fire-resistant glazing products with which products are used for applications and fire-protection ratings indicated.
- B. Glazing Sealants for Fire-Rated Glazing Products: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.
 1. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.
- C. 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 C1281 and AAMA 800 for products indicated below:
 1. AAMA 804.3 tape, where indicated.
 2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- D. 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 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.

2.7 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- C. Perimeter Insulation for Fire-Resistance-Rated 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.

2.8 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.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with manufacturing and installation tolerances, including those for size, squareness, and offsets at corners, and for compliance with minimum required face and edge clearances.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate fire side and protected side. Label or mark units as needed so that fire side and protected side are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

- A. Use methods approved by testing agencies that listed and labeled fire-resistant glazing products.

- B. 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.
- 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.
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch-minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- 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 in accordance with requirements in referenced glazing publications.
- I. Set glass lites with proper orientation so that coatings face fire side or protected side as specified.
- J. 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.
- K. 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 in writing by gasket manufacturer.

3.4 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.

3.5 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.
- D. Install gaskets so they protrude past face of glazing stops.

3.6 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. 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.

3.7 CLEANING AND PROTECTION

- A. Immediately after installation, remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. 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.

1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces 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 088813

SECTION 088853 - SECURITY GLAZING**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes:
 - 1. Laminated-glass security glazing
- B. Related Requirements:
 - 1. Section 085653 "Security Windows."

1.2 DEFINITIONS

- A. Glazing Manufacturers: Firms that produce primary glass, monolithic plastic glazing, or fabricated security glazing, as defined in referenced glazing publications.

1.3 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on security glazing, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Security Glazing Schedule: List security glazing types and thicknesses for each size opening and location. Use same designations indicated on Drawings. Indicate coordinated dimensions of security glazing and construction that receives security glazing, including clearances and glazing channel dimensions.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Statements: For installers.
- B. Sample warranties.

1.6 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installers: Fabricator of products.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect security glazing and glazing materials according to manufacturer's written instructions. Prevent damage from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating security glazing and with air-gap security glazing manufacturers' written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.8 FIELD 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.

1.9 WARRANTY

- A. Special Warranty, Laminated-Glass Security Glazing: Manufacturer agrees to replace laminated-glass security glazing that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated-glass security glazing contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
 - 2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS**2.1 SOURCE LIMITATIONS**

- A. Obtain each type of security glazing from single source from single manufacturer.
 - 1. Obtain glass from single source from single manufacturer.
- B. Obtain glazing sealants and gaskets from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS**A. General:**

1. Installed security glazing will withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
2. Installed security glazing will withstand security-related loads and forces without damage to the glazing beyond that allowed by referenced standards.

B. Structural Performance: Glazing will withstand the following design loads within limits and under conditions indicated.

1. Design Procedure for Glass: ASTM E1300 and the IBC.
2. Design Wind Pressures: As indicated on Drawings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.**D. Temperature Change:** 120 deg F, ambient; 180 deg F, material surfaces.**E. Windborne-Debris Impact Resistance:** Exterior security glazing passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 4 for basic protection.

1. Large-Missile Test: For glazing located within 30 feet of grade.
2. Small-Missile Test: For glazing located between 30 feet and 60 feet above grade.

F. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.**2.3 SECURITY GLAZING, GENERAL****A. Glazing Publications:** Comply with published recommendations of security glazing and glazing material 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. AAMA Publications: AAMA GDSG-1 and AAMA TIR-A7.
2. NGA Publications: "Laminated Glazing Reference Manual" and "GANA Glazing Manual."

B. Plastic Glazing Labeling: Identify plastic sheets with appropriate markings of applicable testing and inspecting agency, indicating compliance with required fire-test-response characteristics.**C. Safety Glazing Labeling:** Where safety glazing is indicated, permanently mark glazing with certification label of the Safety Glazing Certification Council or manufacturer. Label will indicate manufacturer's name, type of glazing, glass thickness, and safety glazing standard with which glazing complies.

- D. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- E. Fire-Test-Response Characteristics of Polycarbonate Sheets: As determined by testing polycarbonate sheets identical to those used in security glazing products by a qualified testing agency acceptable to authorities having jurisdiction.
 - 1. Self-ignition temperature of 650 deg F or more when tested in accordance with ASTM D1929 on plastic sheets in thicknesses indicated for the Work.
 - 2. Smoke-Developed Index of 450 or less when tested in accordance with ASTM E84 or UL 723, or smoke density of 75 or less when tested in accordance with ASTM D2843 on plastic sheets in thicknesses indicated for the Work.
 - 3. Burning extent of 1 inch or less when tested in accordance with ASTM D635 at a nominal thickness of 0.060 inch or thickness indicated for the Work.
- F. Thermal and Optical Performance Properties: Provide security glazing with performance properties specified, as indicated in manufacturer's published test data, based on construction products indicated and on procedures indicated below:
 - 1. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x deg F.
 - 2. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW 7.7 computer program.
 - 3. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

2.4 LAMINATED-GLASS SECURITY GLAZING

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. School Guard Glass – SG4
 - 2. **Global Security Glazing - Childguard**
- B. Laminated-Glass Security Glazing: ASTM C1172. Two or more glass lites bonded with interlayer. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
 - 1. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
 - 2. Interlayer Color: Clear unless otherwise indicated.

2.5 SPALL-RESISTANT FILM

- A. Composite of clear polyvinyl butyral film and clear abrasion-resistant polyester film.
- B. Laminating Process: Factory laminate spall-resistant film to glazing assemblies to produce laminated lites free of foreign substances, air, and glass pockets.

2.6 GLAZING SEALANTS**A. General:**

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they contact, including security glazing, seals of insulating security glazing and air-gap security glazing, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and security glazing manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of Industry colors.

B. Glazing Sealant:

1. Neutral-Curing Silicone Glazing Sealant, Class 50: Complying with ASTM C920, Type S, Grade NS, Use NT.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Pecora Corporation.
 - 2) Sika Corporation.
 - 3) Tremco Incorporated.

2.7 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 security glazing manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
2. 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.

2.8 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of security glazing 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:
 - 1. EPDM or Silicone with Shore A durometer hardness of 85, plus or minus 5.
 - 2. Type recommended in writing by sealant or glass manufacturer.
- D. Spacers:
 - 1. Neoprene blocks or continuous extrusions of hardness required by security glazing manufacturer to maintain security glazing lites in place for installation indicated.
 - 2. Type recommended in writing by sealant or security glazing manufacturer.
- E. Edge Blocks:
 - 1. EPDM or Silicone with Shore A durometer hardness in accordance with manufacturer's written instructions.
 - 2. Type recommended in writing by sealant or security glazing manufacturer.
- F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.9 FABRICATION OF SECURITY GLAZING

- A. Fabricate security glazing 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. Grind smooth and polish exposed security glazing edges and corners.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine framing for security glazing, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep system.

3. Minimum required face or edge clearances.
4. Minimum required bite.
5. Effective sealing between joints of framing members.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving security glazing immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of security glazing, sealants, gaskets, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect edges of security glazing from damage during handling and installation. Remove damaged security glazing from Project site and legally dispose of it off Project site. Damaged security glazing includes units with edge or face damage or other imperfections that, when installed, could weaken security glazing and impair performance and appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications unless otherwise required by glazing unit manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by security glazing manufacturers for installing lites.
- F. Provide spacers for security glazing lites where the length plus width is larger than 50 inches.
1. Locate spacers directly opposite each other on both inside and outside faces of security glazing. Install correct size and spacing to preserve required face clearances unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with performance requirements.
 2. Provide 1/8-inch minimum bite of spacers on glazing lites and use thickness equal to sealant width. With glazing tape, use thickness of slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent security glazing from moving sideways in glazing channel, as recommended in writing by security glazing manufacturer and in accordance with requirements in referenced glazing publications.

- H. Set security glazing in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set coated security glazing with proper orientation so that coatings and films face exterior or interior as specified.
- J. 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.
- K. 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 in writing by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by security glazing, 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 just before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center security glazing 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.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended in writing by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glazing unit 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 security glazing 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 security glazing. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

- D. Installation with Pressure-Glazing Stops: Center security glazing 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 security glazing. Seal gasket joints with sealant recommended in writing by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.6 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect security glazing from contact with contaminating substances resulting from construction operations, including weld splatter. Examine security glazing 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.
 - 1. If, despite such protection, contaminating substances do contact with security glazing, remove substances immediately as recommended in writing by security glazing manufacturer. Remove and replace security glazing that cannot be cleaned without damage.
- C. Wash security glazing on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash security glazing as recommended in writing by security glazing manufacturer.

3.7 LAMINATED-GLASS SECURITY GLAZING SCHEDULE

- A. Security Glazing: Clear laminated glass.
 - 1. Basis-of-Design Product: School Guard Glass – SG4
 - 2. Forced-Entry Resistance, ASTM F1233: Class 1.0 in accordance with ASTM F1233.
 - 3. Forced-Entry Resistance, HPW-TP-0500.03: Level I in accordance with HPW-TP-0500.03.
 - 4. Ballistic Resistance, ASTM F1233: Class HG1 in accordance with ASTM F1233.
 - 5. Ballistic Resistance, UL 752: Level 1 in accordance with UL 752.
 - 6. Maximum Overall Unit Thickness: ½”.
 - 7. Provide safety glazing labeling.
- B. Security Glazing: Tinted laminated glass with clear glass and tinted interlayer.
 - 1. Basis-of-Design Product: School Guard Glass – SG4
 - 2. Forced-Entry Resistance, ASTM F1233: Class 1.0 in accordance with ASTM F1233.
 - 3. Forced-Entry Resistance, HPW-TP-0500.03: Level I in accordance with HPW-TP-0500.03.

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4. Ballistic Resistance, ASTM F1233: Class HG1 in accordance with ASTM F1233.
5. Maximum Overall Unit Thickness: ½”.
6. Basis-of-Design Product: Solarban 60 Solargray.
7. Outdoor Lite: Tinted annealed (Fully Tempered when required) float glass.
8. Tint Color: Gray.
9. Indoor Lite: Clear annealed (Fully tempered where required) float glass.
10. Low-E Coating: Sputtered on second surface.
11. Winter Nighttime U-Factor: .29 maximum.
12. Summer Daytime U-Factor: .27 maximum.
13. Visible Light Transmittance: 70 percent minimum.
14. SGHC: .45 maximum.
15. Safety glazing required.

END OF SECTION 088853

SECTION 092216 - NON-STRUCTURAL METAL FRAMING**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Framing systems.
2. Suspension systems.
3. Grid suspension systems.

B. Related Requirements:

1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; and roof rafters and ceiling joists.

1.2 ACTION SUBMITTALS**A. Product Data:**

1. Framing systems.
2. Suspension systems.
3. Grid suspension systems.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.
- B. Evaluation Reports: For embossed, high-strength steel studs and tracks firestop tracks post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.4 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to one of the product-certification program of: the Certified Steel Stud Association, the Steel Framing Industry Association, the Steel Stud Manufacturers Association or the Supreme Steel Framing System Association.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Notify manufacturer of damaged materials received prior to installation.

- B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, in accordance with ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.
- C. Horizontal Deflection: For composite wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft..
- D. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members," unless otherwise indicated.
- E. Design Loads: As indicated on architectural Drawings or 5 lbf/sq. ft. minimum as required by the IBC.
- F. Design framing systems to accommodate deflection of primary building structure and construction tolerances and to withstand design loads with a maximum deflection imposed on it.

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with AISI S220 for conditions indicated.
 - 1. Steel Sheet Components: Comply with AISI S220 requirements for metal unless otherwise indicated
 - 2. Protective Coating: Comply with AISI S220; ASTM A653/A653M, G40; or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.
 - a. Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.
- B. Studs and Track: AISI S220.
 - 1. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection.

2. Depth: As indicated on Drawings.
- C. High-Strength Steel Studs and Tracks: Roll-formed with surface deformations to stiffen the framing members.
 1. Minimum Base-Steel Thickness: As required by horizontal deflection performance requirements.
 2. Depth: As indicated on Drawings.
- D. Slip-Type Head Joints: Where indicated, provide the following:
 1. Double-Track System: Top outer tracks, inside track with 2-inch-deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
 2. Deflection Track: Steel sheet top track 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.
- E. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 1. Minimum Base-Steel Thickness: As indicated on Drawings.
- G. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-steel thickness, with minimum 1/2-inch-wide flanges.
 1. Depth: 1-1/2 inches.
 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.
- H. Hat-Shaped, Rigid Furring Channels:
 1. Minimum Base-Steel Thickness: 0.0179 inch.
 2. Depth: As indicated on Drawings.
- I. Resilient Furring Channels: 1/2-inch-deep, steel sheet members designed to reduce sound transmission.
 1. Configuration: Asymmetrical.
- J. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.
 1. Depth: 3/4 inch.
 2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch.
 3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

- K. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 3/4 inch, minimum uncoated-steel thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.
- B. Hanger Attachments to Concrete:
- C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- D. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.
- E. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.
 - 1. Depth: 2-1/2 inches.
- F. Furring Channels (Furring Members):
 - 1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
 - 2. Steel Studs and Tracks:
 - a. Minimum Base-Steel Thickness: 0.0179 inch.
 - b. Depth: As indicated on Drawings.
 - 3. High-Strength Steel Studs and Tracks:
 - a. Minimum Base-Steel Thickness: 0.0147 inch.
 - b. Depth: As indicated on Drawings.
 - 4. Hat-Shaped, Rigid Furring Channels: 7/8 inch deep.
 - a. Minimum Base-Steel Thickness: As indicated on Drawings.
 - 5. Resilient Furring Channels: 1/2-inch-deep members designed to reduce sound transmission.
 - a. Configuration: Asymmetrical or hat shaped.

2.4 GRID SUSPENSION SYSTEMS

- A. Grid Suspension Systems for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.

2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Steel 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 the following:
 - 1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch 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 C754.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLATION OF FRAMING SYSTEMS

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- 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 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 that penetrate 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 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 clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
 - 6. Curved Partitions:
 - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.
- 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 o.c.

F. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.**3.5 INSTALLATION OF 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 o.c.
2. Carrying Channels (Main Runners): 48 inches o.c.
3. Furring Channels (Furring Members): 16 inches 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, countersplaying, 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.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
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. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for

structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.

5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

3.6 INSTALLATION OF GRID SUSPENSION SYSTEMS

- A. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

3.7 FIELD QUALITY CONTROL

- A. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Interior gypsum board.
2. Tile backing panels.

B. Related Requirements:

1. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
2. Section 079219 "Acoustical Joint Sealants" for acoustical joint sealants installed in gypsum board assemblies.
3. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.
4. Section 093013 "Ceramic Tiling" for cementitious backer units installed as substrates for ceramic tile.

1.2 ACTION SUBMITTALS**A. Product Data: For the following:**

1. Gypsum wallboard.
2. Gypsum board, Type X.
3. Glass-mat interior gypsum board.
4. Water-resistant gypsum backing board.
5. Joint treatment materials.
6. Sound-attenuation blankets.
7. Acoustical sealant.

B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.**1.3 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.****1.4 FIELD CONDITIONS****A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, 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, 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 blotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of gypsum panel and joint finishing material from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.
- C. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Wallboard: ASTM C1396/C1396M.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Gypsum.
 - b. Georgia-Pacific Gypsum LLC.
 - c. USG Corporation.
 - 2. Thickness: 5/8 inch.
 - 3. Long Edges: Tapered.
- B. Gypsum Board, Type X: ASTM C1396/C1396M.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Gypsum.

- b. Georgia-Pacific Gypsum LLC.
 - c. USG Corporation.
- 2. Thickness: 5/8 inch.
 - 3. Long Edges: Tapered.

2.4 TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN.
 - b. Georgia-Pacific Gypsum LLC.
 - c. USG Corporation.
 - 2. Core: 5/8 inch, Type X.
 - 3. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.
- B. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Custom Building Products.
 - b. PermaBASE Building Products, LLC provided by National Gypsum Company.
 - c. USG Corporation.
 - 2. Thickness: 5/8 inch.
 - 3. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.
- C. Water-Resistant Gypsum Backing Board: ASTM C1396/C1396M, with manufacturer's standard edges.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Gypsum.
 - b. Georgia-Pacific Gypsum LLC.
 - c. USG Corporation.
 - 2. Core: 5/8 inch, Type X.

2.5 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. L-Bead: L-shaped; exposed long flange receives joint compound.
 - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - e. Base-of-Wall Galvanized Moisture Barrier Trim: Galvanized-steel sheet, 2 inches high.
 - 1) Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a) VersaDry, LLC.
 - f. Base-of-Wall PVC Moisture Barrier Trim: Extruded PVC, 1/2 inch high.
 - 1) Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a) Waterguard.
- B. Exterior Trim: ASTM C1047.
1. Material: Hot-dip galvanized-steel sheet, plastic, or rolled zinc.
 2. Shapes:
 - a. Cornerbead.
 - 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.
- C. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fry Reglet Corporation.
 - b. Gordon Inc.
 - c. Tamlyn.
 2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B221, Alloy 6063-T5.
 3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.

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.
4. Tile Backing Panels: As recommended by panel manufacturer.

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.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

D. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
2. Cementitious Backer Units: As recommended by backer unit manufacturer.
3. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

2.7 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound-Attenuation Blankets: ASTM C665, 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.
- E. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

- F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

2.8 TEXTURE FINISHES

- A. Primer: As recommended by textured finish manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- 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.

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C840.
- 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 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. 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-wide joints to install sealant.

- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-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. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. 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 C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Wallboard Type: As indicated on Drawings.
 - 2. Type X: As indicated on Drawings.
 - 3. Glass-Mat Interior Type: As indicated on Drawings.
- 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 vertically (parallel 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-shaped 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 Z-shaped 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.
 - 2. Fastening Methods: Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners.

3.4 INSTALLATION OF TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at showers, tubs, and where indicated on Drawings locations indicated to receive tile. Install with 1/4-inch gap where panels abut other construction or penetrations.

3.5 INSTALLATION OF 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 in accordance with ASTM C840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners.
 - 2. LC-Bead: Use at exposed panel edges.
 - 3. U-Bead: Use at exposed panel edges.
 - 4. Curved-Edge Cornerbead: Use at curved openings.

3.6 FINISHING OF 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 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 in accordance with ASTM C840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Panels that are substrate for tile.
 - 3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.
- F. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.
- G. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 APPLICATION OF 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 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 instructions.

3.8 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 SUMMARY**

- A. Section Includes:
 - 1. Ceramic mosaic tile.
 - 2. Tile backing panels.
 - 3. Waterproof membranes.
 - 4. Setting material.
 - 5. Grout materials.
- B. Related Requirements:
 - 1. Section 079200 "Joint Sealants" for sealing of movement joints in tile surfaces.
 - 2. Section 092900 "Gypsum Board" for tile backing panels.

1.2 DEFINITIONS

- A. General: Definitions in ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. Face Size: Actual tile size, excluding spacer lugs.
- C. Large Format Tile: Tile with at least one edge 15 inches or longer.
- D. Module Size: Actual tile size plus joint width indicated.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Ceramic mosaic tile.
 - 2. Tile backing panels.
 - 3. Waterproof membranes.
 - 4. Setting material.
 - 5. Grout materials.
- B. Shop Drawings: Show locations, plans, and elevations, of each type of tile and tile pattern. Show widths, details, and locations of movement joints in tile substrates and finished tile surfaces.
- C. Samples for Verification:
 - 1. Full-size units of each type and composition of tile and for each color and finish required.
 - 2. Full-size units of each type of trim and accessory.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of product, including product use classification.
- C. Product Test Reports:
 - 1. Tile-setting and -grouting products.
 - 2. Certified porcelain tile.
 - 3. Slip-resistance test reports from qualified independent testing agency.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
 - 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.6 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.

1.7 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" Article in the Evaluations and manufacturer's written instructions.

1.8 WARRANTY

- A. System Warranty: Manufacturer's non-prorated comprehensive warranty that agrees to repair and replace defective installation areas, material, and labor that fail under normal usage within specified warranty period.

1. Warranty Period: 25 years from date of Product Purchase.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Tile: Obtain tile of each type 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. Tiling System: Obtain system products 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.
 2. Obtain underlayment from manufacturer of setting and grouting materials.
 3. Obtain waterproof membrane, crack isolation, and other required membranes from manufacturer of setting and grouting materials.
 4. Obtain joint sealants from manufacturer of setting and grouting materials.
- C. Accessory Products: Obtain each of the following products specified in this Section from a single manufacturer:
 1. Backer units.

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.
- 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.

- E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.3 PORCELAIN TILE

A. Porcelain Tile Type: Glazed.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Olean; Division of Dal-Tile International Inc.
 - b. Crossville, Inc.
 - c. Daltile; Division of Dal-Tile International Inc.
 - d. Anatolia
2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: Per the drawings.
4. Face Size Variation: Rectified.
5. Thickness: 3/8 inch.
6. Product Use Classification: Interior, Wet (IW).
7. Tile Color, Glaze, and Pattern: Per the drawings.
8. Grout Color: Per the drawings.
9. 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. Base Cap: Surface bullnose, module size same as adjoining flat tile Insert size.

2.4 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges in maximum lengths available to minimize end-to-end butt joints.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. C-Cure; C-Cure Board 990.
 - b. Custom Building Products; Wonderboard.
 - c. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
 - d. USG Corporation; DUROCK Cement Board.
 2. Thickness: 5/8 inch.
 3. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.
- B. Water-Resistant Gypsum Backing Board: ASTM C1396/C1396M, with manufacturer's standard edges. Gypsum backing board is not permitted for use as a backing board for tile shower areas or as wall board or ceiling panels in shower areas.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Gypsum.
 - b. Georgia-Pacific Gypsum LLC.
 - c. USG Corporation.
 2. Core: As indicated on Drawings.
- C. Glass-Mat, Water-Resistant Gypsum Panel: ASTM C1658/C1658M, with fiberglass mat partially or completely embedded into the core.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Gypsum.
 - b. Georgia-Pacific Gypsum LLC.
 - c. USG Corporation.
 2. Core: As indicated on Drawings.
 3. Long Edges: Tapered.
 4. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

2.5 WATERPROOF MEMBRANES

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and ANSI A118.12 and is recommended by manufacturer for application indicated. Include reinforcement and accessories recommended by manufacturer.
- A. PVC Sheet: Two layers of PVC sheet heat-fused together and to facings of nonwoven polyester; Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; 0.008-inch nominal thickness.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Schluter Systems L.P.; KERDI.
- A. Latex-Portland Cement: Flexible mortar consisting of cement-based mix and latex additive.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Boiardi Products; a QEP company; Elastiment 323 Cement Based Waterproofing, Anti-Fracture/Crack Suppression Membrane.
 - b. C-Cure; UltraCure 971.
 - c. MAPEI Corporation; Mapelastic (PRP 315).
 - d. Southern Grouts & Mortars, Inc.; Southcrete 1100.
 - e. TEC; a subsidiary of H. B. Fuller Company; Triple Flex Waterproofing, Crack Isolation Membrane & Mortar.

2.6 CRACK ISOLATION MEMBRANES

- A. General: Manufacturer's standard product that complies with ANSI A118.12 for standard performance and is recommended by manufacturer for application indicated. Include reinforcement and accessories recommended by manufacturer.

2.7 SETTING MATERIALS

- A. Modified Dry-Set Mortar (Thinset): ANSI A118.4.
 - 1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
 - 2. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.
 - 3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to other requirements in ANSI A118.4.

2.8 GROUT MATERIALS

- A. Standard Cement Grout: ANSI A118.6.
- B. High-Performance Tile Grout: ANSI A118.7.
 - 1. Polymer Type:
 - a. Dry, redispersible form, prepackaged with other dry ingredients.
 - b. Liquid-latex form for addition to prepackaged dry-grout mix.

2.9 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting and adhesive materials for installations indicated.
- B. Vapor-Retarder Membrane: Polyethylene sheeting, ASTM D4397, 4.0 mils thick.
- C. Metal Flooring Transitions: Profile designed specifically for flooring applications; height to match tile and setting-bed thickness.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Blanke Corporation.
 - b. Ceramic Tool Company, Inc.
 - c. Schluter Systems L.P.
 - 2. Description: L-shaped or Square Insert profile.
 - 3. Material and Finish: Metallic or combination of metal and PVC or neoprene base; per the drawings exposed-edge material.

- A. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Blanke Corporation.
 - b. Ceramic Tool Company, Inc.
 - c. Schluter Systems L.P.
- B. 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.
- C. Grout Sealer: Grout manufacturer's standard product for sealing grout joints that does not change color or appearance of grout.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Bonsal American, an Oldcastle company; Grout Sealer.
 - b. Custom Building Products; Surfaceguard Sealer.
 - c. Jamo Inc.; Surfaceguard Sealer.
 - d. Southern Grouts & Mortars, Inc.; Clear Penetrating Sealer & Grout Release.
 - e. Summitville Tiles, Inc.; SL-15, Invisible Seal.
 - f. TEC, H. B. Fuller Construction Products Inc.; Grout Guard Penetrating Grout Sealer.

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 thinset mortar 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. Remove coatings, including curing compounds or other coatings, that are incompatible with tile-setting materials.
- B. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- C. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1 and is sloped 1/4 inch per foot toward drains.
- D. 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.
- E. Substrate Flatness:
 1. For tile shorter than 15 inches, confirm that structure or substrate is limited to variation of 1/4 inch in 10 ft. from the required plane, and no more than 1/16 inch in 12 inches when measured from tile surface high points.
 2. For large format tile, tile with at least one edge 15 inches or longer, confirm that structure or substrate is limited to 1/8 inch in 10 ft. from the required plane, and no more than 1/16 inch in 24 inches when measured from tile surface high points.
- F. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 INSTALLATION OF CERAMIC TILE SYSTEM

- A. Install tile backing panels and treat joints in accordance with ANSI A108.11 and manufacturer's written instructions for type of application indicated.
- B. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
 1. Allow waterproof membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.

- C. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.
 - 1. Allow crack isolation membrane to cure before installing tile or setting materials over it.
- D. Mix mortars and grouts to comply with "Referenced Standards" Article in the Evaluations and mortar and grout manufacturers' written instructions.
 - 1. Add materials, water, and additives in accurate proportions.
 - 2. 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.
- E. Install tile in accordance with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of ANSI A108 series that are referenced in TCNA installation methods and specified in tile installation schedules, and apply to types of setting and grouting materials used.
 - 1. For the following installations, follow procedures in ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Exterior tile floors and walls.
 - b. Tile floors in wet areas.
 - c. Tile swimming pool decks.
 - d. Tile floors in laundries.
 - e. Tile floors consisting of tiles 8 by 8 inches or larger.
 - f. Tile floors consisting of rib-backed tiles.
 - 2. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
 - 3. 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.
 - 4. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
 - 5. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
 - 6. 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 use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - a. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets, so joints between sheets are not apparent in finished Work.
 - b. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 - c. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

7. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

F. **Movement Joints:** Provide movement joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated on Drawings. Form joints during installation of setting materials, mortar beds, and tile. Keep joints free of dirt, debris, and setting materials prior to filling with sealants. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

G. **Metal Flooring Transitions:** Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.

H. **Metal Wall Trim:** Install at locations indicated on Drawings.

I. **Grout Sealer:** Apply grout sealer to grout joints in tile floors in accordance with manufacturer's written instructions. As soon as sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

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 in accordance with tile and grout manufacturer's written instructions. 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 Floor Installations, Concrete Subfloor:**

1. TCNA F125-Full CT-1, CT-4: Thinset mortar on crack isolation membrane.
 - a. Ceramic Tile Type: CT-1, CT-4.
 - b. Thinset Mortar: Modified dry-set mortar.
 - c. Grout: Standard unsanded cement grout.
 - d. Crack Isolation Membrane: As recommended by setting material manufacturer.
 - e. Joint Width: 1/8 inch.
 - f. Movement Joints: Types located on Drawings.

B. Interior Wall Installations, Wood or Metal Studs or Furring:

1. TCNA W245 CT-2, CT-3, CT-5: Thinset mortar on glass-mat, water-resistant gypsum backer board.
 - a. Ceramic Tile Type: CT-2, CT-3, CT-5.
 - b. Thinset Mortar: Modified dry-set mortar.
 - c. Grout: Standard unsanded cement grout.
 - d. Waterproof Membrane: As recommended by setting material manufacturer.
 - e. Joint Width: 1/8 inch 3/16 inch 1/4 inch 3/8 inch Insert width.
 - f. Movement Joints: Types located on Drawings.

SECTION 095113 - ACOUSTICAL PANEL CEILINGS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Acoustical panels.
2. Metal suspension system.
3. Metal edge moldings and trim.

B. Related Requirements:

- C. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.2 ACTION SUBMITTALS**A. Product Data:**

1. Acoustical panels.
2. Metal suspension system.
3. Metal edge moldings and trim.

- B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

- C. Samples for Initial Selection: For components with factory-applied finishes.

- D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Panels: Set of 6-inch-square Insert size Samples of each type, color, pattern, and texture.
2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- long Samples of each type, finish, and color.

1.3 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. Ceiling suspension-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.

4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical panels.
6. Items penetrating finished ceiling and ceiling-mounted items including the following for wood panel ceiling type CLG-5:
 - a. Lighting fixtures.
 - b. Diffusers.
 - c. Grilles.
 - d. Speakers.
 - e. Sprinklers.
 - f. Access panels.
 - g. Perimeter moldings.
7. Minimum Drawing Scale: 1/4 inch = 1 foot.

B. Qualification Data: For testing agency.

C. Product Test Reports: For each acoustical panel ceiling, for tests performed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.5 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. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
3. Hold-Down Clips: Equal to 2 percent of quantity installed.
4. Impact Clips: Equal to 2 percent of quantity installed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
 - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 - PRODUCTS**2.1 SOURCE LIMITATIONS**

- A. Source Limitations for Ceiling System: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Class A B C in accordance with ASTM E1264.
 - 2. Smoke-Developed Index: 50 or less.
- B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL or from the listings of another qualified testing agency.

2.3 ACOUSTICAL PANELS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Armstrong Ceiling & Wall Solutions.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels in accordance with ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- C. Color: As indicated on Drawings.
- D. Light Reflectance (LR): Not less than 0.85.
- E. Ceiling Attenuation Class (CAC): Not less than 25.
- F. Noise Reduction Coefficient (NRC): Not less than 0.95.

- G. Articulation Class (AC): Not less than 190.
- H. Edge/Joint Detail: As indicated by manufacturer's designation.
- I. Thickness:
 - 1. 5/8 inch.
- J. Modular Size: As indicated on Drawings.
- K. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested in accordance with ASTM D3273, ASTM D3274, or ASTM G21 and evaluated in accordance with ASTM D3274 or ASTM G21.

2.4 METAL SUSPENSION SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armstrong Ceiling & Wall Solutions.
 - 2. CertainTeed; SAINT-GOBAIN.
 - 3. USG Corporation.
- B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories in accordance with ASTM C635/C635M and designated by type, structural classification, and finish indicated.
 - 1. High-Humidity Finish: Where indicated, provide coating tested and classified for "severe environment performance" in accordance with ASTM C635/C635M.
- C. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 15/16-inch-wide metal caps on flanges.
 - 1. Structural Classification: Intermediate-duty system.
 - 2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
 - 3. Face Design: Flat, flush.
 - 4. Cap Material: Cold-rolled steel or aluminum.
 - 5. Cap Finish: Painted to match color indicated by manufacturer's designation.

2.5 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
 - 2. Stainless Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.

3. Nickel-Copper-Alloy Wire: ASTM B164, nickel-copper-alloy UNS No. N04400.
 4. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- diameter wire.
- C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- E. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.
- F. Hold-Down Clips: Manufacturer's standard hold-down.
- G. Impact Clips: Manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

2.6 METAL EDGE MOLDINGS AND TRIM

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Armstrong Ceiling & Wall Solutions.
- B. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.
1. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils. Comply with ASTM C635/C635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.7 ACOUSTICAL SEALANT

- A. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION OF ACOUSTICAL PANEL CEILINGS

- A. Install acoustical panel ceilings in accordance with ASTM C636/C636M and manufacturer's written instructions.
 - 1. Fire-Rated Assembly: Install fire-rated ceiling systems in accordance with tested fire-rated design.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 7. Do not attach hangers to steel deck tabs.
 - 8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 9. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 - 10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 - 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
 - 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
 - 1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 - 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 - 3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 - 4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
 - 5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 - 6. Install hold-down clips in areas as required; space in accordance with panel manufacturer's written instructions unless otherwise indicated.
 - a. Hold-Down Clips: Space 24 inches o.c. on all cross runners.

3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet Insert dimensions, non-cumulative.

3.5 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 095426 - SUSPENDED WOOD CEILINGS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Solid-wood, linear-panel ceilings.

1.2 DEFINITIONS**A. NRC: Noise Reduction Coefficient.****1.3 COORDINATION**

- A. Coordinate layout and installation of wood ceilings and suspension systems with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.4 ACTION SUBMITTALS**A. Product Data: For each type of product.**

1. Solid-wood, linear-panel ceilings.

B. Shop Drawings: For suspended wood ceilings.

1. Include reflected ceiling plans, sections, and details, drawn to scale, showing the following:
 - a. Wood ceiling patterns and joints.
 - b. Ceiling suspension members.
 - c. Method of attaching hangers to building structure and locations of cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
 - d. Ceiling-mounted items including, but not limited to, light fixtures, diffusers, grilles, speakers, sprinklers, and access panels.
 - e. Ceiling perimeter and penetrations through ceiling; trim and moldings.

C. Samples: For each exposed product and for each type, color, and finish specified, 12 inches long by 12 inches wide or full width in size.**D. Samples for Verification: For the following products:**

1. Wood Ceilings: 12-inch-long by 12-inch-wide or full-width Samples of each type, color, and finish.
2. Veneer Edge Banding: Applied to a cut end of a wood-ceiling Sample for each type, color, and finish.
3. Filler Strips: 12-inch-long Samples of each type, color, and finish.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 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. Suspended-Wood-Ceiling Components: Quantity of each wood-ceiling unit, suspension-system component, accessory, and exposed molding and trim equal to 2 percent of quantity installed.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ceiling components and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they are protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
 1. Store materials flat and level, raised from the floor.
- B. Handle ceiling components and accessories in a manner that prevents damage.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install interior ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
 1. Store and acclimatize wood products in the spaces where they will be installed for a minimum of 72 hours immediately before ceiling installation.

PART 2 - PRODUCTS**2.1 SOLID-WOOD, LINEAR-PANEL CEILINGS**

- A. Solid-Wood Linear Ceiling Panels: Manufacturer's standard linear panels fabricated from kiln-dried solid-wood planks free of knots and without finger joints, cracks, checks, or warp. Planks run parallel to panel length.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Armstrong World Industries, Inc. Woodworks 8177 W1
 2. Plank Species: Poplar.
 3. Plank Cut: Manufacturer's standard.
 4. Plank Width: 5 1/4 inches.
 5. Plank Depth: 3/4 inch.
 6. Plank Length: 96 inches nominal; 95 inches actual with 1inch reveal panel to panel @ lengths.
 7. Plank Edges: Square.
 8. Reveal/Plank Spacing: Equal spacing between long edges of planks.
 9. Backing Boards: Manufacturer's standard, 1/2-inch-thick solid-wood boards or HPVA HP-1 hardwood plywood.
 10. Panel Module: 12 by 96 by 1-1/4 inches.
 11. Panel Attachment: Provide black, zinc-aluminum coated steel sheet metal screws recommended in manufacturer's written installation instructions through factory pre-drilled holes in backing boards for attaching panels to grid suspension system, spaced to support ceiling and in accordance with manufacturer's written installation instructions.
 12. Factory Finish: Manufacturer's standard interior finish; applied on every wood surface.
 - a. Surface-Burning Characteristics: Provide manufacturer's standard intumescent finish system with the following characteristics when tested in accordance with ASTM E84:
 - 1) Flame-Spread Index: 25 or less.
 - 2) Smoke-Developed Index: 450 or less.
 - b. Plank Finish: Clear.
 - c. Plank Stain: Per the drawings.
 - d. Plank Gloss: Manufacturer's standard.
 - e. Backing Board Gloss and Color: Flat black.
- B. Linear-Ceiling-Panel Accessories: Linear-ceiling-panel manufacturer's accessories required to provide a complete installation of ceiling in accordance with manufacturer's written installation instructions.
1. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements

- a. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils. Comply with ASTM C635/C635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
- C. Grid Suspension System: ASTM C635/C635M; recommended in writing by ceiling and suspension-system manufacturers for applications indicated; main- and cross-runner system complete with suspension-system components required to support ceiling units and other ceiling-supported construction.
 1. Material: ASTM A653/A653M, hot-dip galvanized, cold-rolled sheet steel, G60 coating designation ASTM A653/A653M, hot-dip galvanized, cold-rolled sheet steel, G60 coating designation with ASTM B209 aluminum cap.
 2. Structural Classification: Heavy-duty system.
 3. Face Width: 15/16 inch.
 4. Finish: Flat black.

2.2 SUSPENSION-SYSTEM HANGERS, BRACES, AND TIES

- A. Attachment Devices: Size for 5 times the design load indicated in ASTM C635/C635M, Table 1, Direct Hung, unless otherwise indicated.
- B. Wire Hangers, Braces, and Ties: Provide wire complying with the following requirements:
 1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
 2. Stainless Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.
 3. Nickel-Copper-Alloy Wire: ASTM B164 nickel-copper alloy UNS No. N04400.
 4. Size: Select wire diameter so its stress at 3 times the hanger design load indicated in ASTM C635/C635M, Table 1, Direct Hung is less than yield stress of wire, but provide not less than 0.106-inch-diameter wire.
- C. Rods and Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- D. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed from 0.04-inch-thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing and substrates to which suspended wood ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage, and with requirements for installation tolerances and other conditions affecting performance of suspended wood ceilings.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of suspended wood ceilings.

1. Balance border widths at opposite edges of each ceiling.
2. Avoid using less-than-half-width units.

3.3 INSTALLATION OF SUSPENDED WOOD CEILINGS

A. Comply with ASTM C636/C636M and seismic requirement indicated, in accordance with manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns in 3 inches. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate to which hangers are attached and for type of hanger involved.
5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that does not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts or postinstalled mechanical or adhesive anchors that extend through forms into concrete.
7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns in 1-1/2 inches. Suspend bracing from building's structural members as required for hangers and without attaching to permanent metal forms, steel deck, or steel deck tabs.

- D. Install edge moldings and trim at perimeter of ceiling area and where necessary to conceal edges and ends of wood units.
 - 1. Screw-attach metal moldings to substrate at intervals of not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 - 2. Do not use exposed fasteners on moldings and trim.
- E. Grid Suspension Systems: Space main beams at 48 inches o.c.
 - 1. Install cross tees to form modules sized in accordance with manufacturer's written installation instructions.
 - 2. Remove and replace dented, bent, or kinked members.
- F. Linear-Carrier Suspension Systems: Install carriers at no more than 24 inches o.c. aligned and securely interlocked with one another.
 - 1. Install stabilizer channels, tees, and bars at regular intervals to stabilize carriers and at light fixtures, air-distribution equipment, access doors, and other equipment; spaced as standard with manufacturer for use indicated.
 - 2. Remove and replace dented, bent, or kinked members.
- G. Install wood components and accessories in accordance with manufacturer's written instructions and to accommodate natural expansion and contraction of wood products resulting from fluctuations in humidity.
- H. Cut wood components for accurate fit at borders and at interruptions and penetrations by other work through ceilings.
 - 1. Stiffen edges of cut wood components as required to eliminate variations in flatness.
- I. Treat field-cut edges of wood components in accordance with manufacturer's written recommendations; finish exposed field cuts to match factory finish.
 - 1. Solid-Wood Planks: Use solid-wood end caps to conceal exposed field-cut edges.
- J. Install wood components in coordination with suspension system and moldings and trim.
 - 1. Install wood components in patterns indicated on Drawings.
- K. Install field-constructed access panels in locations indicated on Drawings.

3.4 CLEANING

- A. Clean exposed surfaces of ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented units.

SUSPENDED WOOD CEILINGS

LXT Eastside Development

SECTION 09 54 23

Project #47732472

Permit Set 09/29/22

END OF SECTION 095426

SECTION 096513 - RESILIENT BASE AND ACCESSORIES**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Thermoplastic-rubber base.
 - 2. Vinyl base.
 - 3. Vinyl molding accessories.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 4 inches long.
- C. Product Schedule: For resilient base and accessory products.

1.3 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. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.4 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 or more than 90 deg F.

1.5 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following 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 or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOPLASTIC-RUBBER BASE

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Johnsonite; a Tarkett company.
 - 2. Equal approved by architect
- B. Product Standard: ASTM F1861, Type TP (rubber, thermoplastic).
 - 1. Group: I (solid, homogeneous).
 - 2. Style and Location:
 - a. Style A, Straight: Per finish schedule.
- C. Thickness: .375.
- D. Height: 4 ½ inches.
- E. Lengths: Cut lengths 96 inches long.
- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.
- H. Colors: Per the drawings.

2.2 VINYL BASE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armstrong World Industries, Inc.
 - 2. Johnsonite; a Tarkett company.
 - 3. Roppe Corporation; Roppe Holding Company.
- B. Product Standard: ASTM F1861, Type TV (vinyl, thermoplastic).
 - 1. Group: I (solid, homogeneous).
 - 2. Style and Location:
 - a. Style B, Cove: Per the finish schedule.

- C. Minimum Thickness: 0.125 inch.
- D. Height: 4 inches.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Preformed.
- G. Inside Corners: Preformed.
- H. Colors and Patterns: Per the drawings.

2.3 VINYL MOLDING ACCESSORY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armstrong World Industries, Inc.
 - 2. Johnsonite; a Tarkett company.
 - 3. Roppe Corporation; Roppe Holding Company.
- B. Description: Vinyl transition strips.
- C. Profile and Dimensions: Per the drawings.
- D. Locations: At doorways.
- E. Colors and Patterns: Per the drawings.

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. 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. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F710.
 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 2. 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.
 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until materials are the same temperature as 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.
- E. 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. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches 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 in length.
 - a. Miter or cope corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Stair Accessories:
 - 1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
 - 2. Tightly adhere to substrates throughout length of each piece.
 - 3. For treads installed as separate, equal-length units, install to produce a flush joint between units.
- C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

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 surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.
 - 3. Damp-mop horizontal surfaces to remove marks and soil.
- 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

PART 1 GENERAL

1.1 Basis of design Product: Subject to compliance with requirements, provide SikaFloor Multidur HS or comparable product by one of the following:

- a. Master Builders Solutions; brand of MBCC Group.
- b. Neogard; Hempel Group.
- c. PPG Paints; PPG Industries, Inc.
- d. Pecora Corporation.
- e. Sherwin-Williams Company (The).
- f. Tremco Incorporated.

1.2 SECTION INCLUDES

A. Labor, products, equipment and services necessary for resinous flooring Work in accordance with the Contract Drawings covering the following components:

- .1 Primer: Sikafloor® 161.
- .2 Body Coat: Sikafloor® 264.
- .3 1st Top Coat: Sikafloor® 340.

1.3 RELATED SECTIONS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 03 39 00 - Concrete Curing.

1.4 REFERENCES

- A. ASTM C579, Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
- B. ASTM D2240, Standard Test Method for Rubber Property—Durometer Hardness.
- C. ASTM D2369, Standard Test Method for Volatile Content of Coatings.
- D. ASTM D4060, Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
- E. ASTM D4541, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
- F. For additional standards please refer to Product Data Sheets

1.5 SUBMITTALS

- A. Comply with Section 01 33 00 - Submittal Procedures.
- B. Product Data for each type of product: Submit manufacturer's technical data, installation instructions, and recommendations for each resinous flooring component required, including physical properties and colors available.
- C. Manufacturer's Safety Data Sheet for each product being used.

- D. Product Samples: Submit Architectural Standard samples representative of the final finish, as applied. The Standard shall be approved in writing by the Architect and shall be the final standard of acceptance of the finish.

- E. Maintenance Instructions: Submit manufacturer's maintenance instructions.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications:

- .1 Acceptable Manufacturer: Sika Corporation, 201 Polito Drive, Lyndhurst, NJ 07071
 - .1 No request for substitution shall be considered that would change the generic type of system specified. Equivalent materials of other manufacturers may be substituted only on approval of the Architect or Engineer. Requests shall include the respective manufacturer's technical literature for each product giving the name, generic type, descriptive information, recommended dry film thickness (DFT), Material Safety Data Sheet (MSDS), and certified test reports showing results of performance criteria of products specified herein.

B. Applicator Qualifications:

- .1 Pre-Qualification: Each bidder for this project shall be pre-qualified and approved in writing by the material manufacturer.
- .2 Applicator Experience: Each bidder must have a minimum 5 years experience in the application of the type of system specified. Contractor shall submit a list of five projects of similar size, scope and complexity.

C. Mock-Up:

- .1 Construct one 100 sq.ft. (10 sq.m.) mock-up of resinous flooring in location acceptable to Architect/Engineer to demonstrate quality of finished system, complying with manufacturer's instructions.
- .2 Arrange for Architect/Engineer's review and acceptance, obtain written acceptance before proceeding with Work.
- .3 Upon acceptance, mock-up shall serve as a minimum standard of quality for the balance of the work of this Section. Mock-up shall be left in place for the duration of the work.

- D. Pre-application Meeting: Convene a pre-application meeting minimum one week before start of application of floor coating at project site. Require attendance of parties directly affecting work of this section, including Contractor, Architect, applicator, and manufacturer's representative. Review surface preparation, priming, application, curing, protection, and coordination with other work.

1.7 DELIVERY, STORAGE AND HANDLING

A. Delivery:

- .1 Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name, manufacturer, batch or lot number, and date of manufacture.

- .2 Material should be delivered to job site and checked for completeness and shipping damage prior to job start.
- B. Storage:
 - .1 Store materials in accordance with manufacturer's written instructions.
 - .2 Keep containers sealed until ready for use. Material should be stored in a dry, enclosed, protected area from the elements.
 - .3 Do not subject material to excessive heat or freezing.
 - .4 Shelf life: Established based on manufacturer's written recommendation for each material being used.
- C. Handling: Protect materials during handling and application to prevent damage or contamination.
- D. Condition materials for use accordingly to manufacturer's written instructions prior to application.
- E. Record material lot number and quantity delivered to jobsite/storage.

1.8 SITE CONDITIONS

- A. Do not install the Work of this Section outside of the following environmental ranges with Manufacturers' written acceptance:
 - .1 Material Temperature: Precondition material for at least 24 hours between 65° to 75°F (18° to 24°C)
 - .2 Ambient Temperature: Minimum/Maximum 50°/85°F (10°/30°C)
 - .3 Substrate Temperature: Minimum/Maximum 50°/85°F (10°/30°C). Substrate temperature must be at least 5°F (3°C) above measured Dew Point.
 - .4 Mixing and Application attempted at Material, Ambient and/or Substrate Temperature conditions less than 65°F (18°C) will result in a decrease in product workability and slower cure rates.
 - .5 Relative Ambient Humidity: Minimum ambient humidity 30%, maximum ambient humidity 75% (during application and curing)
 - .6 Measure and confirm Substrate Moisture Content, Ambient Relative Humidity, Ambient and Surface Temperature and Dew Point.
- B. Substrate moisture:
 - .1 Moisture content of concrete substrate must be $\leq 4\%$ by mass as measured with a Tramex® CME/CMExpert type concrete moisture meter.
 - .2 Additionally, relative humidity tests may be conducted per ASTM F2170 and values must be $\leq 85\%$.
 - .3 If moisture content of concrete substrate is $> 4\%$ by mass as measured with Tramex® CME/CMExpert type and/or if relative humidity tests per ASTM F2170 exceed values $> 85\%$, consider moisture mitigation systems or moisture tolerant primer.
- B. Alkalinity and Adhesion Testing: Perform tests recommended in writing by resinous flooring manufacturer. Proceed with installation only after substrate alkalinity is not less

than 6 or more than 8 pH unless otherwise recommended in writing by flooring manufacturer,

- C. Utilities, including electric, water, HVAC and permanent lighting to be supplied by General Contractor
- D. Maintain constant ambient room temperature of plus or minus 15°F (plus or minus 7°C) with a minimum temperature of 50°F (10°C) and maximum temperature of 85°F (30°C). Maintain constant ambient room temperature for 48 hours before, during and after installation, or until cured. Do not apply while ambient and temperatures are rising.
- E. Erect suitable barriers and post legible signs at points of entry to prevent traffic and trades from entering the work area during application and cure period of the floor.
- F. Protection of finished floor from damage by subsequent trades shall be the responsibility of the General Contractor.
- G. Insure adequate ventilation and air flow.

1.9 WARRANTY

- C. Manufacturer's Warranty: Manufacturer agrees to repair or replace traffic coating that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, 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 MANUFACTURER

- A. Manufacturer shall be certified under ISO 9001: 2008 All liquid materials, including primers, resins, curing agents, finish coats, and sealants are manufactured and tested under an ISO 9001:2008 registered quality system.
- B. Approved Manufacturer shall be Sika Corporation, Industrial Flooring, 201 Polito Avenue, Lyndhurst, NJ 07071, Phone 201.933.8800, Fax 201.933.6225, www.sikafloorusa.com
- C. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.

2.2 SYSTEM

- A. Resinous flooring system: Sikafloor Multidur Hangar System is a monolithic solid color flooring system offering chemical resistance, applied between 28 - 38 mils thick. System to consist of the following components:
- .1 Primer: Sikafloor 161 applied between 8 – 10 mils.
 - .2 Body coat: Sikafloor 264 applied between 12 - 16 mils.
 - .3 1st top coat: Sikafloor 340 applied at 4 - 6 mils.

2.3 MATERIALS

- A. Primer: Sikafloor 161 is a two part, epoxy resin for priming and leveling mortars with the following properties:
- .1 Pull-off Strength (ASTM D4541): > 400 psi (2.7 MPa) with 100% concrete failure.
 - .2 Shore D Hardness (ASTM D2240): 76 at 7 days.
 - .3 Solid Content: ~ 100% (by volume) / ~ 100% (by weight).
 - .4 VOC Content (ASTM D2369): ≤ 50 g/L.
 - .5 Permeability (ASTM E96): 9.0 g/m² (24 hours / +75°F).
 - .6 Water Absorption (ASTM D570): 0.14 g/h - m².
 - .7 Viscosity (approximately) of Components A + B: 775 (SP2/100).
- B. Body Coat: Sikafloor 264 is a pigmented two part, low viscosity, self-priming, epoxy coating binder in [*Refer to Sikafloor color chart*] color with the following properties:
- .1 Pull-off Strength (ASTM D4541): > 400 psi (2.7 MPa) with 100% concrete failure.
 - .2 Shore D Hardness (ASTM D2240): 76 at 7 days.
 - .3 Solid Content: ~ 100% (by volume) / ~ 100% (by weight).
 - .4 VOC Content (ASTM D2369): ≤ 50 g/L.
 - .5 Compressive Strength (ASTM C579): 7,250 psi (50 N/mm²) at 28 days.
 - .6 Flexural Strength (ASTM C580): 2,900 psi (20 N/mm²) at 28 days.
- C. Top Coat: Sikafloor 340 is an aliphatic urethane with excellent chemical resistance and UV resistance coating in [*Refer to Sikafloor color chart*] color with the following properties:
- .1 VOC Content (ASTM D2369): ≤ 280 g/L.
 - .2 UV Light Resistance - Q-U-V Accelerated Weather Tester: Excellent
 - .3 Abrasion Resistance (ASTM D4060): 18 mg loss (CS-17 Wheel, 1000 gm load, 1000 cycles).
 - .4 Flexibility: Bent on 1/8" conical
 - .5 Gloss at 60°: 90
 - .6 Slip Resistance: Equivalent to ASTM D2047 Passes.
- D. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended in writing by manufacturer for installation indicated.

PART 3 EXECUTION**3.1 EXAMINATION**

- A. Examine surfaces to receive flooring system. Notify Architect/General Contractor/Owner/Owner's representative if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected. Do not apply to substrate treatments for moisture, repair, or leveling not of the same Manufacturer.
- B. Surface must be clean, sound and dry. Remove dust, laitance, grease, curing compounds bond inhibiting impregnations, waxes and any other contaminants. All projections, rough spots, etc. should be dressed off to achieve a level surface prior to the application.
- C. Concrete substrate to have a minimum compressive strength of 3,500 psi (24 MPa) at 28 days and a minimum of 215 psi (1.5 MPa) in tension at time of application.
- D. Substrate moisture:
 - .1 Measure and confirm Substrate Moisture Content, Ambient Relative Humidity, Ambient and Surface Temperature and Dew Point.
 - .2 Confirm and record above values at least once every 3 hours during installation, or more frequently whenever conditions change (e.g. Ambient Temperature rise/fall, Relative Humidity increase/decrease, etc.).
- E. Ensure concrete substrate conforms to the minimum requirements of the flooring manufacturer.
- F. Flooring system shall not be applied to sand-cement setting beds. Sand-cement beds shall be removed to structural concrete substrate and re-leveled/sloped as necessary to achieve grade and/or adequate drainage.
- G. Flooring system shall not be applied to asphaltic or bitumen membranes, soft wood, aluminum, copper or fiberglass reinforced polyester/vinyl ester composites.
- H. Application to glazed or vitrified brick and tile, structural wood, steel shall only be permitted with Manufacturer's written recommendation.
- I. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Prepare surface to receive flooring systems in accordance with manufacturer's written instructions.
- B. Remove dust, dirt, oil, grease, wax, laitance, glaze, efflorescence, curing compounds, water-soluble concrete hardeners, and other surface contaminants. Remove sealers, finishes, and paints and other contaminants incompatible with resinous flooring. Repair damaged and deteriorated concrete in accordance with resinous flooring manufacturer's written instructions
- C. Concrete: Shall be cleaned and prepared to achieve laitance-free and contaminant-free, open textured surface by shot blasting or equivalent mechanical means (CSP level as per ICRI guidelines and manufacturer's written recommendation).
- D. Chemical Surface Preparation: Chemical surface preparation (acid etching) is unacceptable and will void Manufacturer's warranty.

- E. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates in accordance with manufacturer's written instructions.
- F. Control joints and cracks: Provide repair and treatment of control joints and surface cracks utilizing manufacturer's standard materials and installation details.
 - .1 Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring in accordance with manufacturer's written instructions.

3.3 APPLICATION

- A. Mix and apply material with strict adherence to manufacturer's written installation procedures and coverage rates.
- B. Follow Manufacturer's written recommendations on terminations and connections to walls, drains, doorways, columns and floor-to-floor transitions.
- C. Do not apply while ambient and substrate temperatures are rising.
- D. Apply resinous flooring with care to ensure that no laps, voids, or other marks or irregularities are visible, and with an appearance of uniform color, sheen and texture, all within limitations of materials and areas concerned.
- E. Match colors and textures of approved samples.
- F. Topcoats: Apply topcoats in number indicated for flooring system specified, at spreading rates recommended in writing by manufacturer, and to produce wearing surface specified.

3.4 FIELD QUALITY CONTROL

- A. Material Sampling: Owner may, at any time and any number of times during resinous flooring installation, require material samples for testing for compliance with requirements.
 - .1 Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
 - .2 Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
 - .3 If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reinstall flooring materials to comply with requirements.
- B. Core Sampling: At Owner's direction and at locations designated by Owner, take one core sample per 1000 sq. ft. of resinous flooring, or portion of, to verify thickness. For each sample that fails to comply with requirements, take two additional samples. Repair damage caused by coring. Correct deficiencies in installed flooring as indicated by testing.

3.5 CLEAN UP

- A. Disposal of this product, solution and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements.
- B. Empty containers should be taken to an approved waste handling site for recycling or disposal.

3.6 PROTECTION

- A. Freshly applied material should be protected from dampness, condensation and water for at least 72 hrs.
- B. Beware of air flow and changes in air flow. Introduction of dust, debris, and particles, etc. may result in surface imperfections and other defects.
- C. Follow manufacturer's written recommendation with respect to cure, wait time and return to service.

END OF SECTION

SECTION 099114 - EXTERIOR PAINTING (MPI STANDARDS)**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Surface preparation and application of paint systems on exterior substrates, the following exterior substrates:
 - a. Galvanized metal.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for shop priming metal fabrications.

1.2 DEFINITIONS

- A. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- B. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- C. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
- D. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.

1.3 ACTION SUBMITTALS**A. Product Data:** For each type of product.

1. Include preparation requirements and application instructions.
2. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
3. Indicate VOC content.

B. Samples: For each type of topcoat product.**C. 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. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

- D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in the Exterior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

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. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.5 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - 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.

1.6 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.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.7 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.

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. Benjamin Moore & Co.
 - 2. PPG Paints; PPG Industries, Inc.
 - 3. Pratt & Lambert; a subsidiary of The Sherwin-Williams Company.
 - 4. Sherwin-Williams Company (The).
- B. Products: Subject to compliance with requirements, provide product available products that may be incorporated into the Work include, but are not limited to products listed in the Exterior Painting Schedule for the paint category indicated.
- C. Source Limitations: Obtain paint from single source from single manufacturer.

2.2 PAINT PRODUCTS

- A. MPI Standards: Provide products complying with MPI standards indicated and 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 topcoat manufacturers for use in paint system and on substrate indicated.
- C. Colors: As selected by Architec..

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.

2. Fiber-Cement Board: 12 percent.
 3. Masonry (Clay and CMUs): 12 percent.
 4. Wood: 15 percent.
 5. Portland Cement Plaster: 12 percent.
 6. Gypsum Board: 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 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. 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.
 2. SSPC-SP 3.
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. 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.

3.3 INSTALLATION

- A. Apply paints in accordance with 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 the Exterior Painting Schedule may be omitted on items that are factory primed or factory finished if compatible with intermediate and topcoat coatings and acceptable to intermediate and topcoat paint manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. 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.
- D. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed to view:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
1. Contractor shall touch up and restore painted surfaces damaged by testing.
 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written instructions, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written instructions.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

EXTERIOR PAINTING (MPI STANDARDS)**SECTION 09 91 14**

LXT Eastside Development

Project #47732472

Permit Set 09/29/22

1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
 2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
 3. Allow empty paint cans to dry before disposal.
 4. Collect waste paint by type and deliver to recycling or collection facility.
- 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.

3.6 EXTERIOR PAINTING SCHEDULE**A. Galvanized-Metal Substrates:**

1. Water-Based Light Industrial Coating System MPI EXT 5.3J:
 - a. Epoxy Prime Coat: Primer, epoxy, anti-corrosive, MPI #101.
 - b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
 - c. Semigloss Topcoat: Light industrial coating, exterior, water based, semigloss (MPI Gloss Level 5), MPI #163.

PART 4 - END OF SECTION 099114

SECTION 099124 - INTERIOR PAINTING (MPI STANDARDS)**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes surface preparation and the application of paint systems on interior substrates.
- B. Related Requirements:
 - 1. Section 051200 "Structural Steel Framing" for shop priming structural steel.
 - 2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
 - 3. Section 055113 "Metal Pan Stairs" for shop priming metal pan stairs.
 - 4. Section 055213 "Pipe and Tube Railings" for shop priming pipe and tube railings.

1.2 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
- B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
- F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
- G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 - 2. Indicate VOC content.
- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches square.

2. Apply coats on Samples in steps 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: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

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. Paint: 5 percent, but not less than 1 gal. Insert number of each material and color applied.

1.5 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.
 - 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.

1.6 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.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 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 when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F above the dew point; or to damp or wet surfaces.

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. Benjamin Moore & Co.
 - 2. Pratt & Lambert; a subsidiary of The Sherwin-Williams Company.
 - 3. PPG Paints; PPG Industries, Inc.
 - 4. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products List."
- B. 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.
- C. Colors: As selected by Architect.

2.3 PRIMERS/SEALERS

- A. Primer Sealer, Interior, Institutional Low Odor/VOC: MPI #149.

2.4 WATER-BASED PAINTS

- A. Latex, Interior, Institutional Low Odor/VOC, (Gloss Level 3): MPI #145.

2.5 FLOOR COATINGS

- A. Sealer, Water Based, for Concrete Floors: MPI #99.

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.
 - 2. Fiber-Cement Board: 12 percent.
 - 3. Masonry (Clay and CMUs): 12 percent.
 - 4. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. 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 in "MPI Architectural Painting Specification 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 if any.
- 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.
 - 2. SSPC-SP 3.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. 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.
- I. Aluminum Substrates: Remove loose surface oxidation.

3.3 INSTALLATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. 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.
- D. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.

- g. Tanks that do not have factory-applied final finishes.
 - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
- 2. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Other items as directed by Architect.
- 3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

- A. Dry-Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry-film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry-film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry-film thickness that complies with paint manufacturer's written recommendations.

3.5 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.

3.6 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Traffic Surfaces:

1. Water-Based Concrete Floor Sealer System, MPI INT 3.2G:
 - a. First Coat: Sealer, water based, for concrete floors, matching topcoat.
 - b. Topcoat: Sealer, water based, for concrete floors, MPI #99.
- B. CMU Substrates:
 1. Latex System, MPI INT 4.2A:
 - a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.
- C. Steel Substrates:
 1. Latex over Shop-Applied Quick-Drying Shop Primer System, MPI INT 5.1X: At low PEMB frame exposed to human contact up to finish ceiling systems.
 - a. Prime Coat: Primer, quick dry, for shop application, MPI #275.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.
 2. High-Performance Architectural Latex System, MPI INT 5.1R: at handrails, guardrails and steel in contact with human contact.
 - a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.
 - b. Prime Coat: Primer, alkyd, anticorrosive, for metal, MPI #79.
 - c. Prime Coat: Shop primer specified in Section where substrate is specified.
 - d. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 3. Water-Based Dry-Fall System, MPI INT 5.1C, :
 - a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.
 - b. Prime Coat: Primer, alkyd, anticorrosive, for metal, MPI #79.
 - c. Prime Coat: Shop primer specified in Section where substrate is specified.
 - d. Topcoat: Dry fall, latex (MPI Gloss Level 3), MPI #155.
 4. Water-Based Dry-Fall over Shop-Applied Quick-Drying Shop Primer System, MPI INT 5.1CCC:
 - a. Prime Coat: Primer, quick dry, for shop application, MPI #275.

- b. Topcoat: Dry fall, latex (MPI Gloss Level 3), MPI #155.

D. Galvanized-Metal Substrates:

- 1. Water-Based Light-Industrial Coating System, MPI INT 5.3B:
 - a. Prime Coat: Primer, galvanized, cementitious, MPI #26.
 - b. Prime Coat: Primer, galvanized, water based, MPI #134.
 - c. Intermediate Coat: Light-industrial coating, interior, water based, matching topcoat.
 - d. Topcoat: Light-industrial coating, interior, water based, semigloss (MPI Gloss Level 5), MPI #153.
- 2. Water-Based Dry-Fall System, MPI INT 5.3H:
 - a. Prime Coat: Dry fall, water based, for galvanized steel, matching topcoat.
 - b. Topcoat: Dry fall, water based, for galvanized steel, flat (MPI Gloss Level 1), MPI #133.

E. Gypsum Board Substrates:

- 1. Latex over Latex Sealer System, MPI INT 9.2A:
 - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
 - b. Prime Coat: Latex, interior, matching topcoat.
 - c. Intermediate Coat: Latex, interior, matching topcoat.
 - d. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

END OF SECTION 099124

SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Dimensional characters.
 - a. Illuminated, fabricated channel dimensional characters.

1.2 DEFINITIONS

- A. Illuminated: Illuminated by lighting source integrally constructed as part of the sign unit.

1.3 COORDINATION

- A. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For signs.
 1. Include fabrication and installation details and attachments to other work.
 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 3. Show message list, typestyles, graphic elements, and layout for each sign at least half size.
 4. Show locations of electrical service connections.
 5. Include diagrams for power, signal, and control wiring.
 6. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five 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 sign structure and anchorage of dimensional character sign type(s) according to structural performance requirements.
- B. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.
 - 1. Uniform Wind Load: As indicated on Drawings.
 - 2. Concentrated Horizontal Load: As indicated on Drawings.
 - 3. Other Design Load: As indicated on Drawings
 - 4. Uniform and concentrated loads need not be assumed to act concurrently.
- C. Thermal Movements: For exterior fabricated channel dimensional characters, allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

- D. 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 DIMENSIONAL CHARACTERS

- A. Fabricated Channel Characters: Translucent face with metal side returns, formed free from warp and distortion; with uniform faces, sharp corners, and precisely formed lines and profiles; internally braced for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners; and as follows.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ACE Sign Systems, Inc.
 - b. ASI Sign Systems, Inc.
 - c. Gemini Signage; Gemini, Inc.
 2. Illuminated Characters: Frontlighted character construction with LED lighting, including transformers, insulators, and other accessories for operability, with provision for servicing and concealing connections to building electrical system. Use tight or sealed joint construction to prevent unintentional light leakage. Space lamps apart from each other and away from character surfaces as needed to illuminate evenly.
 - a. Power: As indicated on electrical Drawings.
 - b. Weeps: Provide weep holes to drain water at lowest part of exterior characters. Equip weeps with permanent baffles to block light leakage without inhibiting drainage.
 3. Character Material: Sheet or plate aluminum, steel, stainless steel.
 4. Material Thickness: Manufacturer's standard for size and design of character.
 5. Translucent Face Sheet: Acrylic sheet with integral color as selected by Architect from manufacturer's full range.
 - a. Sheet Thickness: Manufacturer's standard thickness for size of character.
 6. Character Height: 40".
 7. Character Depth: 2".
 8. Finishes:
 - a. Integral Metal Finish: As selected by Architect from full range of industry finishes.
 - b. Integral Aluminum Finish: Anodized color as selected by Architect from full range of industry colors and color densities.
 - c. Integral Stainless Steel Finish: As selected by Architect from full range of industry finishes.
 - d. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.
 - e. Overcoat: Manufacturer's standard baked-on clear coating.
 9. Mounting: Projecting studs.

- a. Hold characters at manufacturer's recommended distance as selected by Architect Insert dimension from wall surface.

10. Typeface: Arial Bold.

2.3 DIMENSIONAL CHARACTER MATERIALS

- A. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- B. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
- C. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- D. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
 1. Use concealed fasteners and anchors unless indicated to be exposed.
 2. For exterior exposure, furnish stainless steel or hot-dip galvanized devices unless otherwise indicated.
 3. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
 - b. Fastener Heads: For nonstructural connections, use flathead or oval countersunk screws and bolts with tamper-resistant Allen-head, spanner-head or one-way-head slots unless otherwise indicated.
 4. Sign Mounting Fasteners:
 - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
 - b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
 - c. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.
 5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or

pre-molded to match metal wall panel profile from metal panel provider. Provide closure strips at signs above 12'-0" aff behind signs, recessed from edge 1" to prevent birds from nesting.

2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 - 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 - 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 - 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 - 5. Internally brace dimensional characters for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
 - 6. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
 - 7. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.
- B. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.
 - 1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish to match sign-background color unless otherwise indicated.
 - 2. Stainless Steel Brackets: Factory finish brackets to match sign background finish unless otherwise indicated.

2.6 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.
- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

- D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.
- B. Color Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.8 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. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 2. Directional Satin Finish: No. 4.
 - 3. Dull Satin Finish: No. 6.
 - 4. Reflective, Directional Polish: No. 7.
 - 5. Mirrorlike Reflective, Nondirectional Polish: No. 8.

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.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Verify that electrical service is correctly sized and located to accommodate signs.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF DIMENSIONAL CHARACTERS

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.

2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.
3. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
4. Back Bar and Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position, so that signage is correctly located and aligned.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101419

SECTION 101423.16 - ROOM-IDENTIFICATION PANEL SIGNAGE**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes room-identification signs that are directly attached to the building.
- B. Related Requirements:
 - 1. Section 101300 "Directories" for building directories.
 - 2. Section 101416 "Plaques" for one-piece, solid metal signs, with or without frames, that are used for high-end room-identification.

1.2 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.3 COORDINATION

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.
- B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For room-identification signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
- C. Product Schedule: For room-identification signs. Use same designations indicated on Drawings or specified.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.

- B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

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. Tools: One set(s) of specialty tools for assembling signs and replacing variable sign components.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer of products.

1.9 FIELD CONDITIONS

- A. Field Measurements: Verify locations of anchorage devices and electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
 - c. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the ABA standards of the Federal agency having jurisdiction and ICC A117.1.

2.2 ROOM-IDENTIFICATION SIGNS

- A. Room-Identification Sign: Sign system with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Vista System, LLC. V200-WFP 40 and WFP48.

2.3 SIGN MATERIALS

- A. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- B. Aluminum Extrusions: ASTM B221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- D. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
 - 1. Use concealed fasteners and anchors unless indicated to be exposed.
 - 2. For exterior exposure, furnish nonferrous-metal or hot-dip galvanized devices unless otherwise indicated.
 - 3. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened sign unless otherwise indicated.
 - b. Fastener Heads: Use flathead or oval countersunk screws and bolts with tamper-resistant Allen-head slots unless otherwise indicated.
 - 4. Sign Mounting Fasteners:
 - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
 - b. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.

- B. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 - 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 - 3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 - 4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
- B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.
- C. Subsurface-Etched Graphics: Reverse etch back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.
- D. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:
 - 1. For slide-in changeable inserts, fabricate slot without burrs or constrictions that inhibit function. Furnish initial changeable insert. Subsequent changeable inserts are by Owner.

2.6 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.

2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Accessibility: Install signs in locations on walls in according to the accessibility standard.
- C. Mounting Methods:
 - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
 - 2. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
 - 3. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
 - 4. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

3.2 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.

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- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101423.16

SECTION 102113.17 - PHENOLIC-CORE TOILET COMPARTMENTS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Phenolic-core toilet compartments.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for supports that attach floor-and-ceiling-anchored compartments to overhead structural system.
2. Section 061000 "Rough Carpentry" for blocking overhead support of floor-and-ceiling-anchored compartments.
3. Section 092216 "Non-Structural Metal Framing" for blocking.
4. Section 102800 "Toilet, Bath, and Laundry Accessories" for accessories mounted on toilet compartments.

1.2 COORDINATION

- A. Coordinate requirements for overhead supports, blocking, reinforcing, and other supports concealed within wall and ceiling to ensure that toilet compartments can be supported and installed as indicated.

1.3 ACTION SUBMITTALS**A. Product Data.**

1. Phenolic-core toilet compartments.
 - a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

B. Shop Drawings:

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: Actual sample of finished products for each type of toilet compartment, hardware, and accessory.

1. Size: Manufacturers' standard size.

- D. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.
- E. Delegated Design Submittals: For grab bars mounted on toilet compartment panels, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Include structural design calculations indicating compliance with specified structural-performance requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For toilet compartments.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Materials: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Door Hinges: One hinge(s) with associated fasteners.
 - 2. Latch and Keeper: One latch(es) and keeper(s) with associated fasteners.
 - 3. Door Bumper: One door bumper(s) with associated fasteners.
 - 4. Door Pull: One door pull(s) with associated fasteners.
 - 5. Fasteners: 10 fasteners of each size and type.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements, and coordinate before fabrication.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain phenolic-core toilet compartments from single source from single manufacturer.
- B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.
- C. Structural Performance: Where grab bars are mounted on toilet compartments, design panels to comply with the following requirements:

1. Panels are able to withstand a concentrated load on grab bar of at least 250 lbf applied at any direction and at any point, without deformation of panel.
- D. Regulatory Requirements: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1 for toilet compartments designated as accessible.

2.2 PHENOLIC-CORE TOILET COMPARTMENTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. American Sanitary Partition Corporation.
 2. Bobrick Washroom Equipment, Inc.
 3. Bradley Corporation.
- B. Toilet-Enclosure Style: Floor-and-ceiling anchored.
- C. Urinal-Screen Style: Wall hung.
- D. Door, Panel, and Pilaster Construction: Solid phenolic-core material with melamine facing on both sides fused to substrate during manufacture (not separately laminated), and with eased and polished edges. Provide minimum 3/4-inch-thick doors and pilasters and minimum 3/4-inch-thick panels. Provide with no-sightline system consisting of door and pilaster lapped edges on strike side of door and door and pilaster lapped edges on hinge side of door (unless continuous hinge is used).
- E. Urinal-Screen Construction: Matching panel construction.
- F. Pilaster Shoes: Formed from stainless steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.
- G. Pilaster Sleeves (Caps): Formed from stainless steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.
- H. Brackets (Fittings):
 1. Stirrup Type: Ear or U-brackets, stainless steel.
 2. Full-Height (Continuous) Type: Manufacturer's standard design, stainless steel.
- I. Phenolic Compartment Finish: One color in each room.
 1. Dark-Core Phenolic: Manufacturer's standard dark color core and edge.
 - a. Facing Sheet Color: Per drawings.

2.3 HARDWARE AND ACCESSORIES

- A. Door Hardware and Accessories: Manufacturer's operating hardware and accessories. Mount with through bolts.
 - 1. Hinges: Manufacturer's stainless steel continuous, cam type that swings to a closed or partially open position, allowing emergency access by lifting door.
 - 2. Latch and Keeper: Manufacturer's standard stainless steel, 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 toilet enclosures designated as accessible.
 - 3. Coat Hook: Manufacturer's standard stainless steel combination hook and rubber-tipped bumper, sized to prevent inswinging door from hitting compartment-mounted accessories.
 - 4. Door Bumper: Manufacturer's standard stainless steel, rubber-tipped bumper at outswinging doors.
 - 5. Door Pull: Manufacturer's standard stainless steel pull at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at toilet enclosures designated as accessible.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match 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 B26/B26M.
- B. Aluminum Extrusions: ASTM B221.
- C. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
- D. Stainless Steel Castings: ASTM A743/A743M.

2.5 FABRICATION

- A. 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. Floor-and-Ceiling-Anchored Units: Manufacturer's standard corrosion-resistant anchoring assemblies at pilasters and walls, with leveling adjustment nuts at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

- C. Urinal-Screen Posts: Manufacturer's standard corrosion-resistant anchoring assemblies walls, with leveling adjustment nuts at tops and bottoms of posts.
- D. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide, inswinging doors for standard toilet enclosures and 36-inch-wide, outswinging doors with a minimum 32-inch-wide, clear opening for toilet enclosures 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 or Screens: 1/2 inch.
 - b. Panels or Screens and Walls: 1 inch.
 - 2. Full-Height (Continuous) Brackets: Secure panels or screens 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. Floor-and-Ceiling-Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust so doors are level and aligned with panels when doors are in closed position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware in accordance with hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to

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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 102113.17

SECTION 102123 - CUBICLE CURTAINS AND TRACK**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Cubicle-curtain support systems.
2. Cubicle curtains.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for supplementary wood framing and blocking for mounting items requiring anchorage.
2. Section 092216 "Non-Structural Metal Framing" for supplementary metal framing and blocking for mounting items requiring anchorage.

1.2 ACTION SUBMITTALS**A. Product Data:**

1. Cubicle-curtain support systems.
2. Cubicle curtains.

B. Product Data Submittals: For each product.

1. For each type of curtain fabric indicated, include durability, laundry temperature limits, fade resistance, applied curtain treatments, and fire-test-response characteristics.

C. Shop Drawings: For curtains and tracks.

1. Show layout and types of cubicles, sizes of curtains, number of carriers, anchorage details, and conditions requiring accessories. Indicate dimensions taken from field measurements.
2. Include details of blocking for track support.

D. Samples for Verification: For each type of product required, prepared on Samples of size indicated below:

1. Curtain Fabric: Not less than 10 inches square and showing complete pattern repeat, from dye lot used for the Work, with specified treatments applied. Mark top and face of material.
2. Mesh Top: Not less than 10 inches square.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For curtains, tracks, and hardware to include in operation and maintenance manuals.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- 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. Curtain Carriers and Track End Caps: Full-size units equal to 3 percent of amount installed for each size indicated, but no fewer than 5 units.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. Cubicle Curtains: Provide curtain fabrics with the following characteristics:
 - 1. Laundering: Launderable to a water temperature of not less than 160 deg F.
 - 2. Flame Resistance: Provide fabrics identical to those that have passed NFPA 701 when tested by a qualified testing agency acceptable to authorities having jurisdiction.
 - a. Identify fabrics with appropriate markings of a qualified testing agency.

2.2 CUBICLE-CURTAIN SUPPORT SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AR Nelson.
 - 2. Cubicle Curtain Factory, Inc.
 - 3. Healthcare Curtains.
- B. Extruded-Aluminum Curtain Track: Not less than 1-1/4 inches wide by 3/4 inch high.
 - 1. Track Minimum Wall Thickness: 0.050 inch.
 - 2. Finish: Clear anodized.
- C. Curtain-Track Mounting: Surface.
- D. Curtain-Track Accessories: Fabricate splices, end caps, connectors, end stops, coupling and joining sleeves, wall flanges, brackets, ceiling clips, and other accessories from same material and with same finish as track.
 - 1. Surface -Track Support: Not less than 5/8-inch-square 7/8-inch-OD tube.
 - 2. End Stop: Nonremovable.

- E. Curtain Roller Carriers: Two nylon rollers and nylon axle with chrome-plated steel hook.
- F. Curtain Glide Carriers: One-piece nylon glide with chrome-plated steel nylon hook.
- G. Exposed Fasteners: Stainless steel.
- H. Concealed Fasteners: Hot-dip galvanized.

2.3 CUBICLE CURTAINS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Quiet Curtains
 - 2. Equal approved by Architect
- B. Fabric: Curtain manufacturer's standard, 100 percent polyester; inherently and permanently flame resistant, stain resistant, and antimicrobial.
 - 1. Pattern: Per the drawings.
 - 2. Width: Per the drawings.
 - 3. Color: Per the drawings.
- C. Curtain Grommets: Two-piece, rolled-edge, rustproof, nickel-plated brass; spaced not more than 6 inches o.c.; machined into top hem.

2.4 CURTAIN FABRICATION

- A. Continuous Curtain Panels:
 - 1. Width: Equal to track length from which curtain is hung plus 10 percent of added fullness, but not less than 2 inches of added fullness.
 - 2. Length: Equal to floor-to-ceiling height, minus depth of track and carrier at top, and minus clearance above the finished floor of 12 inches.
 - 3. Top Hem: Not less than 1 inch and not more than 1-1/2 inches wide, triple thickness, reinforced with integral web, and double lockstitched.
 - 4. Bottom Hem: Not less than 1 inch and not more than 1-1/2 inches wide, double thickness and single lockstitched.
 - 5. Side Hems: Not less than 1/2 inch and not more than 1-1/4 inches wide, with double turned edges, and single lockstitched.
 - 6. Vertical Seams: Not less than 1/2 inch wide, double turned and double stitched.

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. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install tracks level and plumb, according to manufacturer's written instructions.
- B. For tracks of up to 20 feet in length, provide track fabricated from single, continuous length.
 - 1. Curtain-Track Mounting: Surface.
- C. Surface-Track Mounting: Fasten tracks to ceilings at intervals recommended by manufacturer. Fasten tracks to structure at each splice and tangent point of each corner. Center fasteners in track to ensure unencumbered carrier operation. Attach track to ceiling as follows:
 - 1. Mechanically fasten to suspended ceiling grid with screws.
 - 2. Attach track to suspended ceiling grid with manufacturer's proprietary clip.
- D. Track Accessories: Install splices, end caps, connectors, end stops, coupling and joining sleeves, and other accessories as required for a secure and operational installation.
- E. Curtain Carriers: Provide curtain carriers adequate for 6-inch spacing along full length of curtain plus an additional carrier.
- F. Cubicle Curtains: Hang curtains on each curtain track.

END OF SECTION 102123

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Public-use washroom accessories.
2. Private-use bathroom accessories.
3. Underlavatory guards.
4. Custodial accessories.

B. Related Requirements:

1. Section 088300 "Mirrors" for frameless mirrors.
2. Section 093013 "Ceramic Tiling" for ceramic toilet and bath accessories.

1.2 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.

1.3 ACTION SUBMITTALS**A. Product Data:**

1. Public-use washroom accessories.
2. Private-use bathroom accessories.
3. Underlavatory guards.
4. Custodial accessories.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Include electrical characteristics.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify accessories using designations indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For accessories to include in maintenance manuals.

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. Structural Performance: Design accessories and fasteners to comply with the following requirements:
 1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.
 2. Shower Seats: Installed units are able to resist 360 lbf concentrated load applied in any direction and at any point.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.
- B. Toilet Tissue (Roll) Dispenser:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASI-American Specialties, Inc.
 - b. Bobrick Washroom Equipment, Inc.
 - c. Bradley Corporation.
 2. Description: Roll-in-reserve dispenser with hinged front.
 3. Mounting: Recessed and Surface mounted.
 4. Operation: Noncontrol delivery with standard spindle.
 5. Capacity: Designed for 4-1/2- or 5-inch- 5-inch- Insert dimension diameter tissue rolls.
 6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

- C. Combination Towel (Folded) Dispenser/Waste Receptacle:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASI-American Specialties, Inc.
 - b. Bobrick Washroom Equipment, Inc.
 - c. Bradley Corporation.
 2. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
 3. Mounting: Surface mounted with stainless steel collar Recessed with projecting receptacle.
 - a. Designed for nominal 4-inch wall depth.
 4. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels.
 5. Minimum Waste-Receptacle Capacity: 12 gal..
 6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
 7. Liner: Reusable, vinyl waste-receptacle liner.
 8. Lockset: Tumbler type for towel-dispenser compartment and waste receptacle.
- D. Soap Dispenser:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASI-American Specialties, Inc.
 - b. Bobrick Washroom Equipment, Inc.
 - c. Bradley Corporation.
 2. Description: Designed for manual operation and dispensing soap in liquid or lotion form.
 3. Mounting: Vertically oriented, surface mounted.
 4. Capacity: 40 oz.
 5. Materials: Stainless Steel.
 6. Lockset: Tumbler type.
 7. Refill Indicator: Window type.
- E. Grab Bar:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASI-American Specialties, Inc.
 - b. Bobrick Washroom Equipment, Inc.
 - c. Bradley Corporation.
 2. Mounting: Flanges with concealed fasteners.
 3. Material: Stainless steel, 0.05 inch thick.
 - a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin) on ends and slip-resistant texture in grip area.
 4. OD: 1-1/2 inches.
 5. Configuration and Length: As indicated on Drawings.

F. Sanitary-Napkin Disposal Unit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASI-American Specialties, Inc.
 - b. Bobrick Washroom Equipment, Inc.
 - c. Bradley Corporation.
2. Mounting: Surface mounted.
3. Door or Cover: Self-closing, disposal-opening cover.
4. Receptacle: Removable.
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

G. Hook:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASI-American Specialties, Inc.
 - b. Bobrick Washroom Equipment, Inc.
 - c. Bradley Corporation.
2. Description: Combination hat and coat hook.
3. Mounting: Concealed.
4. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

2.3 PRIVATE-USE BATHROOM ACCESSORIES

- A. Source Limitations: Obtain each type of private-use bathroom accessory from single source from single manufacturer.
- B. Refer to Public Use Restroom accessories for balance of fixtures for the Private Use Bathroom Accessories.
- C. Private-Use Shower Curtain Rod:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASI-American Specialties, Inc.
 - b. Bobrick Washroom Equipment, Inc.
 - c. Bradley Corporation.
 2. Description: 1-inch- OD, curved rod.
 3. Configuration: As indicated on Drawings.
 4. Mounting Flanges: Exposed Insert requirements fasteners; in manufacturer's standard material and finish material and finish matching rod.
 5. Rod Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
 6. Features: Integral chrome-plated brass glide hooks.

D. Private-Use Folding Shower Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASI-American Specialties, Inc.
 - b. Bobrick Washroom Equipment, Inc.
 - c. Bradley Corporation.
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, ASTM A480/A480M No. 4 finish (satin).
5. Dimensions: 22" x 34 1.2".

2.4 UNDERLAVATORY GUARDS**A. Underlavatory Guard:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASI-American Specialties, Inc.
 - b. Bobrick Washroom Equipment, Inc.
 - c. Bradley Corporation.
2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
3. Material and Finish: Antimicrobial, molded plastic, white.

2.5 CUSTODIAL ACCESSORIES**A. Source Limitations: Obtain each type of custodial accessory from single source from single manufacturer.****B. Custodial Mop and Broom Holder:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASI-American Specialties, Inc.
 - b. Bobrick Washroom Equipment, Inc.
 - c. Bradley Corporation.
2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
3. Length: 36 inches.
4. Hooks: Four.
5. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.

- 6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
 - a. Shelf: Not less than nominal 0.05-inch-thick stainless steel.
 - b. Rod: Approximately 1/4-inch-diameter stainless steel.

2.6 MATERIALS

- A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch-minimum nominal thickness unless otherwise indicated.
- B. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch-minimum nominal thickness.
- C. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 hot-dip zinc coating.
- D. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.
- E. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.
- F. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).

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.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories in accordance with 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.
 - 1. Remove temporary labels and protective coatings.
- B. Grab Bars: Install to comply with specified structural-performance requirements.
- C. Shower Seats: Install to comply with specified structural-performance requirements.

TOILET, BATH AND LAUNDRY ACCESSORIES**SECTION 10 28 00**

LXT Eastside Development

Project #47732472

Permit Set 09/29/22

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.

END OF SECTION 102800

SECTION 104413 - FIRE PROTECTION CABINETS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:****1. Fire-protection cabinets for the following:****a. Portable fire extinguisher.****B. Related Requirements:****1. Section 104416 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets****1.2 ACTION SUBMITTALS****A. Product Data: For each type of product.****1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.****B. Shop Drawings: For fire-protection cabinets.****1. Include plans, elevations, sections, details, and attachments to other work.****C. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function.****1.3 CLOSEOUT SUBMITTALS****A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.****1.4 COORDINATION****A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.****B. Coordinate sizes and locations of fire-protection cabinets with wall depths.**

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.
- 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.

2.3 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Guardian Fire Equipment, Inc.
 - b. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
 - c. Larsen's Manufacturing Company.
- B. Cabinet Construction: Nonrated.
- C. Cabinet Material: Stainless steel sheet.
- D. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
 - 1. Square-Edge Trim: 1-1/4- to 1-1/2-inch backbend depth.
- E. Cabinet Trim Material: Stainless steel sheet.
- F. Door Material: Stainless steel sheet.
- G. Door Style: Fully glazed panel with frame.
- H. Door Glazing: Tempered float glass (clear).
 - 1. Acrylic Sheet Color:
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide recessed door pull and friction latch.

2. Provide continuous hinge, of same material and finish as trim,, permitting door to open 180 degrees.

J. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
 - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet glazing.
 - 2) Application Process: Silk-screened, Decals, Pressure-sensitive vinyl letters.
 - 3) Lettering Color: Red.
 - 4) Orientation: Vertical.

K. Materials:

1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304.
 - a. Finish: ASTM A480/A480M No. 4 directional satin finish,.
2. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.4 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
1. Weld joints and grind smooth.
 2. Miter corners and grind smooth.
 3. Provide factory-drilled mounting holes.
 4. Prepare doors and frames to receive locks.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
 2. Fabricate door frames of one-piece construction with edges flanged.
 3. Miter and weld perimeter door frames and grind smooth.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. 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 walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for semirecessed 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 or, if not indicated, at height indicated below:
 - 1. Fire-Protection Cabinet Mounting Height: 42 inches above finished floor to top of fire extinguisher.
- B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
 - 1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed 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:
 - 1. Apply decals or vinyl lettering at locations indicated.
 - 2. Apply decals or vinyl lettering on field-painted fire-protection cabinets after painting is complete.

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 SUMMARY**

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.
- B. Related Requirements:
 - 1. Section 104413 "Fire Protection Cabinets."

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function.

1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

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 when testing interval required by NFPA 10 is within the warranty period.
 - b. Faulty operation of valves or release levers.
2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- 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 FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Guardian Fire Equipment, Inc.
 - b. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
 - c. Larsen's Manufacturing Company.
 2. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.
 3. Valves: Manufacturer's standard.
 4. Handles and Levers: Manufacturer's standard.
 5. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.
- B. **Multipurpose Dry-Chemical Type in Steel Container: UL-rated 3-A:40-B:C, 5-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container. Typical unless noted otherwise.**
- C. **Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container. At vehicle recharging locations.**

2.3 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Guardian Fire Equipment, Inc.
 - b. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
 - c. Larsen's Manufacturing Company.
 - 2. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
 - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical.

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 and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
 - 1. Mounting Height: Top of fire extinguisher to be at 42 inches above finished floor.

END OF SECTION 104416

SECTION 113013 - RESIDENTIAL APPLIANCES**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Refrigeration appliances.

B. Related Requirements:

1. Section 224100 "Residential Plumbing Fixtures" for kitchen sinks, dishwasher air-gap fittings, waste (garbage) disposers, and instant hot-water dispensers.

1.2 ALLOWANCES**1.3 ACTION SUBMITTALS****A. Product Data:**

1. Refrigeration appliances.

B. Product Data Submittals: For each product.

1. Include installation details, material descriptions, dimensions of individual components, and finishes for each appliance.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

1.4 INFORMATIONAL SUBMITTALS**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

1.6 WARRANTY

- A. Special Warranties: Manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period except as qualified below:

1. Warranty Period: Five years from date of Substantial Completion.

- B. Microwave Oven: Limited warranty, including parts and labor for first year and parts thereafter, for on-site service.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- C. Refrigerator/Freezer, Freezer, and Ice maker, Sealed System: Full warranty, including parts and labor, for on-site service on the product.
 - 1. Warranty Period for Sealed Refrigeration System: Five years from date of Substantial Completion.
 - 2. Warranty Period for Other Components: Two years from date of Substantial Completion.
- D. Dishwasher: Full warranty, including parts and labor, for on-site service on the product.
 - 1. Warranty Period for Deterioration of Tub and Metal Door Liner: Five years from date of Substantial Completion.
 - 2. Warranty Period for Other Components: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of residential appliance from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with applicable provisions in the DOJ's 2010 ADA Standards for Accessible Design the ABA standards of the Federal agency having jurisdiction and ICC A117.1.

2.3 COOKING APPLIANCES

- A. Microwave Oven:
 - 1. 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]:**
 - a. GE Appliances; Haier Group.
 - b. Jennair; Whirlpool Corporation.
 - c. Kenmore; Transformco SR Brands LLC.
 - d. KitchenAid; Whirlpool Corporation.

- e. LG Electronics USA, Inc.; LG Electronics Inc.
- f. Maytag; Whirlpool Corporation.
- g. Samsung Electronics America, Inc. (SEA); Samsung Electronics Co., Ltd. (SEC).
- h. Sharp Electronics Corp.
- i. Whirlpool Corporation.
- 2. Mounting: Undercabinet.
- 3. Type: Conventional.
- 4. Dimensions:
 - a. Width: As indicated on Drawings.
 - b. Depth: As indicated on Drawings.
 - c. Height: As indicated on Drawings.
- 5. Capacity: 1.2 cu. Ft.
- 6. Oven Door: Door with observation window and pushbutton latch release.
- 7. Microwave Power Rating: Manufacturer's standard.
- 8. Electric Power Supply: 120 V, 60 Hz, 1 phase, 15 A.
- 9. Controls: Digital panel controls and timer display.
- 10. Material: Manufacturer's standard.
 - a. Color/Finish: Stainless Steel.

2.4 REFRIGERATION APPLIANCES

- A. Refrigerator/Freezer: Two-door refrigerator/freezer with freezer on bottom and complying with AHAM HRF-1.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Frigidaire.
 - b. GE Appliances; Haier Group.
 - c. Jennair; Whirlpool Corporation.
 - d. Kenmore; Transformco SR Brands LLC.
 - e. KitchenAid; Whirlpool Corporation.
 - f. LG Electronics USA, Inc.; LG Electronics Inc.
 - g. Maytag; Whirlpool Corporation.
 - h. Whirlpool Corporation.
 - 2. Type: Freestanding.
 - 3. Dimensions:
 - a. Width: As indicated on Drawings.
 - b. Depth: As indicated on Drawings.
 - c. Height: As indicated on Drawings.
 - 4. Storage Capacity:
 - a. Refrigeration Compartment Volume: 16.2 cu. ft..
 - b. Freezer Volume: 7.1 cu. ft..

- c. Shelf Area: Three adjustable glass shelves,.
 - 5. General Features:
 - a. Door Configuration: Overlay.
 - b. Built-in water-filtration system.
 - c. Dual refrigeration systems.
 - 6. Refrigerator Features:
 - a. Interior light in refrigeration compartment.
 - b. Compartment Storage: vegetable crisper and meat compartment.
 - c. Door Storage: Modular compartments.
 - d. Temperature-controlled meat/deli bin.
 - e. .
 - 7. Freezer Features: Two freezer compartment(s) with door(s) configured as pull-out drawer(s).
 - a. Automatic defrost.
 - b. Interior light in freezer compartment.
 - c. Automatic icemaker and storage bin.
 - 8. Energy Star: Provide appliances that qualify for the EPA/DOE Energy Star product-labeling program.
 - 9. Front Panel(s): Stainless steel.
 - a. Panel Color: Stainless Steel.
 - 10. Appliance Color/Finish: Stainless steel.
- B. Icemaker:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. GE Appliances; Haier Group.
 - b. Jennair; Whirlpool Corporation.
 - c. KitchenAid; Whirlpool Corporation.
 - d. Maytag; Whirlpool Corporation.
 - e. Viking Range, LLC; Middleby Corporation.
 - f. Whirlpool Corporation.
 - g. Manitowoc Ice
 - 2. Type: Freestanding.
 - 3. Dimensions:
 - a. Width: As indicated on Drawings.
 - b. Depth: As indicated on Drawings.
 - c. Height: As indicated on Drawings.
 - 4. Ice Capacity:

- a. Production: 550 lb per day.
 - b. Storage: 543 lb.
5. Features:
- a. Door Configuration: Overlay.
 - b. Automatic defrost.
 - c. Automatic shutoff.
 - d. Defrost drain.
 - e. .
6. Front Panel: Manufacturer's standard.
- a. Panel Color: Stainless Steel.
7. Appliance Color/Finish: Stainless steel.

2.5 CLEANING APPLIANCES

A. Dishwasher Insert drawing designation: Complying with AHAM DW-1.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bosch US; BSH Home Appliances Corporation.
 - b. Frigidaire.
 - c. GE Appliances; Haier Group.
 - d. Samsung Electronics America, Inc. (SEA); Samsung Electronics Co., Ltd. (SEC).
 - e. Whirlpool Corporation.
- 2. Type: Built-in undercounter.
- 3. Dimensions:
 - a. Width: As indicated on Drawings.
 - b. Depth: As indicated on Drawings.
 - c. Height: As indicated on Drawings.
- 4. Capacity:
 - a. International Place Settings of China: 15.
 - b. Water Consumption for Full Load: 9.5 liters per cycle.
- 5. Sound Level: Maximum 42 dB.
- 6. Tub and Door Liner: Manufacturer's standard with sealed detergent and automatic rinsing-aid dispensers.
- 7. Rack System: Nylon or PVC-coated sliding dish racks, with removable cutlery basket.
- 8. Controls: Touch-pad Rotary-dial Insert description controls with four wash cycles and hot-air and heat-off drying cycle options.
- 9. Features:
 - a. Waste food disposer.

- b. Self-cleaning food-filter system.
 - c. Hot-water booster heater for 140 deg F wash water with incoming water at 100 deg F.
 - d. Lock-out feature.
 - e. Half-load option.
 - f. Delay-wash option.
 - g. Digital display panel.
 - h. Water softener.
 - i. Soil-sensing water use control system.
- 10. Energy Star: Provide appliances that qualify for the EPA/DOE Energy Star product-labeling program.
- 11. Front Panel: Stainless steel.
- 12. Appliance Color/Finish: Stainless steel.
- B. Clothes Washer: Complying with AHAM HLW-1.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. GE Appliances; Haier Group.
 - b. LG Electronics USA, Inc.; LG Electronics Inc.
 - c. Maytag; Whirlpool Corporation.
 - d. Speed Queen
 - 2. Type: Freestanding, top-loading unit.
 - 3. Dimensions:
 - a. Width: As indicated on Drawings.
 - b. Depth: As indicated on Drawings.
 - c. Height: As indicated on Drawings.
 - 4. Drum: Perforated stainless steel.
 - a. Capacity: 3.2 cu. ft..
 - 5. Controls: Rotary-dial controls for water-fill levels, wash/rinse water temperatures, and variable-speed and fabric selectors.
 - a. Wash Cycles: Six wash cycles, including regular, delicate, and permanent press.
 - b. Wash Temperatures: Three settings.
 - c. Speed Combinations: Two.
 - 6. Electrical Power: 120 V, 60 Hz, 1 phase, 15 A.
 - 7. Motor: Manufacturer's standard with built-in overload protector.
 - 8. Features:
 - a. Agitator: Center spindle.
 - b. Self-cleaning lint filter.
 - c. Unbalanced-load compensator.
 - d. Inlet Hoses: Minimum length 60 inches.

- e. Drain Hoses: Minimum length 48 inches.
 - f. Self-leveling legs.
 - g. Automatic dispenser for bleach fabric softener and detergent.
 - h. Spin-cycle safety switch.
 - i. End-of-cycle signal.
 - j. Extra-rinse option.
 - k. Delay-wash option.
 - l. Electronic temperature control.
 - m. Water levels automatically set.
 - n. Pedestal: 8-inch-high laundry pedestal with storage drawer, matching appliance finish.
9. Energy Star: Provide appliances that qualify for the EPA/DOE Energy Star product-labeling program.
10. Water-Efficient Clothes Washer: Provide clothes washer with modified energy factor greater than or equal to 2.0 and water factor less than 5.5.
11. Appliance Finish: Enamel.
- a. Color: White.
12. Front-Panel Finish: Manufacturer's standard.
- a. Panel Color: White or Black.
- C. Clothes Dryer: Complying with AHAM HLD-1.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. GE Appliances; Haier Group.
 - b. LG Electronics USA, Inc.; LG Electronics Inc.
 - c. Maytag; Whirlpool Corporation.
 - d. Speed Queen
2. Type: Freestanding, frontloading, electric unit.
3. Dimensions:
- a. Width: As indicated on Drawings.
 - b. Depth: As indicated on Drawings.
 - c. Height: As indicated on Drawings.
4. Drum: Perforated porcelain-enameled steel.
- a. Capacity: 7.0 cu. ft..
5. Controls: Rotary-dial controls for drying cycle, temperatures, and fabric selectors.
6. Electric-Dryer Power: 240 V, 60 Hz, 1 phase, 30 A.
7. Features:
- a. Removable lint filter.
 - b. Electronic temperature and moisture-level-sensor controls.
 - c. End-of-cycle signal.

- d. Interior drum light.
 - e. Self-leveling legs.
 - f. Antibacterial cycle.
 - g. Auxiliary drying rack.
 - h. Built-in electrical power fuse.
 - i. Pedestal: 8-inch-high laundry pedestal with storage drawer, matching appliance finish.
- 8. Appliance Finish: Enamel.
 - a. Color: White.
- 9. Front-Panel Finish: Manufacturer's standard.
 - a. Panel Color: White or Black.

2.6 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 substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install appliances according to manufacturer's written instructions.
- B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.

- C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
 - 2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After installation, start units to confirm proper operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.
- B. An appliance will be considered defective if it does not pass tests and inspections.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances.

END OF SECTION 113013

SECTION 115213 - PROJECTION SCREENS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Manually operated, front-projection screens.
2. Electrically operated, front-projection screens.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood backing for screen installation.

1.2 DEFINITIONS

- A. ALR: Ambient-light rejection; for specular reflective viewing surfaces, measured as the percentage of ambient light striking the viewing surface that has equal angles of incidence and reflection.
- B. Gain: Ratio of light reflected from viewing-surface material to that reflected perpendicularly from a magnesium carbonate surface as determined in accordance with SMPTE RP 94.
- C. Half-Gain Angle: The angle, measured from the axis of the viewing surface to the most central position on a perpendicular plane through the horizontal centerline of the viewing surface, where the gain is half of the peak gain.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show layouts and types of front-projection screens. Include the following:
- C. Samples for Verification: For each type of exposed finish, in manufacturer's standard sizes.
- D. Product Schedule: For front-projection screens.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For front-projection screens to include in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Environmental Limitations: Do not deliver front-projection screens until spaces are enclosed and weathertight, wet-work in installation spaces is complete and dry, and temporary or

permanent HVAC system is operating and maintaining ambient temperature and humidity conditions planned for building occupants during the remainder of the construction period.

- B. Store front-projection screens in manufacturer's protective packaging and according to manufacturer's written instructions.

1.6 COORDINATION

- A. Coordinate layout and installation of front-projection screens with adjacent construction, including HVAC system components, and partitions.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Source Limitations for Projection Screens: Obtain front-projection screens from single manufacturer. Obtain viewing surfaces and accessories, including mounting hardware, from screen manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Viewing-Surface and Masking Materials:
 - 1. Mildew-Resistance Rating: Zero or 1 when tested in accordance with ASTM G21.
 - 2. Flame Resistance: Passes NFPA 701.
 - 3. Flame-Spread Index: Not greater than 75 when tested in accordance with ASTM E84.

2.3 FRONT-PROJECTION SCREENS

- A. General Requirements: Manufacturer's standard spring-roller-operated units, consisting of case, flexible screen, mounting accessories, and other components necessary for a complete installation.
 - 1. Screen Mounting: Top edge securely anchored to a rigid steel roller; bottom edge formed into a pocket holding a tubular metal slat, with ends of slat protected by plastic caps, and with a saddle and pull attached to slat by screws.
- B. Fixed Screen: Unit with free-hanging screen; with screen case fabricated from formed-steel sheet or aluminum extrusions with manufacturer's standard finish and matching end caps.
 - 1. Surface-Mounting Configuration: Mounted using manufacturer's standard fix screen system.
 - 2. Matte Viewing Surface: White, 1.0 minimum peak gain and 60-degree minimum half-gain angle.
 - 3. Seams: Where height of viewing surface exceeds maximum height without seams, locate horizontal seam with full-width material at top of viewing surface.

PROJECTION SCREEN

LXT Eastside Development

SECTION 11 52 13

Project #47732472

Permit Set 09/29/22

4. Edge Treatment: White
5. Size of Viewing Surface: As indicated in schedule on Drawings.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Install front-projection screens at locations indicated on Drawings to comply with screen manufacturer's written instructions.
- B. Install front-projection screens with screen cases in position and in relation to adjoining construction indicated. Securely anchor them to supporting substrate in a manner that produces a smoothly operating screen that, when lowered, has flat viewing surface and plumb vertical edges.
 1. Test electrically operated units to verify that screen controls, limit switches, closures, and other operating components are in optimum functioning condition.
 2. Test manually operated units to verify that screen-operating components are in optimum functioning condition.

END OF SECTION 115213

SECTION 123623.13 - PLASTIC-LAMINATE-CLAD COUNTERTOPS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Plastic-laminate-clad countertops.
2. Fire-retardant-treated materials.
3. Accessories.

1.2 ACTION SUBMITTALS**A. Product Data:**

1. Plastic-laminate-clad countertops.
2. Fire-retardant-treated materials.
3. Accessories.

B. Product Data Submittals: For each product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

C. Shop Drawings: For plastic-laminate-clad countertops.

1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
2. Show locations and sizes of cutouts and holes for items installed in plastic-laminate-clad countertops.
3. Apply AWI Quality Certification Program label to Shop Drawings.

D. Samples for Verification: As follows:

1. Plastic Laminates: For each type, color, pattern, and surface finish required, 8 by 10 inches in size.
2. Fabrication Sample: For each type and profile of countertop required, provide one sample applied to core material with specified edge material applied to one edge.

1.3 INFORMATIONAL SUBMITTALS**A. Qualification Data: For Installer & fabricator.****B. Product Certificates: For the following:**

1. Composite wood products.

2. High-pressure decorative laminate.
3. Chemical-resistant, high-pressure decorative laminate.
4. Adhesives.

C. Quality Standard Compliance Certificates: AWI Quality Certification Program.

D. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.4 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.

1. Shop Certification: AWI's Quality Certification Program accredited participant.

B. Installer Qualifications: AWI's Quality Certification Program accredited participant.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver countertops only after casework and supports on which they will be installed have been completed in installation areas.

B. Store countertops in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

C. Keep surfaces of countertops covered with protective covering during handling and installation.

1.6 FIELD CONDITIONS

A. Environmental Limitations with Humidity Control: Do not deliver or install countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

B. Field Measurements: Where countertops are 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.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD COUNTERTOPS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of plastic-laminate-clad countertops indicated for construction, finishes, installation, and other requirements.

1. Provide inspections of fabrication and installation together with labels and certificates from AWI certification program indicating that countertops comply with requirements of grades specified.
 2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.
- B. Grade: Custom.
- C. High-Pressure Decorative Laminate: ISO 4586-3, Grade HGS.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Formica Corporation.
 - b. Laminart LLC.
 - c. Arborite
 - d. Wilsonart LLC.
- D. 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.
- E. Edge Treatment: Same as laminate cladding on horizontal surfaces.
- F. Core Material: Fire-retardant-treated plywood or Fire-retardant particleboard or Fire-retardant MDF.
- G. Core Material at Sinks: Particleboard made with exterior glue or MDF made with exterior glue or exterior-grade plywood.
- H. Core Thickness: 3/4 inch.
1. Build up countertop thickness to 1-1/2 inches at front, back, and ends with additional layers of core material laminated to top.
- I. Backer Sheet: Provide plastic-laminate backer sheet, ISO 4586-3, grade to match exposed surface, on underside of countertop substrate.
- J. Paper Backing: Provide paper backing on underside of countertop substrate.
- 2.2 WOOD MATERIALS
- A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.
1. Wood Moisture Content: 5 to 10 percent.

- B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of countertop and quality grade specified unless otherwise indicated.
1. MDF: Medium-density fiberboard, ANSI A208.2, Grade 130.
 2. Particleboard: ANSI A208.1, Grade M-2.
 3. Softwood Plywood: DOC PS 1.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products in accordance with test method indicated by a qualified testing agency.
1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials 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 qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.
- B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, 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 beyond the centerline of the burners at any time during the test.
1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
 2. For items indicated to receive a stained or natural transparent finish, use organic resin chemical formulation.
 3. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
 4. Mill lumber before treatment and implement procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of exposed treated woodwork.
- C. Fire-Retardant Particleboard: Made from softwood particles and fire-retardant chemicals mixed at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less when tested in accordance with ASTM E84.
1. For panels 3/4 inch thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, 1600 psi; modulus of elasticity, 300,000 psi; internal bond, 80 psi; and screw-holding capacity on face and edge, 250 and 225 lbf, respectively.
 2. For panels 13/16 to 1-1/4 inches thick, comply with ANSI A208.1 for Grade M-1 except for the following minimum properties: modulus of rupture, 1300 psi; modulus of

elasticity, 250,000 psi; linear expansion, 0.50 percent; and screw-holding capacity on face and edge, 250 and 175 lbf, respectively.

- D. Fire-Retardant MDF: 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 in accordance with ASTM E84.

2.4 ACCESSORIES

- A. Wire-Management Grommets: Circular, molded-plastic grommets and matching plastic caps with slot for wire passage.
 - 1. Outside Diameter: 2 inches.
 - 2. Color: White

2.5 MISCELLANEOUS MATERIALS

- A. Adhesive for Bonding Plastic Laminate: Type I, waterproof type as selected by fabricator to comply with requirements.
 - 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.6 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 inch over base cabinets. Ease edges to radius indicated for the following:
 - 1. Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.
- C. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- D. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately, and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 - 1. Seal edges of cutouts by saturating with varnish.

PART 3 - EXECUTION**3.1 PREPARATION**

- A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.
- B. Before installing countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing.

3.2 INSTALLATION

- A. Grade: Install countertops to comply with same grade as item to be installed.
- B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.
 - 1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately, and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 - 2. Seal edges of cutouts by saturating with varnish.
- C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
 - 1. Secure field joints in countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten in accordance with manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.
- D. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical-treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- F. Countertop Installation: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Install countertops level and true in line. Use concealed shims as required to maintain not more than a 1/8-inch-in-96-inches variation from a straight, level plane.
 - 2. Secure backsplashes to walls with adhesive.
 - 3. Seal joints between countertop and backsplash, if any, and joints where countertop and backsplash abut walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects. Where not possible to repair, replace countertops. Adjust joinery for uniform appearance.
- B. Clean countertops on exposed and semiexposed surfaces.
- C. Protection: Provide Kraft paper or other suitable covering over countertop surfaces, taped to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION 123623.13

SECTION 123661.16 - SOLID SURFACING COUNTERTOPS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Solid surface material countertops.
2. Solid surface material backsplashes.
3. Solid surface material end splashes.
4. Solid surface material apron fronts.
5. Solid surface material sinks.

B. Related Requirements:

1. Section 224100 "Residential Plumbing Fixtures" for non-integral sinks and plumbing fittings.

1.2 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 Initial Selection: For each type of material exposed to view.**D. Samples for Verification:** For the following products:

1. Countertop material, 6 inches square.

1.3 INFORMATIONAL SUBMITTALS**A. Qualification Data:** For fabricator.**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 ISFA 2-01.
 - 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. Avonite Surfaces; a Brand of Aristech Surfaces LLC.
 - b. DuPont; DuPont de Nemours, Inc.
 - c. Formica Corporation.
 - 2. Type: Provide Standard type or Veneer type made from material complying with requirements for Standard type, as indicated unless Special Purpose type is indicated.
 - 3. Colors and Patterns: Match Architect's samples.
- B. Particleboard: ANSI A208.1, Grade M-2.
- C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 FABRICATION

- A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WT's "Architectural Woodwork Standards."
 - 1. Grade: Custom.

- B. Configuration:

1. Front: Straight, slightly eased at top.
2. Backsplash: Straight, slightly eased at corner.
3. End Splash: Matching backsplash.

C. Countertops:

1. 1/4-inch-thick, solid surface material laminated to 3/4-inch-thick particleboard with exposed edges faced with 1/4-inch-thick, solid surface material.

D. Backsplashes: 1/2-inch- thick, solid surface material.

E. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

1. Fabricate with loose backsplashes for field assembly.

F. Joints:

1. Fabricate countertops without joints.
2. Fabricate countertops in sections for joining in field.
 - a. Joint Locations: Not within 18 inches of a sink or cooktop and not where a countertop section less than 36 inches long would result, unless unavoidable.
 - b. Splined Joints: Accurately cut kerfs in edges at joints for insertion of metal splines to maintain alignment of surfaces at joints. Make width of cuts slightly more than thickness of splines to provide snug fit. Provide at least three splines in each joint.

G. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
 - a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.
2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by solid surface material manufacturer.

B. 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, 1/4 inch maximum. Do not exceed 1/64-inch 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.
 - 1. Install metal splines in kerfs in countertop edges at joints. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
 - 2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.
- 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."

SOLID SURFACE COUNTERTOPS

LXT Eastside Development

SECTION 12 36 61.16

Project #47732472

Permit Set 09/29/22

END OF SECTION 123661.16

SECTION 133419 - METAL BUILDING SYSTEMS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Structural-steel framing.
2. Metal roof panels.
3. Metal wall panels.
4. Metal soffit panels.
5. Thermal insulation.
6. Accessories.

B. Related Requirements:

1. Section 077253 "Snow Guards" for prefabricated devices designed to hold snow on the roof surface.
2. Section 083613 "Sectional Doors" for sectional vehicular doors in metal building systems.

1.2 DEFINITIONS

- A. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in standards referenced by this Section.

1.3 COORDINATION

- A. Coordinate sizes and locations of concrete foundations and casting of anchor-rod inserts into foundation walls and footings. Anchor rod installation, concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS**A. Preinstallation Conference: Conduct conference at Project site.**

1. Review methods and procedures related to metal building systems including, but not limited to, the following:
 - a. Condition of foundations and other preparatory work performed by other trades.
 - b. Structural load limitations.

- c. Construction schedule. Verify availability of materials and erector's personnel, equipment, and facilities needed to make progress and avoid delays.
 - d. Required tests, inspections, and certifications.
 - e. Unfavorable weather and forecasted weather conditions and impact on construction schedule.
- 2. Review methods and procedures related to metal roof panel assemblies including, but not limited to, the following:
 - a. Compliance with requirements for purlin and rafter conditions, including flatness and attachment to structural members.
 - b. Structural limitations of purlins and rafters during and after roofing.
 - c. Flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
 - d. Temporary protection requirements for metal roof panel assembly during and after installation.
 - e. Roof observation and repair after metal roof panel installation.
- 3. Review methods and procedures related to metal wall panel assemblies including, but not limited to, the following:
 - a. Compliance with requirements for support conditions, including alignment between and attachment to structural members.
 - b. Structural limitations of girts and columns during and after wall panel installation.
 - c. Flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
 - d. Temporary protection requirements for metal wall panel assembly during and after installation.
 - e. Wall observation and repair after metal wall panel installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of metal building system component.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Metal roof panels.
 - b. Metal soffit panels.
 - c. Thermal insulation and vapor-retarder facings.
- B. Shop Drawings: Indicate components by others. Include full building plan, elevations, sections, details and the following:
 - 1. Anchor-Rod Plans: Submit anchor-rod plans and templates before foundation work begins. Include location, diameter, and minimum required projection of anchor rods required to attach metal building to foundation. Indicate column reactions at each location.

2. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.
 3. Metal Roof and Wall Panel Layout Drawings: Show layouts of panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, clip spacing, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.
 - a. Show roof-mounted items including roof hatches, equipment supports, pipe supports and penetrations, lighting fixtures, and items mounted on roof curbs.
 - b. Show wall-mounted items including personnel doors, vehicular doors, windows, louvers, and lighting fixtures.
 - c. Show translucent panels.
 4. Accessory Drawings: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
 - a. Flashing and trim.
 - b. Gutters.
 - c. Downspouts.
 - d. Service walkways.
- C. Samples for Initial Selection: For units with factory-applied finishes.
- D. Samples for Verification: For the following products:
1. Panels: Nominal 12 inches long by actual panel width. Include fasteners, closures, and other exposed panel accessories.
 2. Flashing and Trim: Nominal 12 inches long. Include fasteners and other exposed accessories.
 3. Vapor-Retarder Facings: Nominal 6-inch-square Samples.
 4. Windows: Full-size, nominal 12-inch-long frame Samples showing typical profile.
 5. Accessories: Nominal 12-inch-long Samples for each type of accessory.
- E. Door Schedule: For doors and frames. Use same designations indicated on Drawings. Include details of reinforcement.
1. Door Hardware Schedule: Include details of fabrication and assembly of door hardware. Organize schedule into door hardware sets indicating complete designations of every item required for each door or opening.
 2. Keying Schedule: Detail Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.
- F. Delegated Design Submittals: For metal building systems.
1. Include analysis data indicating compliance with performance requirements and design data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For erector & manufacturer.
- B. Welding certificates.
- C. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
 - 1. Name and location of Project.
 - 2. Order number.
 - 3. Name of manufacturer.
 - 4. Name of Contractor.
 - 5. Building dimensions including width, length, height, and roof slope.
 - 6. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
 - 7. Governing building code and year of edition.
 - 8. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).
 - 9. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
 - 10. Building-Use Category: Indicate category of building use and its effect on load importance factors.
- D. Erector Certificates: For qualified erector, from manufacturer.
- E. Material Test Reports: For each of the following products:
 - 1. Structural steel including chemical and physical properties.
 - 2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 3. Tension-control, high-strength, bolt-nut-washer assemblies.
 - 4. Shop primers.
 - 5. Nonshrink grout.
- F. Source quality-control reports.
- G. Field quality-control reports.
- H. Sample Warranties: For special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panel finishes to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. **Manufacturer Qualifications: A qualified manufacturer.**
 - 1. **Regularly manufactures specified products.**

2. Accreditation: Manufacturer's facility accredited according to IAS AC472, "Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems."
 3. Engineering Responsibility: Preparation of comprehensive engineering analysis and Shop Drawings by a professional engineer who is legally qualified to practice in jurisdiction where Project is located.
 4. **Manufactured specified products with satisfactory service on two similar installations in the last seven years.**
 - a. **Project Experience List: Provide contact names and addresses for completed projects.**
- B. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.**
1. **Regularly installs specified products.**
 2. **Installed specified products with satisfactory service on two similar installations in the last seven years.**
 - a. **Project Experience List: Provide contact names and addresses for completed projects.**
- C. Welding Qualifications: Qualify procedures and personnel according to the following:**
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.3, "Structural Welding Code - Sheet Steel."
- D. Land Surveyor Qualifications: A professional land surveyor who practices in jurisdiction where Project is located and who is experienced in providing surveying services of the kind indicated.**

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Protect foam-plastic insulation as follows:
 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 2. Protect against ignition at all times. Do not deliver foam-plastic insulation materials to Project site before installation time.
 3. Complete installation and concealment of foam-plastic materials as rapidly as possible in each area of construction.

1.10 FIELD CONDITIONS

- A. Weather Limitations: Proceed with panel installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.

1.11 WARRANTY

- A. Special Warranty on Metal Panel Finishes: Manufacturer agrees to repair finish or replace metal panels that show 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 D2244.
- b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
- c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 25 years from date of Substantial Completion.

- B. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.

1. Warranty Period: 20 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. Butler Manufacturing Company; a division of BlueScope Buildings North America, Inc.
2. Nucor Building Systems; a Nucor company.
3. Heavy Structures a division of BlueScope Buildings North America, Inc
4. J&M Steel
5. **Arco Steel**
6. **Alliance Steel**
7. **Varco Pruden**
8. **Americam Building**

- B. Source Limitations: Obtain metal building system components, including primary and secondary framing and metal panel assemblies, from single source from single manufacturer.

2.2 SYSTEM DESCRIPTION

- A. Provide a complete, integrated set of mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.
- B. Primary-Frame Type:
 - 1. Rigid Clear Span: Solid-member, structural-framing system without interior columns.
- C. End-Wall Framing:
 - 1. Manufacturer's standard, for buildings not required to be expandable, consisting of primary frame, capable of supporting one-half of a bay design load, and end-wall columns.
- D. Secondary-Frame Type: Manufacturer's standard purlins and joists and partially inset-framed girts.
- E. Eave Height: 42'-0".
- F. Bay Spacing: As determined by manufacturer 21'-4".
- G. Roof Slope: 1/4 inch per 12 inches.
- H. Roof System: Manufacturer's standard standing-seam, trapezoidal-rib, metal roof panels.
 - 1. Liner Panels: Tapered rib.
- I. Exterior Wall System: Manufacturer's standard concealed-fastener, tapered-rib, concealed-fastener, flat-profile, & concealed-fastener, flat-profile stucco finish metal wall panels.
 - 1. Liner Panels: Tapered rib.

2.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal building system.
- B. Structural Performance: Metal building systems to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual."
 - 1. Design Loads: As indicated on Drawings.
 - 2. Deflection and Drift Limits:
 - a. Design metal building system assemblies to withstand serviceability design loads without exceeding deflections and drift limits recommended in AISC Steel Design Guide No. 3 "Serviceability Design Considerations for Steel Buildings."

- b. No greater than the following:
 - 1) Primary Framing: Vertical deflection of 1/180 of the span.
 - 2) Purlins: Vertical deflection of 1/150 of the span.
 - 3) Girts: Horizontal deflection of **1/120** of the span.
 - 4) Metal Roof Panels: Vertical deflection of **1/180** of the span.
 - 5) Metal Wall Panels: Horizontal deflection of **1/120** of the span.
 - 6) Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
 - 7) Lateral Drift: Maximum of **1/240** of the building height for service level wind loads (10 year mean return period).
- C. Seismic Performance: As indicated on Drawings.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- E. Fire-Resistance Ratings: Where assemblies are indicated to have a fire-resistance rating, provide metal panel assemblies identical to those of assemblies tested for fire resistance per ASTM E119 or ASTM E108 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory," FM Global's "Approval Guide," or from the listings of another qualified testing agency.
- F. 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 testing at positive pressure according to NFPA 252 or UL 10C.
- G. Structural Performance for Metal Roof and Wall Panels: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:
 - 1. Wind Loads: As indicated on Drawings.
- H. Air Infiltration for Metal Roof Panels: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E1680 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- I. Air Infiltration for Metal Wall Panels: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- J. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E1646 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- K. Water Penetration for Metal Wall Panels: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
 1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- L. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
 1. Uplift Rating: UL 90.
- M. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
 1. Fire/Windstorm Classification: Class 1A- 105.
 2. Hail Resistance: VSH.
- N. Energy Star Listing: Roof panels that are listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.
- O. Energy Performance: Provide roof panels according to one of the following when tested according to CRRC-1:
 1. Three-year, aged, solar reflectance of not less than 0.55 and emissivity of not less than 0.75.
 2. Three-year, aged, Solar Reflectance Index of not less than 64 when calculated according to ASTM E1980.
- P. Thermal Performance for Opaque Elements: Provide the following maximum U-factors and minimum R-values when tested according to ASTM C1363 or ASTM C518:
 1. Roof:
 - a. U-Factor: .047
 - b. R-Value: R30 min
 2. Walls:
 - a. Hangar and lean space with girt walls.
 - 1) U-Factor: .0909
 - 2) R-Value: R11 min
 - b. Terminal and School spaces with metal stud walls.
 - 1) U-Factor: .0526
 - 2) R-Value: R19 min

2.4 STRUCTURAL-STEEL FRAMING

- A. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings."

- B. Bolted Connections: Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- C. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.
- D. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafters, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.
 - 1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
 - a. Slight variations in span and spacing may be acceptable if necessary to comply with manufacturer's standard, as approved by Architect.
 - 2. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
 - 3. Frame Configuration: Multiple gable.
 - 4. Exterior Column: Tapered.
 - 5. Rafter: Tapered.
- E. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:
 - 1. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet.
- F. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, pre-painted with coil coating, to comply with the following:
 - 1. Purlins:
 - a. C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; minimum 2-1/2-inch-wide flanges.
 - 2. Girts: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees from flange, with minimum 2-1/2-inch-wide flanges.
 - 3. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.
 - 4. Flange Bracing: Minimum 2-by-2-by-1/8-inch structural-steel angles or 1-inch-diameter, cold-formed structural tubing to stiffen primary-frame flanges.
 - 5. Sag Bracing: Minimum 1-by-1-by-1/8-inch structural-steel angles.
 - 6. Base or Sill Angles: Manufacturer's standard base angle, minimum 3-by-2-inch, fabricated from zinc-coated (galvanized) steel sheet.

7. Purlin and Girt Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
 8. Framing for Openings: Channel shapes; fabricated from cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings and head, jamb, and sill of other openings.
 9. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.
- G. Canopy Framing: Manufacturer's standard structural-framing system, designed to withstand required loads; fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide frames with attachment plates and splice members, factory drilled for field-bolted assembly.
1. Type: Straight-beam, eave type.
- H. Bracing: Provide adjustable wind bracing using any method as follows:
1. Rods: ASTM A36/A36M; ASTM A572/A572M, Grade 50; or ASTM A529/A529M, Grade 50; minimum 1/2-inch-diameter steel; threaded full length or threaded a minimum of 6 inches at each end.
 2. Cable: ASTM A475, minimum 1/4-inch-diameter, extra-high-strength grade, Class B, zinc-coated, seven-strand steel; with threaded end anchors.
 3. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.
 4. Rigid Portal Frames: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
 5. Fixed-Base Columns: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
 6. Diaphragm Action of Metal Panels: Design metal building to resist wind forces through diaphragm action of metal panels.
- I. Anchor Rods: Headed anchor rods as indicated in Anchor Rod Plan for attachment of metal building to foundation.
- J. Materials:
1. W-Shapes: ASTM A992/A992M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
 2. Channels, Angles, M-Shapes, and S-Shapes: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
 3. Plate and Bar: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
 4. Steel Pipe: ASTM A53/A53M, Type E or S, Grade B.
 5. Cold-Formed Hollow Structural Sections: ASTM A500, Grade B or C, structural tubing.
 6. Structural-Steel Sheet: Hot-rolled, ASTM A1011/A1011M, Structural Steel (SS), Grades 30 through 55, or High-Strength Low-Alloy Steel (HSLAS) or High-Strength Low-Alloy Steel with Improved Formability (HSLAS-F), Grades 45 through 70; or cold-rolled, ASTM A1008/A1008M, Structural Steel (SS), Grades 25 through 80, or HSLAS, Grades 45 through 70.

7. Metallic-Coated Steel Sheet: ASTM A653/A653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G60 coating designation; mill phosphatized.
8. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A755/A755M.
 - a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G90 coating designation.
 - b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, SS, Grade 50 or 80; with Class AZ50 coating.
9. Non-High-Strength Bolts, Nuts, and Washers: ASTM A307, Grade A, carbon-steel, hex-head bolts; ASTM A563 carbon-steel hex nuts; and ASTM F844 plain (flat) steel washers.
 - a. Finish: Plain.
10. High-Strength Bolts, Nuts, and Washers, Grade A325: ASTM F3125/F3125M, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
 - a. Finish: Plain.
11. High-Strength Bolts, Nuts, and Washers, Grade A490: ASTM F3125/F3125M, Type 1, heavy-hex steel structural bolts or Grade F2280 tension-control, bolt-nut-washer assemblies with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
12. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1 hardened carbon-steel washers.
 - a. Finish: Plain.
13. Unheaded Anchor Rods: ASTM F1554, Grade 36 or 55.
 - a. Configuration: Straight.
 - b. Nuts: ASTM A563 heavy-hex carbon steel.
 - c. Plate Washers: ASTM A36/A36M carbon steel.
 - d. Washers: ASTM F436 hardened carbon steel.
 - e. Finish: Plain.
14. Headed Anchor Rods: ASTM F1554, Grade 36 or 55.
 - a. Configuration: Straight.
 - b. Nuts: ASTM A563 heavy-hex carbon steel.
 - c. Plate Washers: ASTM A36/A36M carbon steel.
 - d. Washers: ASTM F436 hardened carbon steel.
 - e. Finish: Plain.
15. Threaded Rods: ASTM A36/A36M.

- a. Nuts: ASTM A563 heavy-hex carbon steel.
- b. Washers: ASTM F436 hardened carbon steel.
- c. Finish: Plain.

K. Finish: Factory primed. Apply specified primer immediately after cleaning and pretreating.

- 1. Clean and prepare in accordance with SSPC-SP2.
- 2. Coat with manufacturer's standard primer. Apply primer to primary and secondary framing to a minimum dry film thickness of 1 mil.
 - a. Prime secondary framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil on each side.

2.5 METAL ROOF PANELS

A. Standing-Seam, Trapezoidal-Rib, Metal Roof Panels: Formed with raised trapezoidal ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels.

- 1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
 - a. Exterior Finish: Two-coat fluoropolymer.
 - b. Color: Per the drawings.
- 2. Clips: One-piece fixed to accommodate thermal movement.
- 3. Joint Type: Mechanically seamed.
- 4. Panel Coverage: 24 inches.
- 5. Panel Height: 2 inches.
- 6. Uplift Rating: UL 90.

B. Finishes:

- 1. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish 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.
- 2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

2.6 METAL WALL PANELS

A. Concealed-Fastener Wall Panels:

1. As specified in Section 074213.14 "Formed Metal Wall Panels."

B. Flush-Profile, Metal Liner Panels:

1. As specified in Section 074213.14 "Formed Metal Wall Panels."

2.7 METAL SOFFIT PANELS

- A. General: Provide factory-formed metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. Concealed-Fastener, Flush-Profile, Metal Soffit Panels: Formed with vertical panel edges and flush surface; with flush joint between panels; with 1-inch-wide flange for attaching interior finish; designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps.
1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness. Pre-painted by the coil-coating process to comply with ASTM A755/A755M.
 - a. Exterior Finish: Fluoropolymer.
 - b. Color: Refer to drawings.
 2. Panel Coverage: 12 inches.
 3. Panel Height: 1 inch.

2.8 THERMAL INSULATION

- A. Faced Metal Building Insulation: ASTM C991, Type II, glass-fiber-blanket insulation; 0.5-lb/cu. ft. density; 2-inch-wide, continuous, vapor-tight edge tabs; with a flame-spread index of 25 or less.
- B. Unfaced Metal Building Insulation: ASTM C991, Type I, or NAIMA 202, glass-fiber-blanket insulation; 0.5-lb/cu. ft. density; 2-inch-wide, continuous, vapor-tight edge tabs; with a flame-spread index of 25 or less.
- C. Retainer Strips: For securing insulation between supports, 0.025-inch nominal-thickness, formed, metallic-coated steel or PVC retainer clips colored to match insulation facing.
- D. Vapor-Retarder Facing: ASTM C1136, with permeance not greater than 0.02 perm when tested according to ASTM E96/E96M, Desiccant Method.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Lamtec Corporation.
 2. Composition:

- a. White polypropylene film facing and fiberglass-polyester-blend fabric backing.
- E. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

2.9 PERSONNEL DOORS AND FRAMES

- A. Swinging Personnel Doors and Frames:
 - 1. As specified in Section 081113 "Hollow Metal Doors and Frames."

2.10 WINDOWS

- A. Aluminum Windows:
 - 1. As specified in Section 085113 "Aluminum Windows."
- B. Glazing: Comply with requirements specified in Section 088000 "Glazing."

2.11 TRANSLUCENT PANELS

- A. As specified in Section 084523 "Fiberglass Sandwich Panel Assemblies."

2.12 HANGAR DOORS

- A. As specified in Section 083416 "Hangar Doors."
- B. Coordinate with hangar door provider to provide perpendicular members at approximately 10'-0" o/c, to receive top door guides. Coordinate with the hangar door provider that the perpendicular members will be at the proper elevation and within the tolerance specified for the bottom rails.

2.13 ACCESSORIES

- A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.
 - 1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
- B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.
 2. Clips: Manufacturer's standard, formed from stainless steel sheet, designed to withstand negative-load requirements.
 3. Cleats: Manufacturer's standard, mechanically seamed cleats formed from stainless steel sheet or nylon-coated aluminum sheet.
 4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or pre-molded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
 6. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide 1-inch standoff; fabricated from extruded polystyrene.
 7. Closures: Provide closures at eaves and rakes, fabricated of same material as metal panels.
 8. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 9. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, pre-painted with coil coating; finished per drawings
1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
- D. Gutters: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, pre-painted with coil coating; finished to match roof fascia and rake trim per drawings. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch-long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."
1. Gutter Supports: Fabricated from same material and finish as gutters.
 2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.
- E. Downspouts: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, pre-painted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot-long sections, complete with formed elbows and offsets.
1. Mounting Straps: Fabricated from same material and finish as gutters.
- F. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.
- G. Materials:

1. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.
2. Fasteners for Metal Roof Panels:
 - a. Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless steel cap or zinc-aluminum-alloy head and EPDM sealing washer.
 - b. Self-drilling, Type 410 stainless steel or self-tapping, Type 304 stainless steel or zinc-alloy-steel hex washer head, with EPDM washer under heads of fasteners bearing on weather side of metal panels.
3. Fasteners for Metal Wall Panels:
 - a. Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws , with EPDM sealing washers bearing on weather side of metal panels.
4. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
5. Blind Fasteners: High-strength aluminum or stainless steel rivets.
6. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
7. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
8. Metal Panel Sealants:
 - a. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene-compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape of manufacturer's standard size.
 - b. Joint Sealant: ASTM C920; one part elastomeric polyurethane or polysulfide; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

2.14 FABRICATION

- A. General: Design components and field connections required for erection to permit easy assembly.
 1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
 2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members to be free of cracks, tears, and ruptures.
- B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.

- C. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
1. Make shop connections by welding or by using high-strength bolts.
 2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
 3. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
 4. Weld clips to frames for attaching secondary framing if applicable, or punch for bolts.
 5. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary framing with specified primer after fabrication.
- D. Secondary Framing: Shop fabricate framing components to indicated size and section by roll forming or break forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
1. Make shop connections by welding or by using non-high-strength bolts.
 2. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary framing with specified primer after fabrication.
- E. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

2.15 SOURCE QUALITY CONTROL

- A. Special Inspection: Owner will engage a qualified special inspector to perform source quality control inspections and to submit reports.
1. Accredited Manufacturers: Special inspections will not be required if fabrication is performed by an IAS AC472-accredited manufacturer approved by authorities having jurisdiction to perform such Work without special inspection.
 - a. After fabrication, submit copy of certificate of compliance to authorities having jurisdiction, certifying that Work was performed according to Contract requirements.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.
 - 1. Engage land surveyor to perform surveying.
- C. Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.
- B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION OF STRUCTURAL FRAMING

- A. Erect metal building system according to manufacturer's written instructions and drawings.
- B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.
- C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
- D. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

- E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.
- F. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.
 - 1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt type and joint type specified.
 - a. Joint Type: Snug tightened or pretensioned as required by manufacturer.
- G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.
 - 1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
 - 2. Locate and space wall girts to suit openings such as doors and windows.
 - 3. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.
- H. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
 - 1. Tighten rod and cable bracing to avoid sag.
 - 2. Locate interior end-bay bracing only where indicated.
- I. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.
- J. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

3.4 METAL PANEL INSTALLATION, GENERAL

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

- C. Examination: Examine primary and secondary framing to verify that structural-panel support members and anchorages have been installed within alignment tolerances required by manufacturer.
 - 1. Examine roughing-in for components and systems penetrating metal panels, to verify actual locations of penetrations relative to seams before metal panel installation.
- D. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Install metal panels perpendicular to structural supports unless otherwise indicated.
 - 2. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
 - 3. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 4. Locate metal panel splices over structural supports with end laps in alignment.
 - 5. Lap metal flashing over metal panels to allow moisture to run over and off the material.
- E. Lap-Seam Metal Panels: Install screw fasteners using power tools with controlled torque adjusted to compress EPDM washers tightly without damage to washers, screw threads, or metal panels. Install screws in predrilled holes.
 - 1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
- F. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- G. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.
 - 1. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.
 - 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.5 METAL ROOF PANEL INSTALLATION

- A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.
 - 1. Install ridge caps as metal roof panel work proceeds.
 - 2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.

- B. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint, at location and spacing and with fasteners recommended by manufacturer.
1. Install clips to supports with self-drilling or self-tapping fasteners.
 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
 3. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so that clip, metal roof panel, and factory-applied sealant are completely engaged.
 4. Rigidly fasten eave end of metal roof panels and allow ridge end free movement for thermal expansion and contraction. Predrill panels for fasteners.
 5. Provide metal closures at peaks rake edges rake walls and each side of ridge caps.
- C. Lap-Seam Metal Roof Panels: Fasten metal roof panels to supports with exposed fasteners at each lapped joint, at location and spacing recommended by manufacturer.
1. Provide metal-backed sealing washers under heads of exposed fasteners bearing on weather side of metal roof panels.
 2. Provide sealant tape at lapped joints of metal roof panels and between panels and protruding equipment, vents, and accessories.
 3. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps and on side laps of nesting-type metal panels, on side laps of ribbed or fluted metal panels, and elsewhere as needed to make metal panels weatherproof to driving rains.
 4. At metal panel splices, nest panels with minimum 6-inch end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.
- D. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

3.6 METAL SOFFIT PANEL INSTALLATION

- A. Provide metal soffit panels the full width of soffits. Install panels perpendicular to support framing.
- B. Flash and seal metal soffit panels with weather closures where panels meet walls and at perimeter of all openings.

3.7 THERMAL INSULATION INSTALLATION

- A. General: Install insulation concurrently with metal panel installation, in thickness indicated to cover entire surface, according to manufacturer's written instructions.
1. Set vapor-retarder-faced units with vapor retarder toward warm side of construction unless otherwise indicated. Do not obstruct ventilation spaces except for firestopping.
 2. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to the surrounding construction to ensure airtight installation.
 3. Install factory-laminated, vapor-retarder-faced blankets straight and true in one-piece lengths, with both sets of facing tabs sealed, to provide a complete vapor retarder.

- B. Blanket Roof Insulation: Comply with the following installation method:
1. Two-Layers-between-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder between purlins. Carry vapor-retarder-facing tabs up and over purlin, overlapping adjoining facing of next insulation course and maintaining continuity of retarder. Install layer of filler insulation over first layer to fill space between purlins formed by thermal spacer blocks. Hold in place with bands and crossbands below insulation.
 - a. Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.
 2. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
- C. Blanket Wall Insulation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal wall panels fastened to secondary framing.
1. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
- D. Board Wall Insulation: Extend board insulation in thickness indicated to cover entire wall. Hold in place by metal wall panels fastened to secondary framing. Comply with manufacturers' written instructions.
1. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.

3.8 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to

form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.

2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- C. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
 1. Tie downspouts to underground drainage system indicated.
- E. Roof Curbs: Install curbs at locations indicated on Drawings. Install flashing around bases where they meet metal roof panels.
- F. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

3.9 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform field quality control special inspections and to submit reports.
 1. High-Strength, Field-Bolted Connections: Connections shall be tested and inspected during installation according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 2. Welded Connections: In addition to visual inspection, field-welded connections shall be tested and inspected according to AWS D1.1 and the following inspection procedures, at inspector's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- B. Product will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.10 ADJUSTING

3.11 CLEANING AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.
- B. Touchup Painting:
 - 1. After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing[, **bearing plates,**] and accessories.
 - a. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."
 - b. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
 - 2. Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- C. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
 - 1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 13 34 19

SECTION 142123.16 - MACHINE ROOM-LESS ELECTRIC TRACTION PASSENGER ELEVATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Machine-room-less electric traction elevators.

B. Related Requirements:

1. Section 011000 "Summary" for purchase contract for elevators negotiated by Owner and assigned to Contractor.
2. Section 015000 "Temporary Facilities and Controls" for temporary use of elevators for construction purposes.
3. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
4. Section 042000 "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
5. Section 051200 "Structural Steel Framing" for the following:
 - 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.
6. Section 055000 "Metal Fabrications" for the following:
 - a. Attachment plates and angle brackets for supporting guide-rail brackets.
 - b. Divider beams.
 - c. Hoist beams.
 - d. Structural-steel shapes for subsills.
 - e. Pit ladders.
 - f. Cants made from steel sheet in hoistways.
7. Section 093013 "Ceramic Tiling" for finish flooring in elevator cars.
8. Section 221429 "Sump Pumps" for sump pumps, sumps, and sump covers in elevator pits.
9. Section 271513 "Communications Copper Horizontal Cabling" for twisted pair cable for telephone service for elevators.
10. Section 284621.11 "Addressable Fire-Alarm Systems" for smoke detectors in elevator lobbies to initiate emergency recall operation, for heat detectors in shafts and machine rooms to disconnect power from elevator equipment before or on sprinkler activation, and for connection to elevator controllers.

1.2 DEFINITIONS

- A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

1.3 ACTION SUBMITTALS

- A. Product Data:

- 1. Machine-room-less electric traction elevators.

- B. Product Data Submittals: For each product.

- 1. Include capacities, sizes, performances, operations, safety features, finishes, and similar information.
 - 2. Include Product Data for car enclosures, hoistway entrances, and operation, control, and signal systems.

- C. Shop Drawings:

- 1. Include plans, elevations, sections, and large-scale details indicating service at each landing, coordination with building structure, relationships with other construction, and locations of equipment.
 - 2. Include large-scale layout of car-control station.
 - 3. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

- B. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway and pit layout and dimensions, as indicated on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.

- C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.

- 1. Submit manufacturer's or Installer's standard operation and maintenance manual, in accordance with ASME A17.1/CSA B44.

- B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

- C. Continuing Maintenance Proposal:

1. Submit 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.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Elevator manufacturer or an authorized representative who is trained and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.8 COORDINATION

- A. Coordinate installation of inserts, sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, inserts, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
- B. Coordinate locations and dimensions of work specified in other Sections that relates to electric traction elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways and pits.

1.9 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, 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.
 2. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.

- B. Accessibility Requirements: Comply with requirements for accessible elevators in the United States Access Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.
- C. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7 and shall comply with elevator seismic requirements in ASME A17.1/CSA B44.
 - 1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified."
 - 2. Project Seismic Design Category: B.
 - 3. Elevator Component Importance Factor: 1.0.
 - 4. Design earthquake spectral response acceleration short period (Sds) for Project is .35.
 - 5. Provide earthquake equipment required by ASME A17.1/CSA B44.
 - 6. Provide seismic switch required by ASCE/SEI 7.

2.2 ELEVATORS

- A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard elevator systems and as required for complete system.
- B. Elevator Description:
 - 1. Elevator Number(s): Insert elevator number(s) as indicated on Drawings.
 - 2. Emergency Elevator Number(s): Insert elevator number(s) as indicated on Drawings.
 - 3. Rated Load: 2500 lb.
 - 4. Rated Speed: 150 fpm.
 - 5. Operation System: Selective-collective automatic operation.
 - 6. Auxiliary Operations:
 - a. Battery-powered lowering.
 - b. Automatic operation of lights and ventilation fans.
 - 7. Car Enclosures:
 - a. Inside Width: Not less than 80 inches from side wall to side wall.
 - b. Inside Depth: Not less than 53 inches from back wall to front wall (return panels).
 - c. Inside Height: Not less than 93 inches to underside of ceiling.
 - d. Front Walls (Return Panels): Brushed stainless steel, ASTM A480/A480M, No. 4 finish.
 - e. Car Fixtures: Polished stainless steel, ASTM A480/A480M, No. 8 finish.
 - f. Side and Rear Wall Panels: Brushed stainless steel, ASTM A480/A480M, No. 4 finish.
 - g. Reveals: Black.
 - h. Door Faces (Interior): Brushed stainless steel, ASTM A480/A480M, No. 4 finish.
 - i. Door Sills: Aluminum.
 - j. Ceiling: Brushed stainless steel, ASTM A480/A480M, No. 4 finish.
 - k. Handrails: 1/2 by 2 inches rectangular satin stainless steel, at sides and rear of car.
 - l. Floor recessed and prepared to receive ceramic tile (specified in Section 093013 "Ceramic Tiling").
 - m. Floor Thickness, Including Setting Materials: 5/8 inch above plywood subfloor.

8. Hoistway Entrances:
 - a. Width: 42 inches.
 - b. Height: 84 inches.
 - c. Type: Single-speed side sliding.
 - d. Frames: Brushed stainless steel, ASTM A480/A480M, No. 4 finish.
 - e. Doors and Transoms: Brushed stainless steel, ASTM A480/A480M, No. 4 finish.
 - f. Sills: Aluminum.
9. Hall Fixtures: Brushed stainless steel, ASTM A480/A480M, No. 4 finish.

2.3 MACHINE ROOM-LESS ELECTRIC TRACTION ELEVATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Otis Worldwide Corporation.
 2. Schindler Elevator Corp.
 3. ThyssenKrupp Elevator.
- B. Source Limitations: Obtain elevators from single manufacturer.
 1. Major elevator components, including driving machines, controllers, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

2.4 TRACTION SYSTEMS

- A. Elevator Machines: Permanent magnet, variable-voltage, variable-frequency, ac-type hoisting machines and solid-state power converters.
 1. Provide regenerative system.
 2. Provide regenerative system that complies with the IgCC.
 3. Limit total harmonic distortion of regenerated power to 5 percent in accordance with IEEE 519.
 4. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system.
- B. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.
- C. Machine Beams: Provide steel framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Section 055000 "Metal Fabrications" for materials and fabrication.
- D. Car Frame and Platform: Bolted- or welded-steel units.

- E. Guides: Roller guides or polymer-coated, nonlubricated sliding guides. Provide guides at top and bottom of car and counterweight frames.

2.5 OPERATION SYSTEMS

- A. Provide manufacturer's standard microprocessor operation systems as required to provide type of operation indicated.
- B. Auxiliary Operations:
 - 1. Single-Car Battery-Powered Automatic Evacuation: 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 moves to the next floor above or below, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.
 - 2. Automatic Operation of Lights and Fan: When elevator is stopped and unoccupied with doors closed, lighting, ventilation fan, and cab displays are de-energized after five minutes and are re-energized before car doors open.
- C. Security features may not affect emergency firefighters' service.

2.6 DOOR REOPENING DEVICES

- A. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams causes 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 sounds and doors begins to close at reduced kinetic energy.

2.7 CAR ENCLOSURES

- A. Provide enameled or powder-coated steel car enclosures to receive removable wall panels, with removable car roof, access doors, power door operators, and ventilation.
 - 1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.
- B. Materials and Finishes: Manufacturer's standards, but not less than the following:
 - 1. Subfloor:
 - a. Exterior, C-C Plugged grade plywood, not less than 7/8-inch nominal thickness.
 - 2. Floor Finish:
 - a. Specified in Section 093013 "Ceramic Tiling"
 - 3. Stainless Steel Wall Panels: Flush, formed-metal construction; fabricated from stainless steel sheet.

4. Fabricate car with recesses and cutouts for signal equipment.
5. Fabricate car door frame integrally with front wall of car.
6. Stainless Steel Doors: Flush, hollow-metal construction; fabricated from stainless steel sheet.
7. Sills: Extruded or machined metal, with grooved surface, 1/4 inch thick.
8. Ceiling: Metal flush panels, with LED linear lights.
9. "Light Fixture Efficiency" and "Ventilation Fan Efficiency" subparagraphs below are requirements of the IgCC.
10. Light Fixture Efficiency: Not less than 35 lumens/W.
11. Ventilation Fan Efficiency: Not less than 3.0 cfm/W.

2.8 HOISTWAY ENTRANCES

- A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile to accommodate hoistway wall construction.
 1. Where gypsum board wall construction is indicated, frames to be self-supporting with reinforced head sections.
- B. Materials and Fabrication: Manufacturer's standards, but not less than the following:
 1. Stainless Steel Frames: Formed from stainless steel sheet.
 2. Stainless Steel Doors and Transoms: Flush, hollow-metal construction; fabricated from stainless steel sheet.
 3. Sills: Extruded or machined metal, with grooved surface, 1/4 inch thick.
 4. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M.

2.9 SIGNAL EQUIPMENT

- A. Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Provide buttons and lighted elements illuminated with LEDs.
- B. Car-Control Stations: Provide manufacturer's standard recessed car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.
 1. Mark buttons and switches for required use or function. 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.
- C. Hall Push-Button Stations: Provide one hall push-button station at each landing.
 1. Provide units with flat faceplate for mounting with body of unit recessed in wall.
 2. Equip units with buttons for calling elevator and for indicating desired direction of travel.

- D. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide the following:
 - 1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
- E. 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 cars.

2.10 FINISH MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, commercial steel, Type B, exposed, matte finish.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, commercial steel, Type B, pickled.
- C. Stainless Steel Sheet: ASTM A240/A240M, Type 304.
- D. Stainless Steel Bars: ASTM A276/A276M, Type 304.
- E. Stainless Steel Tubing: ASTM A554, Grade MT 304.
- F. Aluminum Extrusions: ASTM B221, Alloy 6063.
- G. Nickel Silver Extrusions: ASTM B151/B151M, Alloy UNS No. C74500 or UNS No. C77600.

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 of the Work. Examine hoistways, hoistway openings, and pits as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.
- B. 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.

3.2 INSTALLATION OF MACHINE ROOM-LESS ELECTRIC TRACTION ELEVATORS

- A. Comply with manufacturer's written instructions.
- B. 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.

- C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.
- D. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.
- E. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
- F. Leveling Tolerance: 1/8 inch, up or down, regardless of load and travel direction.
- G. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
- H. 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 elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.
- B. Operating Test: Load elevator to rated capacity and operate continuously for 30 minutes over full travel distance, stopping at each level and proceeding immediately to the next. Record temperature rise of elevator machine during 30-minute test period. Record failure to perform as required.
- C. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that 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. No temporary use will be permitted without the prior written approval of the owner and architect.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate elevator(s).

**MACHINE ROOM-LESS ELECTRIC TRACTION
PASSENGER ELEVATOR**

SECTION 14 21 23.16

LXT Eastside Development

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- B. Check operation of elevator with Owner's personnel present before date of Substantial Completion. Determine that operation systems and devices are functioning properly.

END OF SECTION 142123.16

SECTION 031000 - CONCRETE FORMING 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. Form-facing material for cast-in-place concrete.
 - 2. Shoring, bracing, and anchoring.

1.3 DEFINITIONS

- A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.
- B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each of the following:
 - 1. Exposed surface form-facing material.
 - 2. Concealed surface form-facing material.
 - 3. Pan-type forms.
 - 4. Void forms.
 - 5. Form ties.
 - 6. Waterstops.
 - 7. Form-release agent.
- B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.
 - 1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
 - 2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301.

- a. Location of construction joints is subject to approval of the Architect.
- 3. Indicate location of waterstops.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing and inspection agency.
- B. Field quality-control reports.
- C. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

- A. Testing and Inspection Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
 - 1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
 - 2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

1)

2.2 FORM-FACING MATERIALS

- A. As-Cast Surface Form-Facing Material:

1. Provide continuous, true, and smooth concrete surfaces.
2. Furnish in largest practicable sizes to minimize number of joints.
3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:
 - a. Plywood, metal, or other approved panel materials.
 - b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

- 1) APA HDO (high-density overlay).
- 2) APA MDO (medium-density overlay); mill-release agent treated and edge sealed.
- 3) APA Structural 1 Plyform, B-B or better; mill oiled and edge sealed.
- 4) APA Plyform Class I, B-B or better; mill oiled and edge sealed.

- B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.

1. Provide lumber dressed on at least two edges and one side for tight fit.

- C. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation, with straight or tapered end forms.

- D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

2.3 WATERSTOPS

- A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.
- B. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.

2.4 RELATED MATERIALS

- A. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- B. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
 2. Form release agent for form liners shall be acceptable to form liner manufacturer.

- C. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

- A. Comply with ACI 301.
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes .
- C. Limit concrete surface irregularities as follows:
 - 1. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.
- D. Construct forms tight enough to prevent loss of concrete mortar.
 - 1. Minimize joints.
 - 2. Exposed Concrete: Symmetrically align joints in forms.
- E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
 - 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
 - 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
- F. Do not use rust-stained, steel, form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
 - 1. Provide and secure units to support screed strips
 - 2. Use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.

1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
 2. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.
- K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
1. Determine sizes and locations from trades providing such items.
 2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- L. Construction and Movement Joints:
1. Construct joints true to line with faces perpendicular to surface plane of concrete.
 2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 3. Place joints perpendicular to main reinforcement.
- M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.
- 3.2 INSTALLATION OF EMBEDDED ITEMS
- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

3. Clean embedded items immediately prior to concrete placement.

3.3 INSTALLATION OF WATERSTOPS

- A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.
 1. Install in longest lengths practicable.
 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
 3. Protect exposed waterstops during progress of the Work.

3.4 REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 75 percent of its 28-day design compressive strength.
 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work.
 1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
 2. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
 1. Align and secure joints to avoid offsets.
 2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
 1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.

END OF SECTION

SECTION 032000 - CONCRETE REINFORCING**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Steel reinforcement bars.
2. Welded-wire reinforcement.

1.2 ACTION SUBMITTALS**A. Product Data: For the following:**

1. Each type of steel reinforcement.
2. Bar supports.
3. Mechanical splice couplers.

B. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.

1. Location of construction joints is subject to approval of Engineer.

1.3 INFORMATIONAL SUBMITTALS**A. Qualification Statements: For testing and inspection agency.****B. Welding certificates.**

1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M.

C. Material Test Reports: For the following, from a qualified testing agency:

1. Steel Reinforcement:

- a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.
- 2. Mechanical splice couplers.
- D. Field quality-control reports.
- E. Minutes of preinstallation conference.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60 , deformed.
- B. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, deformed.
- C. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.2 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
 - 1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

- a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
- C. Mechanical Splice Couplers: ACI 318 Type 1, same material of reinforcing bar being spliced; mechanical-lap type.
- D. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
 - 1. Finish: Plain.

2.3 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection of In-Place Conditions:
 - 1. Do not cut or puncture vapor retarder.
 - 2. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
 - 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
 - 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.

1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
2. Stagger splices in accordance with ACI 318.
3. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.
4. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.

G. Install welded-wire reinforcement in longest practicable lengths.

1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
 - a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches.
2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
4. Lace overlaps with wire.

3.3 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
1. Place joints perpendicular to main reinforcement.
 2. Continue reinforcement across construction joints unless otherwise indicated.
 3. Do not continue reinforcement through sides of strip placements of floors and slabs.
- B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

3.4 INSTALLATION TOLERANCES

- A. Comply with ACI 117.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

END OF SECTION

SECTION 033000 - CAST-IN-PLACE CONCRETE**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Concrete standards.
2. Concrete materials.
3. Admixtures.
4. Vapor retarders.
5. Floor and slab treatments.
6. Liquid floor treatments.
7. Curing materials.
8. Accessories.
9. Repair materials.
10. Concrete mixture materials.
11. Concrete mixture class types.
12. Concrete mixing.

B. Related Requirements:

1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.

1.2 DEFINITIONS**A. Cementitious Materials:** Portland cement or blended hydraulic cement alone or in combination with one or more of the following:

1. Fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. Water/Cementitious Materials (w/cm) Ratio: The ratio by weight of mixing water to cementitious materials.**1.3 ACTION SUBMITTALS****A. Product Data:**

1. Portland cement.
2. Blended hydraulic cement.

3. Fly ash.
4. Slag cement.
5. Silica fume.
6. Aggregates.
7. Admixtures:
 - a. Include limitations of use. Admixtures that do not comply with reference ASTM International requirements must be submitted with test data for approval.
8. Vapor retarders.
9. Floor and slab treatments.
10. Liquid floor treatments.
11. Curing materials.
12. Joint fillers.
13. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Compressive strength at 28 days or other age as specified.
3. Durability exposure classes for Exposure Categories F, S, W, and C.
4. Maximum w/cm ratio.
5. Slump or slump flow limit.
6. Air content.
7. Nominal maximum aggregate size.
8. Intended placement method.
9. Submit adjustments to design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant changes.

C. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - a. Location of construction joints is subject to approval of the Architect.

D. Concrete Schedule: For each location of each class of concrete indicated in "Concrete Mixture Class Types" Article, including the following:

1. Concrete class designation.
2. Location within Project.
3. Exposure class designation.
4. Formed surface finish designation and final finish.
5. Final finish for floors.
6. Floor treatment, if any.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.
 - B. Material Certificates: For each of the following:
 1. Cementitious materials.
 2. Admixtures.
 3. Curing compounds.
 4. Floor and slab treatments.
 5. Bonding agents.
 6. Adhesives.
 7. Vapor retarders.
 8. Semirigid joint filler.
 9. Joint-filler strips.
 10. Repair materials.
 - C. Material Test Reports: For the following:
 1. Portland cement.
 2. Blended hydraulic cement.
 3. Fly ash.
 4. Slag cement.
 5. Silica fume.
 6. Aggregates.
 7. Admixtures.
 - D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances in accordance with ACI 117 and in compliance with ASTM E1155.
 - E. Minutes of preinstallation conference.
- 1.5 **QUALITY ASSURANCE**
- A. Installer Qualifications: A qualified Installer who employs Project personnel qualified as an ACI-certified Concrete Flatwork Associate and Concrete Flatwork Finisher and a supervisor who is a certified ACI Advanced Concrete Flatwork Finisher/Technician or an ACI Concrete Flatwork Finisher with experience installing and finishing concrete.
 1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.
 - B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 1. Manufacturer's production facilities and delivery vehicles certified in accordance with NRMCA's certification requirements or equivalent approval by a State DOT.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and ACI 301.

1.7 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 as follows:

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When air temperature has fallen to, or is expected to fall below 40 deg F during the protection period, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.

- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed .
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS**2.1 CONCRETE STANDARDS**

- A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

- A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type of admixture from single source from single manufacturer.

- B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I/II, [gray] [white].
2. Blended Hydraulic Cement: ASTM C595/C595M, Type IL, portland-limestone cement.
3. Pozzolans: ASTM C618, Class C, F, or N.
4. Slag Cement: ASTM C989/C989M, Grade 100 or 120.

5. Silica Fume: ASTM C1240.

C. Normal-Weight Aggregates:

1. Coarse Aggregate: ASTM C33/C33M, Class 3S
2. Maximum Coarse-Aggregate Size: 1 inch nominal.
3. Fine Aggregate: ASTM C33/C33M.
4. Alkali-Silica Reaction: Comply with one of the following for each aggregate used:
 - a. Expansion Result of Aggregate: Not more than 0.04 percent at one year when tested in accordance with ASTM C1293.
 - b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567. Do not use this option with fly ash with an alkali content greater than 4.0 percent. Submit supporting data for each aggregate showing expansion in excess of 0.10 percent when tested in accordance with ASTM C1260.
 - c. Alkali Content in Concrete: Not to exceed 4 lb./cu. yd. for aggregate with expansion greater than or equal to 0.04 percent and less than 0.12 percent or 3 lb./cu. yd. for aggregate with expansion greater than or equal to 0.12 percent and less than 0.24 percent. Test aggregate reactivity in accordance with ASTM C1293. Calculate alkali content of concrete in accordance with ACI 301. Do not use this option with natural pozzolan or fly ash that has a calcium oxide content greater than 18 percent or an alkali content greater than 4.0 percent; or for an aggregate with expansion at one year greater than or equal to 0.24 percent when tested in accordance with ASTM C1293.

2.3 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C260/C260M.
- B. Chemical Admixtures: Do not use calcium chloride or admixtures containing calcium chloride in steel-reinforced concrete.
 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 2. Retarding Admixture: ASTM C494/C494M, Type B.
 3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
 5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
- C. Mixing Water for Concrete Mixtures and Water Used to Make Ice: ASTM C1602/C1602M. Include documentation of compliance with limits for alkalis, sulfates, chlorides, or solids content of mixing water from Table 2 in ASTM C1602/C1602M.

2.4 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 15 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.5 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

2.6 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
 - 1. Color:
 - a. Ambient Temperature Below 50 deg F (10 deg C): Black.
 - b. Ambient Temperature between 50 and 85 deg F (10 and 29 deg C): Any color.
 - c. Ambient Temperature Above 85 deg F (29 deg C): White.
- D. Water: Potable water that does not cause staining of the surface.
- E. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.

2.7 ACCESSORIES

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 in accordance with ASTM D2240.
- C. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C881/C881M, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.8 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
 4. Compressive Strength: Not less than 4100 psi at 28 days when tested in accordance with ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

2.9 CONCRETE MIXTURE MATERIALS

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland or hydraulic cement in concrete assigned to Exposure Class F3 as follows:
1. Fly Ash or Other Pozzolans: 25 percent by mass.
 2. Slag Cement: 50 percent by mass.
 3. Silica Fume: 10 percent by mass.
 4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.

5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.

- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

2.10 CONCRETE MIXTURE CLASS TYPES

- A. Class A: Normal-weight concrete used for footings, grade beams, tie beams, and foundation walls.

1. Exposure Class: ACI 318 Class F2 Class W1 Class C1.
2. Minimum Compressive Strength: 4500 psi at 28 days.
3. Maximum w/cm Ratio: 0.45.
4. Air Content:
 - a. Exposure Classes F2 and F3: 6.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch nominal maximum aggregate size.
5. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cementitious materials.

- B. Class B: Normal-weight concrete used for interior slabs-on-grade and topping slabs.

1. Exposure Class: ACI 318 Class F0 Class C0.
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Maximum w/cm Ratio : 0.45.
4. Air Content:
 - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
5. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

2.11 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and furnish delivery ticket.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
 1. Daily access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
 4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 TOLERANCES

- A. Comply with ACI 117.

3.4 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.5 INSTALLATION OF VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
 1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
 2. Face laps away from exposed direction of concrete pour.
 3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
 4. Lap joints 6 inches and seal with manufacturer's recommended tape.
 5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
 6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
 7. Protect vapor retarder during placement of reinforcement and concrete.

- a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides and sealing to vapor retarder.

3.6 INSTALLATION OF CAST-IN-PLACE CONCRETE

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
 1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
 1. If a section cannot be placed continuously, provide construction joints as indicated.
 2. Deposit concrete to avoid segregation.
 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
 - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
 - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 1. Do not place concrete floors and slabs in a checkerboard sequence.
 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 3. Maintain reinforcement in position on chairs during concrete placement.
 4. Scream slab surfaces with a straightedge and strike off to correct elevations.
 5. Level concrete, cut high areas, and fill low areas.
 6. Slope surfaces uniformly to drains where required.
 7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
 8. Do not further disturb slab surfaces before starting finishing operations.

3.7 INSTALLATION OF JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
 - 1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
 - 2. Place joints perpendicular to main reinforcement.
 - a. Continue reinforcement across construction joints unless otherwise indicated.
 - 3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.
- D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 - 2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints:
 - 1. Install dowel bars and support assemblies at joints where indicated on Drawings.
 - 2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

3.8 APPLICATION OF FINISHING FLOORS AND SLABS

1.

- B. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
3. Apply float finish to surfaces to receive trowel finish.

C. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface. Use of an approved finishing aid is acceptable.
5. Do not apply troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:

a. Slabs on Ground:

- 1) Specified overall values of flatness, FF 25; and of levelness, FL 20; with minimum local values of flatness, FF 17; and of levelness, FL 15.

b. Suspended Slabs:

- 1) Specified overall values of flatness, FF 25; and of levelness, FL 20; with minimum local values of flatness, FF 17; and of levelness, FL 15.

D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with a fiber-bristle broom perpendicular to main traffic route.
2. Coordinate required final finish with Architect before application.

3.9 APPLICATION OF FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.

- a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
 - b. Remove projections larger than 1 inch.
 - c. Tie holes do not require patching.
 - d. Surface Tolerance: ACI 117, Class D.
 - e. Apply to concrete surfaces for metal lap pan deck formed surfaces and those surfaces that are buried or covered with subsequent installed surfaces.
2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
3. ACI 301 Surface Finish SF-3.0:
 - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - b. Remove projections larger than 1/8 inch.
 - c. Patch tie holes.
 - d. Surface Tolerance: ACI 117 Class A.
 - e. Locations: Apply to concrete surfaces exposed to public view,.
 - f.

3.10 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

- A. Filling in:
 1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
 2. Mix, place, and cure concrete, as specified, to match color and texture with in-place construction exposed to view.
 3. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
 3. Minimum Compressive Strength: 4500 psi at 28 days.
 4. 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 concrete base.
 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
 6. Prior to pouring concrete, place and secure anchorage devices.

- a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - b. Cast anchor-bolt insert into bases.
 - c. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.
 1. Cast-in inserts and accessories, as shown on Drawings.
 2. Screed, tamp, and trowel finish concrete surfaces.

3.11 APPLICATION OF CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
 1. Comply with ACI 301 for cold weather protection during curing.
 2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305R, before and during finishing operations.
- B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
 1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
 2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
 3. If forms remain during curing period, moist cure after loosening forms.
 4. If removing forms before end of curing period, continue curing for remainder of curing period as follows:
 - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
 - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
 - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
 - d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
 - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
 - 2) Maintain continuity of coating and repair damage during curing period.
- C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:
 1. Begin curing after finishing concrete.

2. Interior Concrete Floors:

- a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following not in cold weather:
 - a) Water.
 - b) Continuous water-fog spray.
- b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.

- 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
- c. Floors to Receive Polished Finish: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
- d. Floors To Receive Urethane Flooring:
 - 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - 2) Rewet absorptive cover, and cover immediately with polyethylene moisture-retaining cover with edges lapped 6 inches and sealed in place.
 - 3) Secure polyethylene moisture-retaining cover in place to prohibit air from circulating under polyethylene moisture-retaining cover.
 - 4) Leave absorptive cover and polyethylene moisture-retaining cover in place for duration of curing period, but not less than 28 days.
 - 5)

3.12 APPLICATION OF LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.
 - 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 - 2. Do not apply to concrete that is less than 28 days' old.
 - 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
 - 4. Rinse with water; remove excess material until surface is dry.

5. Apply a second coat in a similar manner if surface has received a float finish or abrasive surface preparation.

- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

3.13 INSTALLATION OF JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
 1. Defer joint filling until concrete has aged at least one month.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.14 INSTALLATION OF CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
 1. Repair and patch defective areas when approved by Architect.
 2. Remove and replace concrete that cannot be repaired and patched to meet specification requirements.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks in excess of 0.01 inch spalls, air bubbles exceeding surface finish limits, honeycombs, rock pockets, fins and other projections on the surface exceeding surface finish limits, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
 - a. Limit cut depth to 3/4 inch.
 - b. Make edges of cuts perpendicular to concrete surface.
 - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
 - d. Fill and compact with patching mortar before bonding agent has dried.
 - e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
 - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
 - b. Compact mortar in place and match surrounding surface.
3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance, as determined by Architect.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by adding patching mortar.
 - a. Finish repaired areas to blend into adjacent concrete.
5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
 - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - b. Feather edges to match adjacent floor elevations.
6. Correct other low areas scheduled to remain exposed with repair topping.
 - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
 - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
 - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.

- b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
 - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
 - d. Place, compact, and finish to blend with adjacent finished concrete.
 - e. Cure in same manner as adjacent concrete.
- 8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
 - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.
 - e. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.15 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
 - 1. Testing agency to be responsible for providing curing facility for initial curing of strength test specimens on-site and verifying that test specimens are cured in accordance with standard curing requirements in ASTM C31/C31M.
 - 2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
 - 3. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
 - a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
 - 1) Project name.
 - 2) Name of testing agency.
 - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
 - 4) Name of concrete manufacturer.
 - 5) Date and time of inspection, sampling, and field testing.
 - 6) Date and time of concrete placement.

- 7) Location in Work of concrete represented by samples.
 - 8) Date and time sample was obtained.
 - 9) Truck and batch ticket numbers.
 - 10) Design compressive strength at 28 days.
 - 11) Concrete mixture designation, proportions, and materials.
 - 12) Field test results of fresh concrete, including slump or slump flow, air content, temperature and density.
 - 13) Information on storage and curing of samples at the Project site, including curing method and maximum and minimum temperatures during initial curing period.
 - 14) Type of fracture and compressive break strengths at seven days and 28 days.
 4. Provide a space and source of power or other resources for curing and access to test specimens by the testing agency.
- C. Delivery Tickets: comply with ASTM C94/C94M.
- D. Inspections:
 1. Headed bolts and studs.
 2. Verification of use of required design mixture.
 3. Concrete placement, including conveying and depositing.
 4. Curing procedures and maintenance of curing temperature.
 5. Verification of concrete strength before removal of shores and forms from beams and slabs.
 6. Batch Plant Inspections: On a random basis, as determined by Architect.
- E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:
 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 150 cu. yd. or fraction thereof.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing is to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C143/C143M:
 3. Slump Flow: ASTM C1611/C1611M:
 - a. One test at point of delivery for each composite sample when strength test specimens are cast, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests as needed.
 4. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete; .
 5. Concrete Temperature: ASTM C1064/C1064M:

- a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample when strength test specimens are cast.
6. Concrete Density: ASTM C138/C138M:
 - a. One test for each composite sample when strength test specimens are cast.
7. Unit Weight: ASTM C138/C138M density of fresh structural lightweight concrete.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture. The fresh density should be consistent with that associated with the equilibrium density within a tolerance of plus or minus 4 lb/ft.3.
8. Compression Test Specimens: ASTM C31/C31M:
 - a. Cast and standard cure two sets of two 6 inches by 12-inches or 4-inch by 8-inch cylindrical specimens for each composite sample.
9. Compressive-Strength Tests: ASTM C39/C39M.
 - a. Test one set of two standard cured specimens at seven days and one set of two specimens at 28 [other age] days.
 - b. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
10. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
11. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests of standard cured cylinders equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
12. 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.
13. Additional Tests:
 - a. Testing and inspecting agency to 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.
 - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
 - 1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.7.6.3.

14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.16 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using floor slab protective covering.

END OF SECTION

SECTION 042000 - UNIT MASONRY**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Concrete masonry units.
2. Lintels.
3. Mortar and grout materials.
4. Reinforcement.
5. Ties and anchors.
6. Accessories.
7. Mortar and grout mixes.

B. Related Requirements:

1. Section 076200 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.2 DEFINITIONS**A. CMU(s): Concrete masonry unit(s).****B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.****1.3 ACTION SUBMITTALS****A. Product Data: For each type of product.****B. Shop Drawings: For the following:**

1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Indicate bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315R. Indicate elevations of reinforced walls.

C. Samples for Verification: For each type and color of the following:

1. Exposed CMUs.
2. Pre-faced CMUs.
3. Pigmented mortar. Make Samples using same sand and mortar ingredients to be used on Project.

1.4 INFORMATIONAL SUBMITTALS**A. Material Certificates:** For each type of the following:

1. Masonry units.
 - a. Include data on material properties.
 - b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
2. Integral water repellent used in CMUs.
3. Cementitious materials. Include name of manufacturer, brand name, and type.
4. Mortar admixtures.
5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
6. Grout mixes. Include description of type and proportions of ingredients.
7. Reinforcing bars.
8. Joint reinforcement.
9. Anchors, ties, and metal accessories.

B. Qualification Statements: For testing agency.**C. Mix Designs:** For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive strength requirement.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined in accordance with TMS 602.**E. Cold-Weather and Hot-Weather Procedures:** Detailed description of methods, materials, and equipment to be used to comply with requirements.**1.5 QUALITY ASSURANCE****A. Qualifications:**

1. Installers: All masonry flashing installers must complete the International Masonry Institute Flashing Upgrade training course.
2. Testing Agency Qualifications: Qualified in accordance with ASTM C1093 for testing indicated.

1.6 MOCKUPS

- A. Sample Panel Mockups: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.
- B. Wall Mockups: Build mockups [to verify selections made under Sample submittals] [to demonstrate aesthetic effects] [to set quality standards for materials and execution] [and] [to set quality standards for installation]. [See Section 014339 "Mockups" for additional construction requirements for integrated exterior mockups.]
 - 1. Build mockups for each type of exposed unit masonry construction in sizes approximately 48 inches long by 48 inches high by full thickness, including face and backup wythes and accessories.
 - a. Include a sealant-filled joint at least 16 inches long in each mockup.
 - 2. Clean exposed faces of mockups with masonry cleaner as indicated.
 - 3. Protect accepted mockups from the elements with weather-resistant membrane.
 - 4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations by Change Order.
 - 5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store 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 preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms 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.

1.8 FIELD 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 down both sides of walls, and hold cover securely in place.
 - 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe, and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such 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.
- D. 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 TMS 602.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

PART 2 - PRODUCTS**2.1 SOURCE LIMITATIONS**

- A. Obtain exposed masonry units from single manufacturer.

- B. For exposed masonry units and cementitious mortar components, obtain each color and grade from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 PERFORMANCE REQUIREMENTS

- A. Provide[**structural**] unit masonry that develops indicated net-area compressive strengths at 28 days.
 - 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) in accordance with TMS 602.
 - 2. Determine net-area compressive strength of masonry by testing masonry prisms in accordance with ASTM C1314.

2.3 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 ft. vertically and horizontally of a walking surface.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
 - 1. Where fire-resistance-rated construction is indicated, use the equivalent thickness method for masonry units in accordance with ACI 216.1.

2.4 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - 2. Provide square-edged units for outside corners unless otherwise indicated.
- B. Integral Water Repellent: Provide units made with integral water repellent where indicated.

1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested in accordance with ASTM E514/E514M as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, will show no visible water or leaks on the back of test specimen.

- a. Manufacturers: Subject to compliance with requirements, provide products by the following:

- 1) Echelon Trenwyth.

- b. .

C. CMUs: ASTM C90, normal weight.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2350 psi.
2. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
3. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

D. Decorative CMUs: ASTM C90, normal weight.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Echelon.
2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2350 psi.
3. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph above.
4. Pattern and Texture: Scored vertically to appear square in stacked bond, standard finish. Match Architect's samples.
5. Colors: Match Architect's samples.
6. Special Aggregate: Provide units made with aggregate matching aggregate in Architect's sample.

2.5 LINTELS

- A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.6 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150/C150M, 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.
 - 1. Alkali content will not be more than 0.1 percent when tested in accordance with ASTM C114.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.
- E. Aggregate for Mortar: ASTM C144.
 - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 - 2. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- F. Aggregate for Grout: ASTM C404.
- G. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
- H. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.
- I. Water: Potable.

2.7 REINFORCEMENT

- A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60.
- B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
- C. Masonry-Joint Reinforcement, General: ASTM A951/A951M.
 - 1. Interior Walls: Mill- galvanized carbon steel.

2. Exterior Walls: Hot-dip galvanized carbon steel.
 3. Wire Size for Side Rods: 0.148-inch diameter.
 4. Wire Size for Cross Rods: 0.148-inch diameter.
 5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
 6. Provide in lengths of not less than 10 ft., with prefabricated corner and tee units.
- D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.

2.8 ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from [neoprene] [urethane] [or] [PVC].
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

2.9 MORTAR AND GROUT 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 or grout.
 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 C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.
1. For masonry below grade or in contact with earth, use Type S.
 2. For reinforced masonry, use Type N.
 3. For mortar parge coats, use Type S or Type N.
 4. For exterior, above-grade, load-bearing, nonload-bearing walls, and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
 5. For interior nonload-bearing partitions, Type O may be used instead of Type N.

- D. Pigmented Mortar: Use colored cement product.
- E. Grout for Unit Masonry: Comply with ASTM C476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602 for dimensions of grout spaces and pour height.
 - 2. Proportion grout in accordance with ASTM C476, [Table 1] [or] [paragraph 4.2.1.2 for specified 28-day compressive strength indicated, but not less than 2000 psi].
 - 3. Provide grout with a slump of 8 to 11 inches as measured in accordance with ASTM C143/C143M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
 - 2. Verify that foundations are within tolerances specified.
 - 3. Verify that reinforcing dowels are properly placed.
 - 4. Verify that substrates are free of substances that impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- D. 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.

- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

3.3 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 or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch 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 ft., or 1/2-inch 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 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch 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 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch 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, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

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: Unless otherwise indicated, lay exposed masonry in running bond ; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- 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: Stop work by stepping 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.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- G. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- H. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
 - 1. Install compressible filler in joint between top of partition and underside of structure above.
 - 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors, and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.
 - 3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
 - 4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

3.5 MORTAR BEDDING AND JOINTING

- A. Lay CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
 2. Bed webs in mortar in all courses of piers, columns, and pilasters.
 3. Bed webs in mortar in grouted masonry, including starting course on footings.
 4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
 5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.
- 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.
- 1.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.6 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at[**corners,**] returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry as follows:
1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
 2. Install preformed control-joint gaskets designed to fit standard sash block.
 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.

4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

- C. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than 3/8 inch.

3.8 LINTELS

- A. Provide masonry lintels where indicated and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are indicated without structural steel or other supporting lintels.
- B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.9 REINFORCED UNIT MASONRY

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 1. Comply with requirements in TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 2. Limit height of vertical grout pours to not more than 60 inches.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements will be at Contractor's expense.
- B. Inspections: Special inspections in accordance with Level 2 in TMS 402.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Concrete Masonry Unit Test: For each type of unit provided, in accordance with ASTM C140/C140M for compressive strength.
- E. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, in accordance with ASTM C780.
- F. Mortar Test (Property Specification): For each mix provided, in accordance with ASTM C780. Test mortar for [mortar air content] [and] [compressive strength].
- G. Grout Test (Compressive Strength): For each mix provided, in accordance with ASTM C1019.
- H. Prism Test: For each type of construction provided, in accordance with ASTM C1314 at 28 days.
- 3.11 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 nonmasonry 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 concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
7. Clean masonry with a proprietary acidic masonry cleaner applied according to manufacturer's written instructions.

3.12 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 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 Section 312000 "Earth Moving."
 3. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.
- D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

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SECTION 051200 - STRUCTURAL STEEL FRAMING**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Structural-steel materials.
2. Shrinkage-resistant grout.

B. Related Requirements:

1. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
2. Section 055000 "Metal Fabrications" for miscellaneous steel fabrications and other steel items not defined as structural steel.
3. Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings" for painting requirements.
4. Section 133419 "Metal Building Systems" for structural steel.

1.2 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

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 anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Shear stud connectors.
4. Anchor rods.
5. Threaded rods.
6. Forged-steel hardware.
7. Shop primer.
8. Galvanized repair paint.
9. Shrinkage-resistant grout.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify members not to be shop primed.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and fabricator.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural-steel materials, including chemical and physical properties.
- E. Product Test Reports: For the following:
 1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
 2. Direct-tension indicators.
 3. Tension-control, high-strength, bolt-nut-washer assemblies.
 4. Shear stud connectors.
- F. Survey of existing conditions.
- G. Source quality-control reports.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU.

- B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector.
- C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- a.

2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992/A992M.
- B. Channels, Angles, S-Shapes: ASTM A36/A36M.
- C. Plate and Bar: ASTM A572/A572M, Grade 50.
- D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade C structural tubing.
- E. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.
- F. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1, compressible-washer type with plain finish.
- B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, heavy-hex head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
 - 1. Finish: Plain.
- C. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.4 RODS

- A. Unheaded Anchor Rods: ASTM F1554, Grade 55, weldable.
 - 1. Configuration: Straight.
 - 2. Nuts: ASTM A563 heavy-hex carbon steel.
 - 3. Plate Washers: ASTM A36/A36M carbon steel.
 - 4. Washers: ASTM F436, Type 1, hardened carbon steel.
 - 5. Finish: Plain.
 - 6.
- B. Threaded Rods: ASTM A36/A36M.
 - 1. Nuts: ASTM A63 heavy-hex carbon steel.
 - 2. Washers: ASTM F436, Type 1, hardened carbon steel.
 - 3. Finish: Plain.

2.5 PRIMER

- A. Steel Primer:
 - 1. Comply with Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

2.6 SHRINKAGE-RESISTANT GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.7 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
 - 4. Mark and match-mark materials for field assembly.
 - 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 2.
- F. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.
- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.8 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

2.9 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded.
 - 3. Surfaces of high-strength bolted, slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - 5. Galvanized surfaces .
 - 6. Corrosion-resisting (weathering) steel surfaces.
 - 7. Surfaces enclosed in interior construction.
- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
 - 1. SSPC-SP 2.
- C. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.10 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
 - 1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
 - 2. Bolted Connections: Inspect shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."

3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E165/E165M.
 - b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E164.
 - d. Radiographic Inspection: ASTM E94/E94M.
4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
 - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.
5. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

- B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
1. Set plates for structural members on wedges, shims, or setting nuts as required.
 2. Weld plate washers to top of baseplate.
 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
1. Joint Type: Snug tightened, unless otherwise noted on drawings.
- B. Weld Connections: Comply with AWS D1.1/D1.1M[and AWS D1.8/D1.8M] for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

- C. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.5 REPAIR

- A. Touchup Painting:
 - 1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - 2. Cleaning and touchup painting are specified in Section 099123 "Interior Painting." and Section 099600 "High-Performance Coatings."
- B. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

3.6 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:
 - 1. Verify structural-steel materials and inspect steel frame joint details.
 - 2. Verify weld materials and inspect welds.
 - 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
 - 1. Bolted Connections: Inspect[and test] bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
 - a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1) Liquid Penetrant Inspection: ASTM E165/E165M.
 - 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - 3) Ultrasonic Inspection: ASTM E164.
 - 4) Radiographic Inspection: ASTM E94/E94M.

3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.

END OF SECTION

SECTION 053100 - STEEL DECKING**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Composite floor deck.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
2. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.

1.2 ACTION SUBMITTALS**A. Product Data:**

1. Composite floor deck.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.3 INFORMATIONAL SUBMITTALS**A. Welding certificates.****B. Product Certificates:** For each type of steel deck.**C. Test and Evaluation Reports:**

1. Research Reports: For steel deck, from ICC-ES showing compliance with the building code.

D. Field Quality-Control Submittals:

1. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding codes:
 - 1. AWS D1.3/D1.3M.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.
- B. Fire-Resistance Ratings: Comply with ASTM E119; testing 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 listings of another qualified testing agency.

2.2 COMPOSITE FLOOR DECK

- A. Fabrication of Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with SDI C, with the minimum section properties indicated, and with the following:
 - 1. Prime-Painted Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 40 minimum, with top surface phosphatized and unpainted and underside surface shop primed with manufacturers' standard baked-on, rust-inhibitive primer.
 - 2. Profile Depth: As indicated.
 - 3. Design Uncoated-Steel Thickness: As indicated.
 - 4. Span Condition: Triple span or more.

2.3 ACCESSORIES

- A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- C. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- D. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- E. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile indicated.
- F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- G. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- H. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions 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 INSTALLATION, GENERAL

- A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.

- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.3 INSTALLATION OF FLOOR DECK

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
 - 1. Weld Diameter: 5/8 inch, nominal.
 - 2. Weld Spacing:
 - a. Weld edge ribs of panels at each support. Space additional welds an average of 12 inches apart, but not more than 18 inches apart.
 - b. Space and locate welds as indicated.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches, and as follows:
 - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
 - 2. Mechanically clinch or button punch.
 - 3. Fasten with a minimum of 1-1/2-inch- long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped or butted at Contractor's option.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure in accordance with SDI recommendations unless otherwise indicated.

- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, in accordance with SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.4 REPAIR

A. Repair Painting:

1. Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
2. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
3. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Section 09 96 00 "High-Performance Coatings" and Section 099123 "Interior Painting."

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.
 - a. Field welds will be subject to inspection.
2. Steel decking will be considered defective if it does not pass tests and inspections.
3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors that are already tested.

C. Prepare test and inspection reports.

END OF SECTION 053100

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SECTION 054000 - COLD-FORMED METAL FRAMING**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Exterior non-load-bearing wall framing.
2. Interior non-load-bearing wall framing.
3. Ceiling joist framing.
4. Soffit framing.

B. Related Requirements:

1. Section 092216 "Non-Structural Metal Framing" for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

1.2 ACTION SUBMITTALS**A. Product Data: For the following:**

1. Cold-formed steel framing materials.
2. Load-bearing wall framing.
3. Exterior non-load-bearing wall framing.
4. Interior non-load-bearing wall framing.
5. Vertical deflection clips.
6. Single deflection track.
7. Double deflection track.
8. Drift clips.
9. Floor joist framing.
10. Roof-rafter framing.
11. Ceiling joist framing.
12. Soffit framing.
13. Post-installed anchors.
14. Power-actuated anchors.
15. Sill sealer gasket.
16. Sill sealer gasket/termite barrier.

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

- C. Delegated Design Submittal: For cold-formed steel framing.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Welding certificates.
- C. Product Certificates: For each type of code-compliance certification for studs and tracks.
- D. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.
 - 1. Steel sheet.
 - 2. Expansion anchors.
 - 3. Power-actuated anchors.
 - 4. Mechanical fasteners.
 - 5. Vertical deflection clips.
 - 6. Horizontal drift deflection clips
 - 7. Miscellaneous structural clips and accessories.
- E. Research Reports:
 - 1. For nonstandard cold-formed steel framing , post-installed anchors , and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.
- B. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment, indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- C. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association , the Steel Framing Industry Association , the Steel Stud Manufacturers Association , or the Supreme Steel Framing System Association.
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect and store cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling as required in AISI S202.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design Loads: [**As indicated on Drawings**] <Insert design loads>.
 - 2. Deflection Limits: Design framing systems to withstand[**design loads**] without deflections greater than the following:
 - a. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height.
 - b. Interior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 5 lbf/sq. ft..
 - c. Ceiling Joist Framing: Vertical deflection of 1/360 of the span for live loads and 1/240 for total loads of the span.
 - 3. Design framing systems to provide for movement of framing members located outside the insulated building envelope 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 of 120 deg F.
 - 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of 1 inch.
 - 5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- B. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing complies with AISI S100 and AISI S240.
- C. Fire-Resistance Ratings: Comply with ASTM E119; testing 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 acceptable to authorities having jurisdiction.

2.2 COLD-FORMED STEEL FRAMING MATERIALS

- A. Framing Members, General: Comply with AISI S240 for conditions indicated.
- B. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
 - 1. Grade: As required by structural performance.
 - 2. Coating: G60, A60, AZ50, or GF30.
- C. Steel Sheet for Vertical Deflection Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:
 - 1. Grade: As required by structural performance.
 - 2. Coating: G60.

2.3 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch.
 - 2. Flange Width: 1-5/8 inches.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch.
 - 2. Flange Width: 1-1/4 inches.
- C. Vertical Deflection Clips, Exterior: Manufacturer's standard clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch .
 - 2. Flange Width: 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.
- E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 - a. Minimum Base-Metal Thickness: 0.0428 inch .
 - b. Flange Width: 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.
 2. Inner Track: Of web depth indicated, and as follows:
 - a. Minimum Base-Metal Thickness: 0.0428 inch.
- F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.
- 2.4 INTERIOR NON-LOAD-BEARING WALL FRAMING
- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0329 inch.
 2. Flange Width: 1-3/8 inches.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0329 inch.
 2. Flange Width: 1-1/4 inches.
- C. Vertical Deflection Clips, Interior: Manufacturer's standard clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
1. Minimum Base-Metal Thickness: 0.0428 inch .
 2. Flange Width: 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.
- E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.5 CEILING JOIST FRAMING

- A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0329 inch.
 2. Flange Width: 1-5/8 inches, minimum.

2.6 SOFFIT FRAMING

- A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0428 inch.
 2. Flange Width: 1-5/8 inches, minimum.

2.7 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.
- 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. Anchor clips.
 5. End clips.
 6. Foundation clips.
 7. Gusset plates.
 8. Stud kickers and knee braces.
 9. Joist hangers and end closures.
 10. Hole-reinforcing plates.
 11. Backer plates.

2.8 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

- B. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58, or ICC-ES AC308 as appropriate for the substrate.
 - 1. Uses: Securing cold-formed steel framing to structure.
 - 2. Type: Torque-controlled expansion anchor or adhesive anchor.
 - 3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
 - 4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.
- C. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.
- E. Welding Electrodes: Comply with AWS standards.

2.9 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A780/A780M.
- B. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.
- C. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.
- D. Sill Sealer Gasket: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

2.10 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.

3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.
 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.
- C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet and as follows:
1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.
 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, conditions, and abutting structural framing 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 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.
- C. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.

- D. Install sill sealer gasket at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- H. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 INSTALLATION OF EXTERIOR NONLOADBEARING WALL FRAMING

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: As indicated on Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Install single deep-leg deflection tracks and anchor to building structure.
 - 2. Connect vertical deflection clips to studs and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
 - 1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 - 2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - 3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
 - 1. Install solid blocking at centers indicated on Shop Drawings.
- G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 INSTALLATION OF INTERIOR NONLOADBEARING WALL FRAMING

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: As indicated on Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 1. Install single deep-leg deflection tracks and anchor to building structure.
 2. Connect vertical deflection clips to studs and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
 1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
 1. Install solid blocking at centers indicated on Shop Drawings.
- G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.6 INSTALLATION OF JOIST FRAMING

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
 1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as required.
- C. Space joists not more than 2 inches from abutting walls, and as follows:
 1. Joist Spacing: As indicated on Drawings.

- D. Frame openings with built-up joist headers, consisting of joist and joist track or another combination of connected joists if indicated.
- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement.
- F. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:
 - 1. Joist-Track Solid Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
 - 2. Combination Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.
- G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.7 INSTALLATION TOLERANCES

- A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.

3.8 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

3.9 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.10 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

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SECTION 055000 - METAL FABRICATIONS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Miscellaneous framing and supports.
2. Metal ladders.
3. Elevator pit sump covers.
4. Metal bollards.

B. Products furnished, but not installed, under this Section include the following:

1. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.
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 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
2. Section 051200 "Structural Steel Framing" for steel framing, supports, elevator machine beams, hoist beams, divider beams, door frames, and other steel items attached to the structural-steel framing.

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions 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.

1.3 ACTION SUBMITTALS**A. Product Data:**

1. Fasteners.
2. Shop primers.

3. Shrinkage-resisting grout.
4. Slotted channel framing.
5. Manufactured metal ladders.
6. Metal bollards.

- 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. Miscellaneous framing and supports for applications where framing and supports are not specified in other Sections.
2. Elevator machine beams, hoist beams, and divider beams.
3. Steel shapes for supporting elevator door sills.
4. Metal ladders.
5. Elevator pit sump covers.
6. Metal bollards.

- C. Delegated Design Submittals: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Research Reports: For post-installed anchors.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:
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."

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls, floor slabs, decks, 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.
 - 1.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, 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 A36/A36M.
- C. Stainless Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 304.
- D. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304.
- E. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
- F. Steel Pipe: ASTM A53/A53M, Standard Weight unless otherwise indicated.
- G. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
 - 1. Size of Channels: 1-5/8 by 1-5/8 inches.
 - 2. Galvanized Steel: ASTM A653/A653M, commercial steel, Type B, with G90 coating; 0.108-inch nominal thickness.
 - 3. Cold-Rolled Steel: ASTM A1008/A1008M, structural steel, Grade 33; 0.0966-inch minimum thickness; hot-dip galvanized after fabrication.
- H. Aluminum Plate and Sheet: ASTM B209, Alloy 6061-T6.
- I. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.

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 B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless steel fasteners for fastening aluminum.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
- C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated, flat washers.
- D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1.
- E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; 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: 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 in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
- G. Post-Installed Anchors: Torque-controlled expansion anchors or adhesive anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.
- H. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer that contains pigments that make it easily distinguishable from zinc-rich primer.
- C. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.
- D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- H. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- I. 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 4000 psi.

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 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.
- 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, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches 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. Fabricate units from slotted channel framing where indicated.
 2. Furnish inserts for units installed after concrete is placed.
- C. Fabricate supports for operable partitions from continuous steel beams of sizes recommended by partition manufacturer with attached bearing plates, anchors, and braces as recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.
- D. Galvanize miscellaneous framing and supports where indicated.
- E. Prime miscellaneous framing and supports with primer specified in Section 099600 "High-Performance Coatings" where indicated.

2.7 METAL LADDERS

- A. General:

1. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Ladders:

1. Space siderails 16 inches apart unless otherwise indicated.
2. Siderails: Continuous, 3/8-by-2-1/2-inch steel flat bars, with eased edges.
3. Rungs: 3/4-inch- diameter, steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
6. Nonslip Surfaces for Steel Ladders: Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
7. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
8. Prime ladders, including brackets and fasteners, with primer specified in Section 099600 "High-Performance Coatings."

2.8 ELEVATOR PIT SUMP COVERS

- A. Fabricate from welded or pressure-locked steel bar grating. Limit openings in gratings to no more than 1 inch in least dimension.
- B. Provide steel angle supports unless otherwise indicated.

2.9 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 40 steel pipe.
 1. Cap bollards with 1/4-inch- thick, steel plate.
 2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
 3. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
- B. Fabricate bollards with 3/8-inch- thick, steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch anchor bolts.
 1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
- C. Fabricate sleeves for bollard anchorage from steel or stainless steel pipe or tubing with 1/4-inch- thick, steel or stainless steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches deep and 3/4 inch larger than OD of bollard.
- D. Prime steel bollards with primer specified in Section 099600 "High-Performance Coatings."

2.10 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize bearing and leveling plates.
- C. Prime plates with primer specified in Section 099600 "High-Performance Coatings."

2.11 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.12 GENERAL FINISH REQUIREMENTS

- 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.

2.13 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized 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 099600 "High-Performance Coatings" are indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 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 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 4. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."
 5. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."
- E. 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.

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 INSTALLATION OF 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, operable partitions, 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 INSTALLATION OF METAL LADDERS

- A. Secure ladders to adjacent construction with the clip angles attached to the stringer.
- B. Install brackets as required for securing of ladders welded or bolted to structural steel or built into masonry or concrete.

3.4 INSTALLATION OF ELEVATOR PIT SUMP COVERS

- A. Install tops of elevator sump pit cover plates and frames flush with finished surface. Adjust as required to avoid lippage that could present a tripping hazard.

3.5 INSTALLATION OF METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
 1. Do not fill removable bollards with concrete.
- B. Anchor bollards to existing construction with anchor bolts. Provide four 3/4-inch bolts at each bollard unless otherwise indicated.
 1. Embed anchor bolts at least 6 inches in concrete.

- C. Anchor bollards in concrete in formed or core-drilled holes not less than 36 inches deep and 3/4 inch larger than OD of bollard. Fill annular space around bollard solidly with shrinkage-resistant grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.
- D. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
- E. Anchor internal sleeves for removable bollards in formed or core-drilled holes not less than 36 inches deep and 3/4 inch larger than OD of sleeve. Fill annular space around internal sleeves solidly with shrinkage-resistant grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward internal sleeve.
- F. Anchor internal sleeves for removable bollards in place with concrete footings. Center and align sleeves in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace sleeves in position until concrete has cured.
- G. Place removable bollards over internal sleeves and secure with 3/4-inch machine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. Owner furnishes padlocks.
- H. Fill bollards solidly with concrete, mounding top surface to shed water.
 - 1. Do not fill removable bollards with concrete.

3.6 INSTALLATION OF LOOSE BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.7 REPAIRS

- A. Touchup Painting:
 - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
 - 2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 96 00 "High Performance Coatings."

- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION

SECTION 055113 - METAL PAN STAIRS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Preassembled steel stairs with concrete-filled treads.
2. Steel tube railings and guards attached to metal stairs.
3. Steel tube handrails attached to walls adjacent to metal stairs.

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs, railings, and guards.
 1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, blocking for attachment of wall-mounted handrails, and items with integral anchors, that are to be embedded in concrete or masonry.
 2. Deliver such items to Project site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so they do not encroach on required stair width and are within fire-resistance-rated stair enclosure.
- D. Schedule installation of railings and guards so wall attachments are made only to completed walls.
 1. Do not support railings and guards temporarily by any means that do not satisfy structural performance requirements.

1.3 ACTION SUBMITTALS**A. Product Data: For metal pan stairs and the following:**

1. Perforated metal.
2. Woven-wire mesh.
3. Welded-wire mesh.
4. Prefilled metal-pan-stair treads.
5. Abrasive nosings.
6. Shop primer products.

7. Nonslip-aggregate concrete finish.
8. Abrasive-coating finish to formed-metal stairs.
9. Handrail wall brackets.
10. Grout.

B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
3. Include plan at each level.
4. Indicate locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.

C. Samples for Verification: For each type and finish of nosing.

D. Delegated Design Submittal: For stairs, railings and guards, , including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data:** For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that engineer is licensed in the State in which Project is located.
- B. Welding certificates.**
- C. Paint Compatibility Certificates:** From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:** Fabricator of products.
- B. Welding Qualifications:** Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification.**
1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
 2. Protect steel members and packaged materials from corrosion and deterioration.
 3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.

- a. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stairs, railings and guards, , including attachment to building construction.
- B. Structural Performance of Stairs: Metal stairs 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 and guard 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 and Guards: Railings and guards, including attachment to building construction, 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.
 3. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- D. Seismic Performance of Stairs:As indicated on drawings.

2.2 METALS

- A. Metal Surfaces: 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 A36/A36M.
- C. Steel Tubing for Railings and Guards: ASTM A500/A500M (cold formed).
- D. Steel Pipe for Railings and Guards: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight, unless another grade and weight are required by structural loads.
- E. Uncoated, Cold-Rolled Steel Sheet: ASTM A1008/A1008M, structural steel, Grade 25, unless another grade is required by design loads; exposed.
- F. Uncoated, Hot-Rolled Steel Sheet: ASTM A1011/A1011M, structural steel, Grade 30, unless another grade is required by design loads.
- G. Galvanized Steel Sheet: ASTM A653/A653M, G90 coating, structural steel, Grade 33, unless another grade is required by design loads.
- H. Expanded-Metal, Carbon Steel: ASTM F1267, , Class 1 (uncoated).
- I. Perforated Metal, Uncoated: Cold-rolled steel sheet, ASTM A1008/A1008M, or hot-rolled steel sheet, ASTM A1011/A1011M, commercial steel Type B, 0.060 inch thick, with 1/4-inch holes 3/8 inch o.c. in staggered rows.
- J. Perforated Metal, Galvanized Steel Sheet: ASTM A653/A653M, G90 coating, commercial steel Type B, 0.064 inch thick, with 1/4-inch holes 3/8 inch o.c. in staggered rows.
- K. Welded-Wire Mesh: Diamond pattern, 2-inch welded-wire mesh, made from 0.236-inch nominal-diameter steel wire complying with ASTM A510/A510M.
- L. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

2.3 ABRASIVE NOSINGS

- A. Extruded Units: Aluminum units with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. American Safety Tread Co., Inc.

- b. Balco; a CSW Industrials Company.
 - c. Nystrom.
- 2. Provide ribbed units, with abrasive filler strips projecting 1/16 inch above aluminum extrusion.
 - 3. Nosings, Square-Back Units: 1-3/8 inches wide, without lip.
 - 4. Abrasive color: Black..

2.4 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls.
 - 1. Select fasteners for type, grade, and class required.
- B. Fasteners for Anchoring Railings and Guards to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings and guards to other types of construction indicated and capable of withstanding design loads.
- C. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
- D. Post-Installed Anchors: Torque-controlled expansion anchors or adhesive 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 E488/E488M, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Electrodes: Comply with AWS requirements.
- B. Shop Primers: Provide primers that comply with Section 099600 "High-Performance Coatings."
- C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- D. Zinc-Rich Primer: Comply with SSPC-Paint 20, [Type I-A] [Type I-B] [Type I-C] [Type II], Level [1] [2] [3], and compatible with topcoat.
- E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish system indicated.

- F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with ASTM A780/A780M and compatible with paints specified to be used over it.
- G. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for interior use; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.
- H. Prefilled Concrete Treads:
 - 1. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with minimum 28-day compressive strength of 3000 psi and maximum aggregate size of 1/2 inch unless otherwise indicated.
 - 2. Nonslip-Aggregate Concrete Finish: Factory-packaged abrasive aggregate made from fused, aluminum-oxide grits or crushed emery; rustproof and nonglazing; unaffected by freezing, moisture, or cleaning materials.
 - 3. Plain Steel Welded-Wire Reinforcement: ASTM A1064/A10645M, steel, 6 by 6 inches, W1.4 by W1.4, unless otherwise indicated on Drawings.
 - 4. Reinforcement Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening welded-wire reinforcement in place.
 - a. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete.

2.6 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, railings and guards, 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.
- B. Assemble stairs, railings, and guards in shop to greatest extent possible.
 - 1. Disassemble units only as necessary for shipping and handling limitations.
 - 2. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately.
 - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
 - 2. 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. Form exposed work with accurate angles and surfaces and straight edges.
- F. 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 Finish #1 - No evidence of welded joint.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
 - 1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
 - 2. Locate joints where least conspicuous.
 - 3. Fabricate joints that will be exposed to weather in a manner to exclude water.
 - 4. Provide weep holes where water may accumulate internally.

2.7 FABRICATION OF STEEL-FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Architectural Class, unless more stringent requirements are indicated.
- B. Stair Framing:
 - 1. Stringers: Fabricate of steel rectangular tubes.
 - a. Stringer Size: As required to comply with "Performance Requirements" Article.
 - b. Provide closures for exposed ends of channel and rectangular tube stringers.
 - c. Finish: Shop primed.
 - 2. Platforms: Construct of steel rectangular tube headers and miscellaneous framing members as required to comply with "Performance Requirements" Article.
 - a. Provide closures for exposed ends of channel and rectangular tube framing.
 - b. Finish: Shop primed.
 - 3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
 - 4. Where stairs are enclosed by gypsum board assemblies, provide hanger rods or struts to support landings from floor construction above or below.
 - a. Locate hanger rods and struts where they do not encroach on required stair width and are 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.
- C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch.
1. Steel Sheet, Uncoated: Cold -rolled steel sheet.
 2. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
 3. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
 4. Shape metal pans to include nosing integral with riser.
 5. Attach abrasive nosings to risers.
 6. At Contractor's option, provide stair assemblies with metal pan subtreads filled with reinforced concrete during fabrication.
 7. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.
 - a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.
- D. Abrasive-Coating-Finished, Formed-Metal Stairs: Form risers, treads, and platforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.097 inch.
1. Steel Sheet: Uncoated, hot-rolled steel sheet unless otherwise indicated.
 2. Directly weld risers and treads to stringers; locate welds on underside of stairs.
 3. Provide platforms of configuration indicated or, if not indicated, the same as treads. Weld platforms to platform framing.
 4. Finish tread and platform surfaces with manufacturer's standard epoxy-bonded abrasive finish.
- 2.8 FABRICATION OF STAIR RAILINGS AND GUARDS
- A. Comply with applicable requirements in Section 057300 "Decorative Metal Railings."
- B. Fabricate railings and guards to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of member, post spacings, wall bracket spacing, and anchorage, but not less than that needed to withstand indicated loads.
- C. Welded Connections: Fabricate railings and guards with welded connections.
1. Fabricate connections that are exposed to weather in a manner that excludes water.
 - a. Provide weep holes where water may accumulate internally.

2. Cope components at connections to provide close fit, or use fittings designed for this purpose.
 3. Weld all around at connections, including at fittings.
 4. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 5. Obtain fusion without undercut or overlap.
 6. Remove flux immediately.
 7. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 - No evidence of a welded joint as shown in NAAMM AMP 521.
- D. Form changes in direction of railings and guards as follows:
1. As detailed.
- E. 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.
- F. Close exposed ends of railing and guard members with prefabricated end fittings.
- G. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.
- H. Connect posts to stair framing by direct welding unless otherwise indicated.
- I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.
1. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
 2. For galvanized railings and guards, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
 3. For nongalvanized railings and guards, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
 4. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.
- J. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports.
1. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.
- 2.9 FINISHES
- A. Finish metal stairs after assembly.

- B. Preparation for Shop Priming: Prepare uncoated, ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
- C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.
 - 1. For wall-mounted railings, verify locations of concealed reinforcement within gypsum board and plaster assemblies.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF METAL PAN STAIRS

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.
 - 1. 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.
 - 1. Grouted Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates.
 - a. Clean bottom surface of plates.
 - b. Set plates for structural members on wedges, shims, or setting nuts.
 - c. Tighten anchor bolts after supported members have been positioned and plumbed.
 - d. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - e. Promptly pack grout solidly between bearing surfaces and plates so no voids remain.

- 1) Neatly finish exposed surfaces; protect grout and allow to cure.
 - 2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- 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.
1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
 2. 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.
 3. Comply with requirements for welding in "Fabrication, General" Article.
- F. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."
1. Install abrasive nosings with anchors fully embedded in concrete.
 2. Center nosings on tread width.

3.3 INSTALLATION OF RAILINGS AND GUARDS

- A. Adjust railing and guard systems before anchoring to ensure matching alignment at abutting joints with tight, hairline joints.
1. Space posts at spacing indicated or, if not indicated, as required by design loads.
 2. Plumb posts in each direction, within a tolerance of 1/16 inch in 3 feet.
 3. Align rails and guards so variations from level for horizontal members and variations from parallel with rake of stairs for sloping members do not exceed 1/4 inch in 12 feet.
 4. Secure posts, rail ends, and guard ends to building construction as follows:
 - a. Anchor posts to steel by welding to steel supporting members.
 - b. Anchor handrail and guard ends to concrete and masonry with steel round flanges welded to rail and guard ends and anchored with post-installed anchors and bolts.
- B. Install railing gates level, plumb, and secure for full opening without interference.
1. Attach hardware using tamper-resistant or concealed means.
 2. Adjust hardware for smooth operation.
- C. Attach handrails to wall with wall brackets.
1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
 2. Secure wall brackets to building construction as required to comply with performance requirements.

3.4 REPAIR

A. Touchup Painting:

1. 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.
 - a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099600 "High-Performance Coatings."

END OF SECTION

SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section includes:

1. Sleeves without waterstop.
2. Sleeves with waterstop.
3. Stack-sleeve fittings.
4. Sleeve-seal systems.
5. Grout.
6. Silicone sealants.
7. Escutcheons.

1.2 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.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product, excluding motors which are included in Part 1 of the fire-suppression equipment Sections.
 - a. Include construction details, material descriptions, and dimensions of components.
 - b. Include operating characteristics and furnished accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.**
1. **PRODUCTS**

1.5 SLEEVES AND SLEEVE SEALS

A. Sleeves without Waterstop:

1. **Cast-Iron Pipe Sleeves:** Cast or fabricated of cast or ductile iron, with plain ends.

2. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
 3. Steel Sheet Sleeves: ASTM A653/A653M, 24 gauge minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.
 4. PVC Pipe Sleeves: ASTM D1785, Schedule 40.
 5. Molded-PVC Sleeves: With nailing flange.
 6. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange.
- B. Sleeves with Waterstop:
1. Description: Manufactured PVC/HDPE, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.
- C. Stack-Sleeve Fittings:
1. Description: Manufactured, Dura-coated or Duco-coated cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with setscrews.
- D. Sleeve-Seal Systems:
1. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - a. Hydrostatic Seal: 20 psig minimum.
 - b. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
 - c. Pressure Plates: Carbon steel.
 - d. Connecting Bolts and Nuts: Carbon steel, with ASTM B633 coating of length required to secure pressure plates to sealing elements.
- E. Grout:
1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
 2. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
 3. Design Mix: 5000 psi, 28-day compressive strength.
 4. Packaging: Premixed and factory packaged.
- F. Silicone Sealants:
1. Silicone Sealant, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
 - a. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.

2. Silicone Foam Sealant: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

- a. ESCUTCHEONS

G. Escutcheon Types:

1. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
2. One-Piece, Stainless Steel Type: With polished stainless steel finish.
3. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished, chrome-plated finish and spring-clip fasteners.
4. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
5. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

H. Floor Plates:

1. Split Floor Plates: Steel with concealed hinge.

PART 2 - EXECUTION

2.1 INSTALLATION OF PIPE LOOPS AND SWING CONNECTIONS

- A. Install pipe loops and offsets in accordance with NFPA 13 requirements for expansion and contraction compensation.

2.2 INSTALLATION OF SLEEVES, GENERAL

- 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.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 2. 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.

3. Using grout or silicone sealant, seal space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire-resistance of floor/slab/wall.
- 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 that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

2.3 INSTALLATION OF SLEEVES WITH WATERSTOP

- A. Install sleeve with waterstop as new walls and slabs are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange centered across width centered in concrete slab or wall.
- C. Secure nailing flanges to wooden concrete forms.
- D. Using grout or silicone sealant, seal space around outside of sleeves.

2.4 INSTALLATION OF STACK-SLEEVE FITTINGS

- 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 Section 076200 "Sheet Metal Flashing and Trim."
 3. Install section of cast-iron soil pipe to extend sleeve to 3 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 silicone sealant, seal space between top hub of stack-sleeve fitting and pipe.

- B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- or smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

2.5 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. 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.

2.6 INSTALLATION OF ESCUTCHEONS

- 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.

2.7 FIELD QUALITY CONTROL

- A. Sleeves and Sleeve Seals:
 - 1. Perform the following tests and inspections:
 - a. 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.
 - 2. Prepare test and inspection reports.
- B. Escutcheons:
 - 1. Using new materials, replace broken and damaged escutcheons and floor plates.

2.8 SLEEVES APPLICATION

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above and below Grade:

- a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
- 2. Concrete Slabs-on-Grade:
 - a. Sleeves with waterstops.
 - 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. Sleeves with waterstops or stack-sleeve fittings.
- 4. Interior Walls and Partitions:
 - a. Sleeves without waterstops.

2.9 ESCUTCHEONS APPLICATION

A. Escutcheons for New Piping:

- 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
- 2. Chrome-Plated Piping: One piece, cast brass with polished, chrome-plated finish.
- 3. Insulated Piping:
 - a. One piece, steel with polished, chrome-plated finish.
 - b. One piece, stainless steel with polished stainless steel finish.
 - c. One piece, cast brass with polished, chrome-plated finish.
 - d. One piece, stamped steel or split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
- 4. Bare Piping at Wall and Floor Penetrations in Finished Spaces:
 - a. One piece, steel with polished, chrome-plated finish.
 - b. One piece, stainless steel with polished stainless steel finish.
 - c. One piece, cast brass with polished, chrome-plated finish.
 - d. One piece, stamped steel or split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
- 5. Bare Piping at Ceiling Penetrations in Finished Spaces:
 - a. One piece, steel with polished, chrome-plated finish.
 - b. One piece, stainless steel with polished stainless steel finish.
 - c. One piece, cast brass with polished, chrome-plated finish.

- d. One piece, stamped steel or split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
- 6. Bare Piping in Unfinished Service Spaces:
 - a. One piece, steel with polished, chrome-plated finish.
 - b. One piece, cast brass with polished, chrome-plated finish.
 - c. One piece, stamped steel or split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
- 7. Bare Piping in Equipment Rooms:
 - a. One piece, steel with polished, chrome-plated finish.
 - b. One piece, cast brass with polished, chrome-plated finish.
 - c. One piece, stamped steel or split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
- B. Escutcheons for Existing Piping to Remain:
 - 1. Chrome-Plated Piping: Split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - 2. Insulated Piping: Split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - 3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - 4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - 5. Bare Piping in Unfinished Service Spaces: Split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - 6. Bare Piping in Equipment Rooms: Split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
- C. Install floor plates for piping penetrations of equipment room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. New Piping and Relocated Existing Piping: One piece, floor plate.
 - 2. Existing Piping: Split floor plate.

END OF SECTION 210500

COMMON WORK RESULTS FOR FIRE SUPPRESSION

LXT Eastside Development

SECTION 210500

Project #47732472
Permit Set 09/29/23

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**SECTION 210523 - GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION
PIPING**

PART 1 - GENERAL

1.1 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.

1.2 DEFINITIONS

- A. NRS:** Nonrising stem.
- B. OS&Y:** Outside screw and yoke.
- C. SBR:** Styrene-butadiene rubber.

1.3 DELIVERY, STORAGE, 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 SOURCE LIMITATIONS

- A. Obtain each type of valve from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings listed below and shall bear UL mark:

- 1. Fire Main Equipment: HAMV - Main Level.
 - a. Indicator Posts, Gate Valve: HCBZ - Level 1.
 - b. Ball Valves, System Control: HLUG - Level 3.
 - c. Butterfly Valves: HLXS - Level 3.
 - d. Check Valves: HMER - Level 3.
 - e. Gate Valves: HMRZ - Level 3.
- 2. Sprinkler System and Water Spray System Devices: VDGT - Main Level.
 - a. Valves, Trim and Drain: VQGU - Level 1.

- B. FM Global Approved: Valves shall be listed in its "Approval Guide," under the headings listed below:

- 1. Automated Sprinkler Systems:
 - a. Indicator posts.
 - b. Valves.
 - 1) Gate valves.
 - 2) Check valves
 - 3) Miscellaneous valves.

- C. ASME Compliance:

- 1. ASME B1.20.1 for threads for threaded-end valves.
- 2. ASME B16.1 for flanges on iron valves.
- 3. ASME B31.9 for building services piping valves.

- D. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

- E. NFPA Compliance for Valves:

1. Comply with NFPA 13, NFPA 24.
- F. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher, as required by system pressures.
- G. Valve Sizes: Same as upstream piping unless otherwise indicated.
- H. 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. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

2.3 TWO-PIECE BALL VALVES WITH INDICATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ames Fire & Waterworks; A WATTS Brand.
 2. Milwaukee Valve Company Ltd.
 3. NIBCO INC.
 4. Victaulic Company.
- B. Description:
 1. UL 1091, except with ball instead of disc and FM Global approved for indicating valves (butterfly or ball type), Class Number 1112.
 2. Minimum Pressure Rating: 175 psig.
 3. Body Design: Two piece.
 4. Body Material: Forged brass or bronze.
 5. Port Size: Full or standard.
 6. Seats: PTFE.
 7. Stem: Bronze or stainless steel.
 8. Ball: Chrome-plated brass.
 9. Actuator: Worm gear
 10. Supervisory Switch: Internal or external.
 11. End Connections for Valves NPS 1 through NPS 2: Threaded ends.
 12. End Connections for Valves NPS 2 through NPS 2-1/2: Grooved ends.

2.4 BRONZE BUTTERFLY VALVES WITH INDICATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ALEUM USA.

2. Globe Fire Sprinkler Corporation.
3. Milwaukee Valve Company.

B. Description:

1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 1112.
2. Minimum: Pressure rating: 175 psig.
3. Body Material: Bronze.
4. Seat Material: EPDM.
5. Stem Material: Bronze or stainless steel.
6. Disc: [Bronze] [Stainless steel][with EPDM coating].
7. Actuator: Worm gear.
8. Supervisory Switch: Internal or external.
9. Ends Connections for Valves NPS 1 through NPS 2: Threaded ends.
10. Ends Connections for Valves NPS 2-1/2: Grooved ends.

2.5 IRON BUTTERFLY VALVES WITH INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ALEUM USA.
2. Anvil International.
3. Globe Fire Sprinkler Corporation.
4. Kennedy Valve Company; a division of McWane, Inc.
5. NIBCO INC.
6. Tyco by Johnson Controls Company.
7. Victaulic Company.
8. Zurn Industries, LLC.

B. Description:

1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
2. Minimum Pressure Rating: 175 psig.
3. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.
4. Seat Material: EPDM.
5. Stem: Stainless steel.
6. Disc: Ductile iron, [nickel plated] [and EPDM or SBR coated].
7. Actuator: Worm gear.
8. Supervisory Switch: Internal or external.
9. Body Design: Grooved-end connections.

2.6 CHECK VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ALEUM USA.
2. Ames Fire & Waterworks; A WATTS Brand.
3. Anvil International.
4. FEBCO; A WATTS Brand.
5. Fire Protection Products, Inc.
6. Globe Fire Sprinkler Corporation.
7. Kennedy Valve Company; a division of McWane, Inc.
8. Matco-Norca.
9. Mueller Co.
10. NIBCO INC.
11. Reliable Automatic Sprinkler Co., Inc. (The).
12. Shurjoint; a part of Aalberts Integrated piping Systems.
13. Tyco by Johnson Controls Company.
14. United Brass Works, Inc.
15. Venus Fire Protection Ltd.
16. Victaulic Company.
17. Viking Corporation.
18. WATTS.
19. Wilson & Cousins Inc.
20. Zurn Industries, LLC.

- B. Description:

1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
2. Minimum Pressure Rating: 175 psig.
3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel with elastomeric seal.
6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.
8. Hinge Spring: Stainless steel.
9. End Connections: Flanged, grooved, or threaded.

2.7 BRONZE OS&Y GATE VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Milwaukee Valve Company.
2. NIBCO INC.

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3. United Brass Works, Inc.
4. Zurn Industries, LLC.

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Bronze or brass.
4. Wedge: One-piece bronze or brass.
5. Wedge Seat: Bronze.
6. Stem: Bronze or brass.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Threaded.

2.8 IRON OS&Y GATE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Cast Iron Pipe Company.
2. Clow Valve Company; a subsidiary of McWane, Inc.
3. Hammond Valve.
4. Kennedy Valve Company; a division of McWane, Inc.
5. Mueller Co.
6. NIBCO INC.
7. Victaulic Company.
8. WATTS.
9. Zurn Industries, LLC.

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron, or bronze[with elastomeric coating].
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Grooved.

2.9 NRS GATE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Cast Iron Pipe Company.
2. Clow Valve Company; a subsidiary of McWane, Inc.
3. Kennedy Valve Company; a division of McWane, Inc.
4. Mueller Co.
5. NIBCO INC.
6. Victaulic Company.
7. Zurn Industries, LLC.

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. End Connections: Grooved.

2.10 TRIM AND DRAIN VALVES

A. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Fire Protection Products, Inc.
 - c. Fire-End & Croker Corporation.
 - d. Flowserve Corporation.
 - e. FNW; Ferguson Enterprises, Inc.
 - f. Jomar Valve.
 - g. KITZ Corporation.
 - h. Legend Valve & Fitting, Inc.
 - i. Metso Automation USA Inc.
 - j. Milwaukee Valve Company.
 - k. NIBCO INC.
 - l. Potter Roemer LLC; a Division of Morris Group International.
 - m. Red-White Valve Corp.

- n. Tyco by Johnson Controls Company.
 - o. Victaulic Company.
 - p. WATTS.
 - q. Zurn Industries, LLC.
2. Description:
- a. Pressure Rating: 175 psig.
 - b. Body Design: Two piece.
 - c. Body Material: Forged brass or bronze.
 - d. Port size: Full or standard.
 - e. Seats: PTFE.
 - f. Stem: Bronze or stainless steel.
 - g. Ball: Chrome-plated brass.
 - h. Actuator: Handlever.
 - i. End Connections for Valves NPS 1 through NPS 2-1/2: Threaded ends.
 - j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2: Grooved ends.

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 INSTALLATION, GENERAL

- A. Comply with requirements in the following Sections for specific valve-installation requirements and applications:
 - 1. Section 211000 "Water-Based Fire Suppression Systems" for application of valves in fire-suppression standpipes; wet-pipe, fire-suppression sprinkler systems; and dry-pipe, fire-suppression sprinkler systems.
 - 2. Section 211339 "Foam-Water Systems" for application of valves in AFFF piping.

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3. Section 331415 "Site Water Distribution Piping" for application of valves in fire-suppression water-service piping.
- 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 double-check valve assembly in each fire-protection water-supply connection.
- D. 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.
- E. Install valves in horizontal piping with stem at or above the pipe center.
- F. Install valves in position to allow full stem movement.
- G. Install valve tags. Comply with requirements in Section 210553 "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.

END OF SECTION 210523

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**SECTION 210529 - HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING AND
EQUIPMENT**

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. Metal pipe hangers and supports.
- 2. Trapeze pipe hangers.
- 3. Metal framing systems.
- 4. Thermal hanger-shield inserts.
- 5. Fastener systems.
- 6. Equipment supports.

B. Related Requirements:

- 1. **Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.**
- 2. **Section 210516 "Expansion Fittings and Loops for Fire-Suppression Piping" for pipe guides and anchors.**
- 3. Section 210548.13 "Vibration Controls for Fire-Suppression Piping and Equipment" for vibration isolation devices **and seismic restraints.**

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

- 1. Trapeze pipe hangers.
- 2. Metal framing systems.
- 3. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers 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. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

1.4 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for fire-suppression piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 3. Design seismic-restraint hangers and supports for piping and equipment **and obtain approval from authorities having jurisdiction.**
- C. NFPA Compliance: Comply with NFPA 13.
- D. UL Compliance: Comply with UL 203.

2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 1. Description: Factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
 2. Galvanized Metallic Coatings: Pregalvanized or hot-dip galvanized.
 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with NFPA-approved, UL-listed, or FM-approved carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

- 1. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
- 2. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
- 3. Channels: Continuous slotted carbon-steel channel with inturned lips.
- 4. Channel Width: Selected for applicable load criteria.
- 5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
- 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- 7. Metallic Coating: Electroplated zinc.

B. Non-MFMA Manufacturer Metal Framing Systems:

- 1. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
- 2. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
- 3. Channels: Continuous slotted carbon-steel channel with inturned lips.
- 4. Channel Width: Select for applicable load criteria.
- 5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
- 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- 7. Metallic Coating: Pregalvanized G90.

2.5 THERMAL HANGER-SHIELD INSERTS

- A. Insulation-Insert Material: ASTM C552, Type II cellular glass with 100-psi or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength.
- B. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- C. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- D. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: NFPA-approved, UL-listed, or FM-approved threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: NFPA-approved, UL-listed, or FM-approved, insert-wedge-type anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Indoor Applications: Zinc-coated or Stainless steel.
 - 2. Outdoor Applications: Stainless steel.

2.7 EQUIPMENT SUPPORTS

- A. Description: NFPA-approved, UL-listed, or FM-approved, welded, shop- or field-fabricated equipment support, made from structural-carbon-steel shapes.

2.8 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout, suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

- 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.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal strut systems.
- D. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick 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. Install in accordance with approvals and listings.
 - 2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. Install in accordance with approvals and listings.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement 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. Install lateral bracing with pipe hangers and supports to prevent swaying.

- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger 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.
- K. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping:
 - 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.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. MSS SP-58, Type 39 Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. MSS SP-58, Type 40 Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. 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.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 - 6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 INSTALLATION OF EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers 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/D1.1M 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 so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

- A. Touchup:
 - 1. Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

2. Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in **Section 099113 "Exterior Painting," Section 099123 "Interior Painting," Section 099600 "High-Performance Coatings."**

- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with NFPA requirements for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- H. Use thermal hanger-shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 2. Steel Pipe Clamps (MSS Type 4): For suspension of NPS 1/2 to NPS 24 if little or no insulation is required.
 3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 6. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.

7. 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 or carbon-steel plate.
 8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 9. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Comply with NFPA requirements.
- L. Building Attachments: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system 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. C-Clamps (MSS Type 23): For structural shapes.
 3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- M. Saddles and Shields: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- N. Comply with NFPA requirements for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 210529

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SECTION 210553 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Warning tape
4. Pipe labels.
5. Valve tags.
6. Warning tags.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.
- C. Valve-numbering scheme.
- D. Valve Schedules: Provide for fire-suppression piping system. Include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032 inch stainless steel, 0.025 inch aluminum, 0.032 inch anodized aluminum, 0.032 inch thick, with predrilled or stamped holes for attachment hardware.
2. Letter and Background Color: As indicated for specific application under Part 3.
3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

5. Fasteners: Stainless steel rivets or self-tapping screws.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch 1/8 inch thick, with predrilled holes for attachment hardware.
2. Letter and Background Color: As indicated for specific application under Part 3.
3. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- C. Label Content:** Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 WARNING SIGNS AND LABELS

- A.** Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch 1/8 inch thick, with predrilled holes for attachment hardware.
- B.** Letter and Background Color: As indicated for specific application under Part 3.
- C.** Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
- D.** Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- E.** Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- F.** Fasteners: Stainless steel rivets or self-tapping screws.
- G.** Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H.** Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.

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- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 WARNING TAPE

- A. Material: Vinyl.
- B. Minimum Thickness: 0.005 inch.
- C. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.
- D. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.
- E. Maximum Temperature: 160 deg F.
- F. Minimum Width: 2 inches 4 inches.

2.4 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include the following:
 1. Pipe size.
 2. Flow-Direction Arrows: Include flow-direction arrows on[main] distribution piping. Arrows may be either integral with label or applied separately.
 3. Lettering Size: **Size letters in accordance with ASME A13.1 for piping**

2.5 VALVE TAGS

- A. Description: Stamped or engraved with 1/4-inch letters for piping-system abbreviation and 1/2-inch numbers.
 1. Tag Material: Brass, 0.04 inch stainless steel, 0.024 inch aluminum, 0.031 inch or anodized aluminum, 0.031 inch thick, with predrilled or stamped holes for attachment hardware.

2. Fasteners: Brass wire link chain beaded chain or S-hook.

B. Letter and Background Color: As indicated for specific application under Part 3.

C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch 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 modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Include valve-tag schedule in operation and maintenance data.

2.6 WARNING TAGS

A. Description: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum Approximately 4 by 7 inches.

2. Fasteners: Brass grommet and wire Reinforced grommet and wire or string.

3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."

4. Letter and Background Color: As indicated for specific application under Part 3.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION GENERAL REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

A. Permanently fasten labels on each item of fire-suppression equipment.

- B. Sign and Label Colors:
 - 1. White letters on an ANSI Z535.1 safety-red background.
- C. Locate equipment labels where accessible and visible.
- D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.

3.4 INSTALLATION OF WARNING TAPE

- A. Warning Tape Color and Pattern: Yellow background with black diagonal stripes .
- B. Install warning tape on pipes and ducts, with cross-designated walkways providing less than 6 ft. of clearance.
- C. Locate tape so as to be readily visible from the point of normal approach.

3.5 INSTALLATION OF PIPE LABELS

- A. Piping Color Coding: Painting of piping is specified in **Section 099123 "Interior Painting."****Section 099600 "High-Performance Coatings."**
- B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- C. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Within 3 ft. of each valve and control device.
 - 2. At access doors, manholes, and similar access points that permit a view of concealed piping.
 - 3. Within 3 ft. of equipment items and other points of origination and termination.
 - 4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.
- D. Flow- Direction Arrows: Provide arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. Fire-Suppression Pipe Label Color Schedule:
 - 1. Fire-Suppression Pipe Labels: White letters on an ANSI Z535.1 safety-red background.

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3.6 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valve-tag schedule in the operating and maintenance manual. Include the identification "FSV" on all fire-suppression system valve tags.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below.
 - 1. Valve-Tag Size and Shape: 1-1/2 inches (DN 38), round.
 - 2. Valve-Tag Color: White letters on an ANSI Z535.1 safety-red background.

3.7 INSTALLATION OF WARNING TAGS

- A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background.
- B. Attach warning tags, with proper message, to equipment and other items where **scheduled**.

END OF SECTION

SECTION 210800 - COMMISSIONING OF FIRE SUPPRESSION**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes Cx process requirements for the following fire-suppression systems, assemblies, and equipment:
 - 1. Water-based fire-suppression systems.
- B. Related Requirements:
 - 1. Section 019113 "General Commissioning Requirements" for general Cx process requirements and CxA responsibilities.
 - 2. For construction checklists, comply with requirements in various Division 21 Sections specifying fire-suppression systems, system components, equipment, and products.

1.2 DEFINITIONS

- A. Cx: Commissioning, as defined in Section 019113 "General Commissioning Requirements."
- B. CxA: Commissioning Authority, as defined in Section 019113 "General Commissioning Requirements."
- C. IgCC: International Green Construction Code.
- D. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fire-suppression testing technician.
- B. Test Equipment and Instruments: For all test equipment and instruments to be used in conducting Cx tests by Contractor, provide the following:
 - 1. Equipment/instrument identification number.
 - 2. Planned Cx application or use.
 - 3. Manufacturer, make, model, and serial number.
 - 4. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.
 - 5. Equipment manufacturers' proprietary instrumentation and tools. For each instrument or tool, identify the following:

- a. Instrument or tool identification number.
- b. Equipment schedule designation of equipment for which the instrument or tool is required.
- c. Manufacturer, make, model, and serial number.
- d. Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.

1.4 QUALITY ASSURANCE

- A. Fire-Suppression Testing Technician Qualifications: Technicians to perform fire-suppression Construction Checklist verification tests, Construction Checklist verification test demonstrations, Cx tests, and Cx test demonstrations shall have the following minimum qualifications:
 1. Journey level or equivalent skill level with knowledge of fire-suppression system, electrical concepts, and building operations.
 2. Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.
- B. Testing Equipment and Instrumentation Quality and Calibration:
 1. Capable of testing and measuring performance within the specified acceptance criteria.
 2. Be calibrated at manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
 3. Be maintained in good repair and operating condition throughout duration of use on Project.
 4. Be recalibrated/repared if dropped or damaged in any way since last calibrated.
- C. Proprietary Test Instrumentation and Tools:
 1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the Cx process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, shall comply with the following:
 - a. Be calibrated by manufacturer with current calibration tags permanently affixed.
 - b. Include a separate list of proprietary test instrumentation and tools in operation and maintenance manuals.
 - c. Fire-suppression system proprietary test instrumentation and tools become property of Owner at the time of Substantial Completion.

PART 2 - PRODUCTS (Not Used)**PART 3 - EXECUTION****3.1 Cx PROCESS**

- A. Perform Cx process for fire-suppression system in accordance with the following:

1. Section 019113 "General Commissioning Requirements."
2. NFPA 3.

3.2 CONSTRUCTION CHECKLISTS

- A. Preliminary detailed construction checklists are to be prepared under Section 019113 "General Commissioning Requirements" for each fire-suppression system, assembly, subsystem, equipment, and component required to be commissioned, as detailed in NFPA 3. Contractor performs the following:

1. Review fire-suppression system preliminary construction checklists and provide written comments on Construction Checklist items where appropriate.
2. Return preliminary Construction Checklist with review comments within 10 days of receipt.
3. When review comments have been resolved, the CxA will provide final construction checklists marked "Approved for Use, (date)."
4. Use only construction checklists marked "Approved for Use, (date)" when performing tests. Mark construction checklists in the appropriate place, as indicated Project events are completed, and provide pertinent details and other information.

- B. Prepare preliminary detailed construction checklists for each fire-suppression system, assembly, subsystem, equipment, and component required to be commissioned, as detailed in NFPA 3.

1. Submit preliminary construction checklists to CxA and Designer for review.
2. When review comments have been resolved, the CxA will provide final construction checklists marked "Approved for Use, (date)."
3. Use only construction checklists marked "Approved for Use, (date)" when performing tests. Mark construction checklists in the appropriate place, as indicated Project events are completed, and provide pertinent details and other information.

- C. Additional Systems Required to Be Commissioned:

1. Facility fire-suppression water-distribution piping outside the building, including the following:
 - a. Fire-suppression water piping, fittings, and specialties outside the building.

- b. Hydrants and fire-department connections.
 - c. Fire-alarm devices.
 - d. Meters and meter pits.
 - e. Outdoor water-storage tanks.
 - f. Sleeves and sleeve seals.
 - g. Meters and gauges.
 - h. General-duty and specialty valves.
 - i. Hangers and supports.
 - j. Heat tracing.
 - k. Vibration isolation.
 - l. Identification.
 - m. Insulation.
2. Fire-suppression sprinkler systems, including the following:
- a. Wet-pipe sprinkler piping, fittings, sprinklers, and specialties.
 - b. Dry-pipe sprinkler piping, fittings, sprinklers, and specialties.
 - c. Pressure-maintenance pumps, motors, accessories, and controls.
 - d. Compressed-air piping, compressors, motors, accessories, and controls.
 - e. Sleeves and sleeve seals.
 - f. Meters and gauges.
 - g. General-duty and specialty valves.
 - h. Hangers and supports.
 - i. Vibration isolation.
 - j. Identification.

3.3 Cx TESTING PREPARATION

- A. Certify that fire-suppression systems, subsystems, and equipment have been installed, calibrated, and started and that they are operating in accordance with the Contract Documents and approved submittals.
- B. Certify that fire-suppression system instrumentation and control systems have been completed and calibrated, that they are operating in accordance with the Contract Documents and approved submittals, and that pretest set points have been recorded.
- C. Set systems, subsystems, and equipment into operating mode to be tested in accordance with approved test procedures (for example, normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

3.4 Cx TEST CONDITIONS

- A. Perform tests using design conditions, whenever possible.

1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by CxA, and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
 2. Cx test procedures may direct that set points be altered when simulating conditions is impractical.
 3. Cx test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.
- B. If tests cannot be completed because of a deficiency outside the scope of the fire-suppression system, document the deficiency and report it to Architect. After deficiencies are resolved, reschedule tests.
- C. If seasonal testing is specified, complete appropriate initial performance tests and documentation, and schedule seasonal tests.

3.5 Cx TESTS COMMON TO FIRE-SUPPRESSION SYSTEMS

- A. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions, to verify compliance with acceptance criteria.
- B. Test systems, assemblies, subsystems, equipment, and components for operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and response compared to acceptance criteria.
- C. Coordinate schedule with, and perform Cx activities at the direction of, CxA.
- D. Comply with Construction Checklist requirements, including material verification, installation checks, startup, and performance test requirements specified in Division 21 Sections specifying fire-suppression systems and equipment.
- E. Provide technicians, instrumentation, tools, and equipment to perform and document the following:
1. Cx Construction Checklist verification tests.
 2. Cx Construction Checklist verification test demonstrations.

3.6 CONSTRUCTION CHECKLIST EXAMPLES

- A. Vibration Isolation in Fire-Suppression Systems:
1. Prerequisites: Acceptance of results of construction checklists for vibration control devices specified in **Section 210548.13 "Vibration Controls for Fire-Suppression Piping and Equipment."**
 2. Components to Be Tested:

- a. Vibration isolation control devices in water-based fire-suppression systems.
 - b. Support systems.
 3. Test Purpose: Evaluate effectiveness of vibration isolation control devices.
 4. Test Conditions: Measure vibration of the facility structure at three locations designated by Owner's witness while the isolated equipment operates.
 - a. Maximum speed.
 - b. Minimum speed.
 - c. Critical speed.
 5. Acceptance Criteria: Structure-borne vibration not to exceed specified performance.
- B. Supervision of Fire-Protection Valves in Water-Based Fire-Suppression Systems:
1. Prerequisites: Acceptance of results of construction checklists for valves specified in the following Sections:
 - a. Section 210523 "General-Duty Valves for Water-Based Fire Protection Piping."
 - b. Section 211000 "Water-Based Fire-Suppression Systems."
 - c. Section 284621.11 "Addressable Fire-Alarm Systems."
 - d. Section 284621.13 "Conventional Fire-Alarm Systems."
 - e. Section 331415 "Site Water Distribution Piping."
 2. Equipment and Systems to Be Tested:
 - a. Supervised valves in water-based fire-suppression systems.
 - b. Division 28 fire-detection and -alarm systems.
 3. Test Purpose: Verify generation of supervisory alarm at the fire-alarm control panel in response to activation of valve supervision device or tamper switch.
 4. Test Conditions:
 - a. Fire-alarm system operating in normal, automatic mode.
 - b. Activate valve supervision devices and tamper switches, one at a time.
 5. Acceptance Criteria: Activation of valve supervision device or tamper switch generates supervisory alarm at fire-alarm control panel.

END OF SECTION

SECTION 211000 - WATER-BASED FIRE-SUPPRESSION SYSTEMS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Fire-suppression piping, fittings, and appurtenances.
2. Fire department connections.
3. System control valves.
4. Fire-suppression piping specialties.
- 5.
6. Sprinklers.
7. Alarm Devices
8. Pressure Gauge

B. Related Requirements:

1. Section 331415 "Site Water Distribution Piping" for site fire-suppression water-service and backflow prevention devices.

1.2 DEFINITIONS

- A. Standard-Pressure Fire-Suppression System Piping: Piping designed to operate at working pressure of 175 psig maximum.
- B. High-Pressure Fire-Suppression System Piping: Piping designed to operate at working pressure higher than standard 175 psig, but not higher than 250 psig.

1.3 ACTION SUBMITTALS**A. Product Data:**

1. For each type of product.
 - a. Include construction details, material descriptions, dimensions of individual components and profiles.
 - b. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Prepare in accordance with NFPA 13 section "Working Plans."

- a. Include plans, elevations, and sections of the system piping and details.
 - b. Include detailed riser diagram and schematic diagram showing system supply, supply connection, devices, valves, pipe and fittings, as well as the delineation of the standard-pressure and high-pressure portions of the fire-suppression system.
 - c. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 2. Prepare computer-generated hydraulic calculations in accordance with the following:
 - a. Minimum operating pressure at hydraulically most remote fire hose valve is to be 100 psig.
 - b. Name of hydraulic program used.
 - c. Water supply information, including fire hydrant flow test data report.
 3. Submit documents and calculations signed and sealed by qualified professional engineer responsible for their preparation
 4. Include diagrams for power, signal, and control wiring.
- C. Delegated Design Submittals: For fire-suppression 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.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Fire-suppression system plans and sections, or Building Information Model (BIM), drawn to scale, showing the items described in this Section and coordinated with all building trades.
- B. Qualification Data: For qualified Installer and professional engineer.
- C. Design Data: Approved fire-suppression piping working plans, prepared in accordance with NFPA 13, including documented approval by AHJs, and including hydraulic calculations if applicable.
- D. Welding certificates.
- E. Field Test Reports:
 1. 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."
 2. Fire-hydrant flow test report.
- F. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-suppression systems and specialties to include in emergency, operation, and maintenance manuals.

1.6 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. 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.
- 2. System control valves.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:

- 1. Installer's responsibilities include designing, fabricating, and installing fire-suppression 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 qualified professional engineer.

- B. Welding Qualifications: Qualify procedures and operators in accordance with ASME Boiler and Pressure Vessel Code.

1.8 FIELD CONDITIONS

- A. Interruption of Existing Fire-Suppression Service: Do not interrupt fire-suppression service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary fire-suppression service in accordance with requirements indicated:

- 1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of fire-suppression service.
- 2. Do not proceed with interruption of fire-suppression service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Automatic wet-pipe sprinkler system.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Suppression System Components, Devices, and Accessories: Listed in UL's "Fire Protection Equipment Directory" and FM Approvals' "Approval Guide."
- 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.
- C. Fire-suppression system equipment, specialties, accessories, installation, and testing to comply with NFPA 13.
- D. Standard-Pressure Piping System Component: Listed for 175 psig minimum working pressure.
- E. Fire sprinkler system shall be designed in accordance with 2022 NFPA 409.
- F. Delegated Design: Engage a qualified professional engineer to design fire-suppression systems.

1. Fire-Hydrant Flow Test:

- a. Perform fire-hydrant flow test and record the following conditions:

- 1) Date: **<Insert test date>**.
- 2) Time: **<Insert time>** [a.m.] [p.m.]
- 3) Performed by: **<Insert operator's name>** of **<Insert firm>**.
- 4) Location of Residual Fire Hydrant R: **<Insert location>**.
- 5) Location of Flow Fire Hydrant F: **<Insert location>**.
- 6) Static Pressure at Residual Fire Hydrant R: **<Insert psig>**.
- 7) Measured Flow at Flow Fire Hydrant F: **<Insert gpm>**.
- 8) Residual Pressure at Residual Fire Hydrant R: **<Insert psig>**.

- b. Fire-hydrant flow test must be performed within previous 12 months prior to completion of design documents and hydraulic calculations.

- 2. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
- 3. Sprinkler Occupancy Hazard Classifications:
 - a. General Storage Areas: Ordinary Hazard, Group 1.
 - b. Offices, including Data Processing: Light Hazard.

4. Minimum Density for Automatic-Sprinkler Piping Design unless otherwise indicated on plans:
 - a. Light-Hazard Occupancy: 0.10 gpm/sq. ft. over 1500 sq. ft. area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm/sq. ft. over 1500 sq. ft. area.
 - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm/sq. ft. over 1500 sq. ft. area.
 - d. Aircraft hangar: 0.17 gpm/sq. ft. over 5000 sq. ft. (8.2 mm/min. over 140 sq. m) area.
 - e. Structural column protection (2 hour rating): .25 gpm/sq. ft. of column wetted area.
5. Maximum protection area per sprinkler in accordance with UL listing.
6. Total Combined Hose-Stream Demand Requirement: In accordance with NFPA 13 unless otherwise indicated:
 - a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
 - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
 - c. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes.
7. Minimum residual pressure at each hose-connection outlet is as follows:
 - a. NPS 1-1/2 Hose Connections: 65 psig.
 - b. NPS 2-1/2 Hose Connections: 100 psig.

G. Obtain documented approval of fire-suppression system design from AHJs.

2.3 FIRE-SUPPRESSION PIPING, FITTINGS, AND APPURTENANCES

A. Steel Pipe, Fittings, and Appurtenances:

1. Schedule 40 Steel Pipe: black-steel pipe, ASTM A53/A53M, ASTM A135/A135M, or ASTM A795/A795M.
 - a. Standards:
 - 1) UL 852.
 - 2) FM 1630.
 - b. Factory-applied exterior coating.
 - c. Factory-applied bacterial-resistant internal coating to reduce microbiologically influenced corrosion.
 - d. Pipe ends may be factory or field formed to match joining method.
2. Schedule 10 Steel Pipe: black-steel pipe, ASTM A53/A53M, ASTM A135/A135M, or ASTM A795/A795M.
 - a. Standards:
 - 1) UL 852.
 - 2) FM 1630.

- b. Factory-applied exterior coating.
 - c. Factory-applied bacterial resistant internal coating to reduce microbiologically influenced corrosion.
 - d. Pipe ends may be factory or field formed to match joining method.
- 3. Engineered Light-Wall Steel Pipe: black-steel pipe, ASTM A135/A135M or ASTM A795/A795M with wall thickness less than Schedule 40. Outside dimension is to be equivalent to Schedule 40.
 - a. Standards:
 - 1) UL 852.
 - 2) FM 1630.
 - b. Factory-applied exterior coating.
 - c. Factory-applied bacterial-resistant internal coating to reduce microbiologically influenced corrosion.
 - d. Pipe ends may be factory or field formed to match joining method.
- 4. Steel Pipe Nipples: black steel, ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.
- 5. Steel Couplings: uncoated steel, ASTM A865/A865M, threaded.
- 6. Gray-Iron Threaded Fittings: uncoated gray-iron threaded fittings, ASME B16.4, Class 125, standard pattern.
- 7. Malleable- or Ductile-Iron Unions: ASME B16.3.
- 8. Cast-Iron Flanges: ASME B16.1, Class 125.
- 9. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
 - a. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick.
 - 1) Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
 - 2) Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
 - b. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1 carbon steel unless otherwise indicated.
- 10. Steel Welding Fittings: ASTM A234/A234M and ASME B16.9.
 - a. 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.
- 11. Plain-End-Pipe Fittings:
 - a. Pressure Rating: 175 psig minimum.
 - b. Plain-End Fittings for Steel Piping: ASTM A53/A53M, carbon steel or ASTM A106/A106M, forged steel with dimensions matching steel pipe.

- c. Plain-End-Pipe Couplings for Steel Piping: Rigid pattern for steel-pipe dimensions, ductile-iron or malleable-iron housing. Include EPDM-rubber gasket, and bolts and nuts.
12. Grooved-Joint, Steel-Pipe Appurtenances:
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) SPF/Anvil; an ASC Engineered Solution.
 - 2) Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
 - 3) Victaulic Company.
 - b. Pressure Rating: [175 psig] [250 psig] [300 psig] minimum.
 - c. Grooved-End Fittings for Steel Piping: ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
 - d. 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.

2.4 FIRE DEPARTMENT CONNECTIONS

A. Fire Department Connection, Flush Type:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Fire Supply.
 - b. Croker; a Division of Morris Group International.
 - c. Elkhart Brass Mfg. Co., Inc.
 - d. Guardian Fire Equipment, Inc.
 - e. Potter Roemer LLC; a Division of Morris Group International.
 - f. Wilson & Cousins Inc.
- 2. Standard: UL 405.
- 3. 5 inch storz connection
- 4. Description: Flush, for wall mounting.
- 5. Pressure Rating: 175 psig minimum.
- 6. Body Material: Corrosion-resistant metal.
- 7. Inlets: NHS (2-1/2 inch) brass with threads in accordance with NFPA 1963 and matching local fire department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
- 8. Caps: Brass, lugged type, with gasket and chain.
- 9. Escutcheon Plate: Rectangular, brass, wall type, with factory-cast letter markings.
- 10. Outlet: With pipe threads.
- 11. Body Style: Horizontal.
- 12. Number of Inlets: One.

13. Outlet Location: Back.
14. Escutcheon Plate Marking: AUTO SPRINKLER .
15. Finish: Rough brass.
16. Outlet Size: NPS 4.

2.5 SYSTEM CONTROL VALVES

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."
- B. Pressure Rating:
 1. Standard-Pressure Piping Valves: 175 psig minimum.
- C. Body Material: Cast or ductile iron.
- D. Size: Same as connected piping.
- E. End Connections: Flanged or grooved.

2.6 FIRE-SUPPRESSION PIPING SPECIALTIES

- A. Branch Outlet Fittings:
 1. Standard: UL 213.
 2. Pressure Rating: 175 psig minimum.
 3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
 4. Type: Mechanical-tee 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. Standard: UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."
 2. Pressure Rating: 175 psig minimum.
 3. Body Material: Cast- or ductile-iron housing with 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. Standard: UL 199.
 2. Pressure Rating: 175 psig.
 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. Sprinkler Inspector's Test Fittings:

1. Standard: UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."
2. Pressure Rating: 175 psig minimum.
3. Body Material: Cast- or ductile-iron housing with sight glass.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

1. Standard: UL 1474.
2. Pressure Rating: 250 psig minimum.
3. Body Material: Steel pipe with EPDM-rubber O-ring seals.
4. Size: Same as connected piping.
5. Length: Adjustable.
6. Inlet and Outlet: Threaded.

F. Flexible Sprinkler Hose Fittings:

1. Standards:
 - a. UL 2443.
 - b. FM 1637.
2. Description: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
3. Pressure Rating: 175 psig minimum.
4. Size: Same as connected piping, for sprinkler.

G. Automatic (Ball-Drip) Drain Valves:

1. Pressure Rating: 175 psig minimum.
2. Type: Automatic draining, ball check.
3. Size: NPS 3/4.
4. End Connections: Threaded.

H. Manual Air Vent/Valve:

1. Description: Ball valve that requires human intervention to vent air.
2. Body: Forged brass.
3. Ends: Threaded.
4. Minimize Size: 1/2 inch.
5. Minimum Water Working Pressure Rating: 300 psig.

I. Automatic Air Vent:

1. Description: Automatic air vent that automatically vents trapped air without human intervention. Approved for use in wet-pipe fire-suppression system.
2. Vents oxygen continuously from system.
3. Float valve to prevent water discharge.
4. Minimum Water Working Pressure Rating: 175 psig.

J. Automatic Air Vent Assembly:

1. Description: Automatic dual air vent assembly that automatically vents trapped air without human intervention, including Y-strainer and ball valve in a pre-piped assembly. Approved for use in wet-pipe fire-suppression system.
2. Vents oxygen continuously from system.
3. Float valve to prevent water discharge.
4. Minimum Water Working Pressure Rating: 175 psig.

2.7 COVER SYSTEMS FOR SPRINKLER PIPING

A. Cover System, Extruded PVC:

1. Description: System of support brackets and covers designed to protect sprinkler piping.
2. Brackets: Per cover manufacturer.
3. Covers: Factory-fabricated extruded-PVC cover with concealed attachment clips.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Reliable Automatic Sprinkler Co., Inc. (The).
2. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
3. Victaulic Company.
4. Viking Group Inc.

C. Standards:

1. UL 199.
2. UL 1767.
3. UL 1626.
4. FM 2000.
5. FM 2008.
6. FM 2030.

D. Listed in UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."

E. Pressure Rating for Sprinklers:

1. Standard Automatic Sprinklers: 175 psig minimum.

F. Sprinklers, Automatic Wet with Heat-Responsive Element:

1. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
2. Standard Spray, Quick Response:
 - a. Upright.
 - b. Pendent.
 - c. Recessed pendent.
 - d. Flat, concealed pendent.
 - e. Vertical sidewall.
 - f. Horizontal sidewall.
 - g. Flat, concealed horizontal sidewall.
3. Standard Spray, Quick Response:
 - a. Upright.
 - b. Pendent.
 - c. Recessed pendent.
 - d. Flat, Concealed pendent.
 - e. Horizontal sidewall.
 - f. Flat, concealed horizontal sidewall.

G. Sprinkler Finishes: Chrome plated.

H. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

I. Sprinkler Guards and Water Shields:

1. Standard: UL 199.
2. Description: Wire cage with fastening device for attaching to sprinkler.

2.8 ALARM DEVICES

A. Match alarm-device material and connection types to piping and equipment materials and connection types.

B. Electrically Operated Notification Appliances:

1. Strobe/Horn:
 - a. Standard: UL 464.

- b. Tone: Selectable, steady, Temporal-3 (T-3) in accordance with ISO 8201 and ANSI/ASA S3.41, 2400 Hz, electromechanical, broadband.
- c. Voltage: 120 V ac, 60 Hz.
- d. Effective Intensity: 110 cd.
- e. Finish: Red, suitable for outdoor use with approved and listed weatherproof backbox. White letters on housing identifying device as for "Fire."
- f. Sign, Integrated: Mount between backbox and strobe/horn with text visible on both sides, above and below strobe/horn. Housing to be shaped to cover surface-mounted weatherproof backbox. Sign is to consist of white lettering on red plastic identifying it as a "Sprinkler Fire Alarm" and instructing viewers to call 911, police or fire department.

C. Water-Flow Indicators:

- 1. Standard: UL 346.
- 2. Water-Flow Detector: Electrically supervised.
- 3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125 V ac and 0.25 A, 24 V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
- 4. Type: Paddle operated.
- 5. Pressure Rating: 250 psig.
- 6. Design Installation: Horizontal or vertical.

D. Valve Supervisory Switches:

- 1. Standard: UL 346.
- 2. Type: Electrically supervised.
- 3. Design: Signals that controlled valve is in other than fully open position.
- 4. Wire Terminal Designations: Indicates normal switch position when switch is properly installed on valve and valve is fully open.
- 5. 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.
- 6. OS&Y Valve Supervisory Switches:
 - a. One or two single-pole, double-throw switches.
 - b. NEMA Rating: NEMA 4 and NEMA 6P enclosures suitable for mounting in any position indoors or outdoors.
 - c. Visual Switch Indication: Indicates device is properly installed and OS&Y valve is fully open.
 - d. Mounting Hardware: Mounting bracket to grip valve yoke and prevent movement of switch assembly on OS&Y valve.
 - e. Trip Rod Length: Adjustable
- 7. Butterfly Valve Supervisory Switches:
 - a. Two single-pole, double-throw switches.
 - b. NEMA Rating: NEMA 4 and NEMA 6P enclosures suitable for mounting in any position indoors or outdoors.

- c. Mounting Hardware: Removable nipple.
 - d. Trip Rod Length: Adjustable
- 8. Ball Valve Supervisory Switches:
 - a. One single-pole, double-throw switch.
 - b. NEMA Rating: NEMA 4 enclosure suitable for mounting in any position indoors or outdoors.
 - c. Mounting Hardware: Suitable for mounting directly to pipe, ball valves, or backflow preventers sized from up to NPS 2.

2.9 MANUAL CONTROL STATIONS

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide"
- B. Description: For hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve.
- C. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.10 PRESSURE GAUGES

- A. Standard: UL 393.
- B. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- C. Pressure Gauge Range: 0 to 250 psig minimum.
- D. Water System Piping Gauge: Include "WATER" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test. Use results for system design calculations required in "Quality Assurance" Article.
 - 1. Flow test is to be performed to meet the criteria established by NFPA 13.
 - 2. Flow test is to be conducted in accordance with NFPA 291.
 - 3. Test is to be performed during a period of ordinary demand for the water system.
 - a. To obtain satisfactory test results of expected flow or rated capacities, sufficient discharge should be achieved to cause drop of at least 10 percent.
 - 4. Pitot readings are to be taken at the 2-1/2-inch orifice connection.
 - 5. The pitot reading is to range from 10 to 35 psig.

6. Open additional hydrant outlets as needed to control pitot readings.
7. The pitot pressure and corresponding residual pressure readings are to be taken consecutively as pressure fluctuates between a high number and low number.

B. Flow Test Data Written Report:

1. Flow data report is to be written in accordance with NFPA 291.
2. Flow data report is to include a copy of all flow data recorded during the test, including a site plan showing the tested fire hydrants with respect to the fire water service to the building. Site plan is to indicate which hydrant was flowed and which hydrant was used for pressure reading. Provide date of test, name of testing agency, and name of individual performing test.

C. Water Supply Curve: Provide water supply curve based on the lowest supply for a given set of test data. For a given residual pressure reading, the supply is to be graphed utilizing the corresponding pitot pressure/flow reading and static pressure reading.

D. Documentation is to include calibration certifications for gauges used in the flow tests. The certifications are to be from within the previous six (6) months from a reputable agency recognized for certifying pressure gauges.

E. Report flow test results promptly and in writing. A copy of the flow test data report is to be submitted with the hydraulic calculations.

3.2 INSTALLATION OF FIRE-SUPPRESSION WATER-SERVICE PIPING

- A.** Comply with requirements for fire-suppression water-service piping in Section 331415 "Site Water Distribution Piping."

3.3 INSTALLATION OF FIRE-SUPPRESSION PIPING

- A. Locations and Arrangements:** Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
1. Deviations from approved working plans for piping require written approval from AHJs. 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 NFPA 13 requirements for installation of fire-suppression piping.
- C.** Install seismic restraints on piping. Comply with NFPA standards requirements for seismic-restraint device materials and installation.
- D.** Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install inspector's test connections in sprinkler system piping, complete with shutoff valve, and sized and located in accordance with NFPA 13.
- H. Install fire-suppression system piping with drains for complete system drainage. Extend drain piping to exterior of building where possible.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. 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 exterior of building.
- K. Install alarm devices in piping systems.
- L. Install hangers and supports for fire-suppression piping in accordance with NFPA standards. Comply with requirements for hanger materials in NFPA standards. In seismic-rated areas, refer to Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."
- M. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe/sprinkler supply. Include pressure gauges with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they are not subject to freezing.
- N. Fill wet-type fire-suppression system piping with water.
- O. Drain dry-type fire-suppression system piping.
 - 1. Install electric heating cables and pipe insulation on fire-suppression piping in areas subject to freezing. Comply with requirements for heating cables in Section 210533 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Section 210700 "Fire-Suppression Systems Insulation."
- P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210500 "Common Work Results for Fire-Suppression Piping."
- Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210500 "Common Work Results for Fire-Suppression Piping."
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210500 "Common Work Results for Fire-Suppression Piping."

3.4 INSTALLATION OF PIPING JOINTS

- 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 in accordance with ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads in accordance with 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. Welded Joints: Construct joints in accordance with AWS D10.12M/D10.12, using qualified processes and welding operators in accordance with "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings in accordance with AWWA C606 for steel-pipe joints.
- J. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings in accordance with AWWA C606 for steel-pipe grooved joints.
- K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.
- L. Plastic-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.

3.5 INSTALLATION OF FIRE DEPARTMENT CONNECTIONS

- A. Install wall-type fire department connections.
- B. Install yard-type fire department connections in concrete slab support. Comply with requirements for concrete in Section 033000 "Cast-in-Place Concrete."
- C. Install two protective pipe bollards on sides of each fire department connection. Comply with requirements for bollards in Section 055000 "Metal Fabrications."
- D. Install automatic horizontal (ball-drip) drain valve at low points of piping for fire department connection.

3.6 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

- A. Install cover system, brackets, and cover components for sprinkler piping in accordance with manufacturer's installation manual and in accordance with NFPA 13 or NFPA 13R for supports.

3.7 INSTALLATION OF VALVES AND SPECIALTIES

- A. Install listed fire-suppression system control valves, trim and drain valves, specialty valves and trim, controls, and specialties in accordance with manufacturer's installation instructions, NFPA standards, and AHJ.
- B. Install listed fire-suppression system shutoff valves in supervised open position, 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. System Control Valves:
 1. Install alarm valves with bypass check valve and retarding chamber drain-line connection.
 2. Install **[dry-pipe]** **[and]** **[preaction]** valves with trim sets for air supply, drain, priming level, alarm connections, ball-drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.
 - a. Install air compressor and compressed-air-supply piping.
 - b. Install air-pressure maintenance device with shutoff valves to permit servicing without shutting down system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14 to 60 psig adjustable range; and 175 psig maximum inlet pressure.
 - c. Install compressed-air-supply piping from building's compressed-air piping system.

3. Install deluge valves with trim sets for drain, priming level, alarm connections, ball-drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.

D. Air Vent:

1. Provide at least one air vent at high point in each wet-pipe fire-suppression system in accordance with NFPA standards. Connect vent into top of fire-suppression piping.
2. Provide dielectric union for dissimilar metals, ball valve, and strainer upstream of automatic air vent.
3. Pipe from outlet of air vent to drain.

3.8 INSTALLATION OF SPRINKLERS

- A. Install sprinklers in suspended ceilings symmetrically in center of narrow dimension of acoustical ceiling panels within tolerance of 1/2 inch. Coordinate entire pattern of sprinkler locations with approved reflected ceiling plan.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.9 INSTALLATION OF NITROGEN GENERATOR WITH PURGE/VENT SYSTEM

- A. Install in accordance with manufacturer's written installation instructions.
- B. Locate purge vent/valve in accordance with manufacturer's written installation instructions.
- C. Route alarm signals in code-approved electrical conduit from nitrogen generator system control panel to the supervisory circuit of BAS.

3.10 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping in accordance with requirements for identification specified in Section 210553 "Identification for Fire-Suppression Piping and Equipment."
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 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 fire-suppression systems in accordance with NFPA standards.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Coordinate with fire-alarm tests. Operate as required.
 - 6. Verify that equipment hose threads are same as local fire department equipment.
 - 7. Verify that sprinklers original factory finish has not been contaminated with dirt, debris, or paint. Sprinklers containing other-than-original factory finish are to be considered defective and replaced with new products. Repair and/or cleaning is not acceptable.
- C. Fire-suppression piping system will be considered defective if it does not pass tests and inspections.
- D. Fire-suppression piping system components considered defective during testing will be replaced with new components. Repair of defective components is not acceptable.
- E. Prepare test and inspection reports.

3.12 CLEANING

- A. Clean dirt and debris from fire-suppression system piping, system control valves, sprinklers, and associated components.
- B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.13 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain system control valves.

3.14 PIPING SCHEDULE

- A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends, cast-iron threaded fittings, and threaded or grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2 and Smaller, to Be One of the Following:

1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 2. Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 3. Schedule 10, steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- D. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2-1/2 and larger, to Be One of the Following:
1. Schedule 10, steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.15 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
1. Rooms without Ceilings: Upright sprinklers.
 2. Rooms with Suspended Ceilings: Flat concealed sprinklers. Rooms with custom ceilings: Flat concealed sprinklers with factory painted cover plate to match surrounding surfaces. Spaces Subject to Freezing: Upright sprinklers, dry pendent sprinklers, and dry sidewall sprinklers as indicated.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
1. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces and locations not generally exposed to view; and wax coated where exposed to acids, chemicals, or other corrosive fumes.
 2. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
 3. Flat Concealed Sprinklers: Rough brass, with factory-painted white cover plate.

END OF SECTION

SECTION 220010 - BASIC MECHANICAL REQUIREMENTS FOR PLUMBING

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 and the other sections of Divisions 21, 22, and 23.

1.2 SUMMARY

- A. This Section includes general administrative and procedural requirements for mechanical installations.

1.3 CONTRACT DOCUMENTS

- A. All work shall be executed in accord with the requirements of national, state, and local codes, regulations, and standards applicable to the trade affected.
- B. Should any change in the Contract Documents be required to comply with the governing codes, regulations, and standards, notify the Architect-Engineer prior to the time of submitting a Bid. After entering into the Contract, the Contractor will be held liable to complete all work necessary to meet these requirements without extra cost to the Owner.
- C. Should any conflict occur in, or between, the Drawings and Specifications, the Contractor is deemed to have based his Bid on the more expensive material, equipment, product, or work, unless he shall have asked for, and obtained, a written clarification or decision in regard to the conflict from the Architect-Engineer. The written decision, in the form of Addenda to the Contract, shall be obtained prior to submission of the Bid.
- D. Work required by the Contract Documents, which exceed the minimum requirements of the governing codes, standards, and regulations shall be done as shown or specified
- E. Include payments for fees, permits, inspections, and licensing required for the Mechanical Work under this Division.
- F. Payment of assessments and charges levied by the serving utilities, relative to Mechanical Work, shall be paid by the Mechanical Contractor.
- G. Arrange for required inspections as early as possible. When possible, have all inspections at the same time.

1.4 DRAWINGS AND MEASUREMENTS

- A. Mechanical drawings are diagrammatic and indicate the general arrangement of systems and equipment, except when specifically dimensioned or detailed. Plumbing, piping, and ductwork plans are intended to show size, capacity, approximate location, direction, and general relationship of one work phase to another, but not the exact detail or arrangement.
- B. As the Mechanical drawings are of small scale, it is not possible to show all necessary offsets, fittings, and accessories. Examine General Construction, Mechanical, and Electrical Drawings and Specifications; obtain exact locations, measurements, levels, etc., at the site; arrange systems accordingly; and, at no additional expense to the Owner, furnish fittings, offsets, and accessories as required.
- C. Mechanical equipment layout and service clearances are associated with the Basis of Design Equipment Requirements. If Contractor chooses to select equipment from other available manufacturers, the Contractor shall be responsible to verify all chosen manufacturer's service clearance are maintained. If the chosen equipment requires system or building design modifications to obtain these clearances, the Contractor shall be fully responsible for those modifications and associated costs.

1.5 SHOP DRAWING SUBMITTALS

- A. Composite Drawings:
 - 1. The Contractor shall prepare composite Drawings and installation layouts when required to solve tight field conditions.
 - 2. Drawings shall consist of dimensioned plans and elevations and shall give complete information, particularly as to size and location of sleeves, inserts, attachments, openings, conduits, ducts, boxes, structural interferences, etc.
- B. Product Data:
 - 1. The purpose of submittals by Contractor's is to demonstrate to the Architect-Engineer that the Contractor understands the design concept; and that his understanding is demonstrated by indicating the equipment and materials he intends to furnish and install, and the fabrication and installation methods he intends to use.
 - 2. The Contractor shall become acquainted with the content of the submittals prior to turning the material over to the Architect-Engineer. The Contractor shall review these submittals and make necessary corrections before merely forwarding them to the Architect-Engineer.
 - 3. Do not fabricate or order products or begin work which requires submittals until approval of submittal.
 - 4. Sequentially number submittals. Revised submittals should include original number and a sequential alphabetic suffix.

5. Submit manufacturer's printed literature in original form. Any fading type of reproduction for example - a "second generation" facsimile will not be accepted.
 6. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with the contract requirements.
 - a. Provide manufacturers catalog sheets, brochures, standard diagrams, schematics, schedules, performance charts, illustrations and other standard descriptive data. Where printed literature describes items in addition to that item being submitted, the submitted item shall be clearly marked on the sheet and superfluous information shall be crossed out. Delete information which is not applicable to the Contract.
 - b. The Contractor shall supplement standard information with additional information applicable to this Contract, and indicate dimensions, clearances, performance characteristics, capacities, wiring and piping diagrams, and controls. Clearly delineate the following information:
 - 1) Applicable Contract Specification Section Numbers.
 - 2) Applicable Standards, such as ASTM or Federal specification numbers.
 - 3) Clearly mark each copy to identify pertinent product, or models. Show descriptive names of materials and equipment, classified item numbers, and locations at which materials or equipment are to be installed in the Work. Use the same reference identification as shown on Contract Drawings.
 - 4) Show physical dimensions, weights, and clearances required.
 - 5) Furnish performance curves for all pumps and fans
 - 6) Show performance data consisting of equipment capabilities, RPM, KW, pressure drops, design and operating points, pressures, temperatures, noise level curves, power characteristics and consumption; conforming as closely as possible to the test methods referenced in the plans and specifications.
 - 7) Show wiring or piping diagrams and controls.
 - 8) Identify any and all deviations from the Contract Drawings and specifications.
 7. The Contractor's stamp, initialed or signed, shall certify dimensional compatibility of the product(s) with the space in which it is intended to be used. Furthermore, it shall signify his review of the submittal(s) for compliance with Contract requirements.
- C. Reviewed Submittals: The Architect-Engineer's review of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Review will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been reviewed by the Architect-Engineer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary, and the Architect-Engineer is financially compensated for the additional review.

- D. Deviations: For submittals which include proposed deviations requested by the Contractor, the proposed deviations from the contract requirements shall be clearly identified. The Contractor shall set forth in writing the reason for any deviations and annotate such deviations on the submittal.

1.6 QUALITY OF WORK

- A. All work shall be of the best quality free from defects in workmanship, materials, and performance.

1.7 DELIVERY AND RECEIVING

- A. Arrange deliveries of products in accordance with construction progress schedules. Allow time for inspection prior to installation.
- B. Coordinate deliveries to avoid conflict with work and conditions at site, work of other contractors, limitations on storage space, availability of personnel and handling equipment.
- C. Deliver products in undamaged, dry condition, in original unopened containers or packaging with identifying labels intact and legible.
- D. Clearly mark partial deliveries of component parts of equipment to identify equipment and contents to permit easy accumulation of parts and to facilitate assembly.

1.8 STORAGE, GENERAL

- A. Store products, immediately on delivery, in accordance with manufacturer's instructions, with seals and labels intact. Protect until installed.
- B. Arrange storage in a manner to provide access for maintenance of stored items and for inspection.
- C. Protect products from dirt, including construction dust. Products left exposed to dirt or dust must be thoroughly cleaned to the satisfaction of the Engineer prior to installation.

1.9 ENCLOSED STORAGE

- A. Store products, subject to damage by the elements, in substantial weather tight enclosures.
- B. Maintain temperature and humidity within ranges stated in manufacturer's instructions.
- C. Provide humidity control and ventilation for sensitive products as required by manufacturer's instructions.

- D. Store unpacked and loose products on shelves, in bins, or in neat groups of like items.

1.10 EXTERIOR STORAGE

- A. Provide substantial platforms, blocking, or skids, to support fabricated products above ground; slope to provide drainage. Protect products from soiling and staining.
- B. For products subject to discoloration or deterioration from exposure to the elements, cover with impervious sheet material. Provide ventilation to avoid condensation.
- C. Store loose granular materials on clean, solid surfaces such as pavement, or on rigid sheet material, to prevent mixing with foreign matter.
- D. Provide surface drainage to prevent erosion and ponding of water.

1.11 SUBSTITUTIONS

- A. Refer to front portion of the specifications.
- B. The Owner shall be the sole and final judge as to the suitability of items substituted for those specified. Requests for substitutions shall be submitted no later than ten (10) days prior to the day of bid opening. If prior approval is not granted, equipment shall be furnished as specified or as shown on the plans.
- C. The entire cost of all changes of any type due to substitutions for materials specified shall be borne by the Contractor at no extra cost to the Owner & shall reimburse other trades of additional cost due to substitution.
- D. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals without separate written request, or when acceptance will require substantial revision of Contract Documents

1.12 CHANGE ORDERS

- A. Refer to front portion of the specifications.
- B. The Contractor shall, in no instance, commence work on, or provide materials for or make changes in, the work for this project which will require additional payment from the Owner to the Contractor until he has requested and obtained, in writing, either a signed written Change Order or a signed written notice to proceed with the extra work.
- C. Each request for approval of additional work which is to require additional payment from the Owner, or in instances where credit is to be allowed to the Owner for omission of certain work or materials, shall be accompanied by a price quotation, including a complete cost breakdown of materials, labor, overhead and profit.

1.13 SALVAGE

- A. Items to be salvaged by the Owner will be identified by the Owner and removed by the Contractor. Coordinate items with Owner before removal work is commenced.
- B. Items that are not salvaged by the Owner, shall be removed from the site by the Contractor. The Contractor shall coordinate salvage with the Owner.

1.14 OPERATING AND MAINTENANCE MANUAL

- A. Refer to front portion of the specifications and to each Section of Divisions 22 and 23.
- B. The Contractor shall furnish three (3) Operating and Maintenance Manuals to the Owner after all tests and adjustments have been completed. Final payment will not be made until this manual has been submitted and approved. In addition to the requirements of the front portion of these specifications, the manual shall include but not limited to:
 - 1. Binder: All of the above described items shall be assembled in a three-ring binder with a hard cover and durable cloth or plastic finish.
 - 2. Index: A complete index shall be included at the front of the manual.
 - 3. Name, Address and Telephone of the Manufacturer and Local Representative: Include a list of all suppliers and representatives of products supplied on the project shall be included in the manual.
 - 4. Valve List: A list of all valves with the number and function of each valve shall be included in the manual.
 - 5. V-Belt and Filter List: A list of all V-belts and filters with sizes, types and quantities required by each piece of equipment shall be included in the manual.
 - 6. Shop Drawings: One copy of each approved shop drawing shall be included in the manual.
 - 7. Manufacturers' Manuals and Parts Lists: Operating and maintenance manuals and parts lists furnished by equipment manufacturers shall be included in the manual.
 - 8. Startup and Shutdown Procedures: A written description of the procedure for starting up and shutting down each mechanical system shall be included in the manual. This description shall include motors to start, valves to open, etc., in proper sequence and location of switches, starters, push buttons and valves.
 - 9. Seasonal Changeover Procedure (if applicable): A written description of the procedures necessary for seasonal changeover from heating to cooling and vice versa shall be included in the manual.
 - 10. Manufacturers Start-up of Equipment Documentation: Documents shall include date and time of start-up, name of authorized personnel who performed start-up, any required settings and notes concerning start-up shall be included in the manual.
 - 11. State or City Tests, Approval, or Acceptance of Equipment and/or systems: This shall include date, time, name of authorized personnel and any other notes. Documentation of domestic water sterilization and equipment approved installation start-ups shall be included in the manual.

12. Reports: Include air and water balancing reports.

1.15 AS-BUILT DRAWINGS

- A. Refer to front portion of the specifications.
- B. This Contractor shall prepare as-built drawings for the various component portions of the mechanical installations. These drawings shall be furnished to the Owner after completion of the work. These drawings shall be prepared by marking up a set of contract drawings with colored pencils to show changes made during construction after the various installations have been completed.

1.16 GUARANTEE

- A. Refer to front portion of the specifications.
- B. The Contractor shall guarantee that all mechanical systems shall be free from defects in workmanship, materials and performance to specified capacities and that if such defects shall appear during a period of one year, or as specified in another section, from date of final acceptance, he will remedy such defects to the satisfaction of the Owner at no extra cost.

1.17 EXTRA MATERIALS

- A. Furnish extra materials as described in each Division 22 and 23 sections and items are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 MECHANICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:
 1. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 2. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

BASIC MECHANICAL REQUIREMENTS FOR PLUMBING

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3. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
4. Coordinate noisy or loud work to be completed during non-business working hours, weekends or during designated times from Owner.
- 5.

END OF SECTION 220010

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SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves without waterstop.
2. Sleeves with waterstop.
3. Sleeve-seal systems.
4. Grout.
5. Silicone sealants.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES WITHOUT WATERSTOP

- A. Steel Pipe Sleeves:** ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.

2.2 SLEEVES WITH WATERSTOP

- A. Description:** Manufactured steel, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

2.3 SLEEVE-SEAL SYSTEMS

- A. Description:** Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
1. Designed to form a hydrostatic seal of 20 psig minimum.
 2. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 3. Pressure Plates: Stainless steel.
 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 GROUT

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, 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.

2.5 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
 - 1. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.
- B. Silicone, S, P, T, NT: Single-component, 25, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant.
 - 1. Standard: ASTM C920, Type S, Grade P, Class 25, Uses T and NT.
- C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES - GENERAL

- 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.
- 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 finished floor level.
 - 2. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
 - 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 Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."
- 3.2 INSTALLATION OF SLEEVES WITH WATERSTOP
- A. Install sleeve with waterstop as new walls and slabs 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 or silicone sealant, seal the space around outside of sleeves.
- 3.3 INSTALLATION OF SLEEVE-SEAL SYSTEMS
- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.
 - 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 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.
2. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

3.5 SLEEVE SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Concrete Slabs-on-Grade:
 - a. Sleeves with waterstops.
 - 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. Sleeves with waterstops.
3. Interior Partitions:
 - a. Sleeves without waterstops.

END OF SECTION

SECTION 220519 - METERS AND GAUGES FOR PLUMBING PIPING**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Thermometers, liquid in glass, lead free.
2. Thermowells, lead free.
3. Pressure gauges, dial type, lead free.
4. Gauge attachments, lead free.
5. Test plugs, lead free.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gauges to include in operation and maintenance manuals.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. All items in this Section in contact with water for human consumption, are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 THERMOMETERS, LIQUID IN GLASS, LEAD FREE

- A. Thermometers, Liquid in Glass, Lead Free - Metal Case, Industrial Style:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Blue Ribbon Corp.
 - b. Flo Fab Inc.

- c. Miljoco Corporation.
 - d. Palmer Wahl Instrumentation Group.
 - e. Trerice, H. O. Co.
 - f. Weiss Instruments, Inc.
 - g. Weksler Glass Thermometer Corp.
 - h. Winters Instruments - U.S.
- 2. Source Limitations: Provide liquid-in-glass, lead-free, metal-case, industrial-style thermometers from single manufacturer.
 - 3. Standard: ASME B40.200.
 - 4. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
 - 5. Case Form: Adjustable angle unless otherwise indicated.
 - 6. Tube: Glass with magnifying lens and blue or red organic liquid, mercury free.
 - 7. Tube Background: Nonreflective aluminum with permanent scale markings graduated in deg F.
 - 8. Window: Glass or acrylic plastic.
 - 9. Stem: Aluminum and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 - 10. Connector: 1-1/4 inches, with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
 - 11. Accuracy: Plus or minus 1 percent of span or one scale division, to a maximum of 1.5 percent of span.

2.3 THERMOWELLS, LEAD FREE

A. Thermowells, Lead Free:

- 1. Standard: ASME B40.200.
- 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
- 3. Material for Use with Copper Tubing: Lead-free copper.
- 4. Material for Use with Steel Piping: Type 304 stainless steel.
- 5. Type: Stepped shank unless straight or tapered shank is indicated.
- 6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, or as required to match threaded opening in pipe.
- 7. Internal Threads: Size and thread type as required to match thermometer mounting threads.
- 8. Bore: Diameter required to match thermometer bulb or stem.
- 9. Insertion Length: Length to extend to match thermometer stem length.
- 10. Lagging Extension: Include on thermowells for insulated piping and tubing. Extension is to be of sufficient length to extend beyond the finished insulation surface.
- 11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
- 12. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.4 PRESSURE GAUGES, DIAL TYPE, LEAD FREE**A. Pressure Gauges, Dial Type, Lead Free - Direct Mounted, Metal Case:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ametek U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Blue Ribbon Corp.
 - d. Ernst Flow Industries.
 - e. Flo Fab Inc.
 - f. Marsh Bellofram.
 - g. Miljoco Corporation.
 - h. Noshok.
 - i. Palmer Wahl Instrumentation Group.
 - j. REOTEMP Instrument Corporation.
 - k. Tel-Tru Manufacturing Company.
 - l. Terice, H. O. Co.
 - m. WATTS; A Watts Water Technologies Company.
 - n. WIKA Instrument Corporation.
 - o. Weiss Instruments, Inc.
 - p. Weksler Glass Thermometer Corp.
 - q. Winters Instruments - U.S.
2. **Source Limitations:** Provide dial-type, lead-free, direct-mounted, metal-case pressure gauges from single manufacturer.
3. **Standard:** ASME B40.100.
4. **Case:** Sealed type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
5. **Pressure-Element Assembly:** Lead-free bourdon tube.
6. **Pressure Connection:** Lead-free brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
7. **Movement:** Mechanical, with link to pressure element and connection to pointer.
8. **Dial:** Nonreflective aluminum with permanent scale markings graduated in psi.
9. **Pointer:** Dark-colored metal.
10. **Window:** Glass or plastic.
11. **Ring:** Stainless steel.
12. **Accuracy:** Grade A, plus or minus 1 percent of middle half of span.

2.5 GAUGE ATTACHMENTS, LEAD FREE

- A. **Snubbers:** ASME B40.100, lead-free brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston -type surge-dampening device. Include extension for use on insulated piping.
- B. **Valves:** Lead-free brass or stainless steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.6 TEST PLUGS, LEAD FREE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. IMI Flow Design, Inc.
 2. Miljoco Corporation.
 3. Nexus Valve, Inc.; Aalberts Hydronic Flow Control.
 4. Peterson Equipment Co., Inc.
 5. Trerice, H. O. Co.
 6. WATTS; A Watts Water Technologies Company.
 7. Weiss Instruments, Inc.
 8. Weksler Glass Thermometer Corp.
- B. Source Limitations: Provide lead-free test plugs from single manufacturer.
- C. Description: Test-station fitting made for insertion into piping tee fitting.
- D. Body: Lead-free brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- E. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
- F. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- G. Core Inserts: EPDM self-sealing rubber.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Install thermometer with thermowell at each required thermometer location.
- B. Install thermowells in vertical position in piping tees.
- C. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- D. Install thermowells with extension on insulated piping.
- E. Fill thermowells with heat-transfer medium.
- F. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- G. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.

H. Install valve and snubber in piping for each pressure gauge for fluids.

I. Install test plugs in piping tees.

J. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.
2. Each main hot-water-recirculating line return pipe.
3. Else where as shown on the plans.

K. Install pressure gauges in the following locations:

1. Building water service entrance into building.
2. Else where as shown on the plans.

3.2 CONNECTIONS

A. Install meters and gauges adjacent to machines and equipment to allow service and maintenance of meters, gauges, machines, and equipment.

3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gauges to proper angle for best visibility.

3.4 THERMOMETER, LEAD FREE, SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping:

1. 0 to 100 deg F.

B. Scale Range for Domestic Hot-Water Piping:

1. 0 to 250 deg F.

3.5 PRESSURE-GAUGE SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Water Piping:

1. 0 to 100 psi.

END OF SECTION

SECTION 220523.12 - BALL VALVES 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. Brass ball valves.
 - 2. Steel ball valves.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
 - 1. Certification that products comply with NSF 61 and NSF 372.

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, and soldered ends.
 - 3. Set ball 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.

PART 2 - PRODUCTS**2.1 GENERAL REQUIREMENTS FOR VALVES**

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded end valves.
 - 2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 3. ASME B16.18 for solder-joint connections.
 - 4. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.
- D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream piping unless otherwise indicated.
- F. Valve Actuator Types:
 - 1. Handlever: For quarter-turn valves smaller than NPS 4.
- G. Valves in Insulated Piping:
 - 1. Include 2-inch stem extensions.
 - 2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
 - 3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRASS BALL VALVES

- A. Brass Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim, Threaded or Soldered Ends:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. Hammond Valve.
 - c. Jomar Valve.
 - d. KITZ Corporation.
 - e. Marwin Valve; Richards Industries.
 - f. Milwaukee Valve Company.

- g. NIBCO INC.

2. Description:

- a. Standard: MSS SP-110 or MSS SP-145.
- b. CWP Rating: 600 psig.
- c. Body Design: Two piece.
- d. Body Material: Forged brass.
- e. Ends: Threaded and soldered.
- f. Seats: PTFE.
- g. Stem: Stainless steel.
- h. Ball: Stainless steel, vented.
- i. Port: Full.

2.3 STEEL BALL VALVES

A. Steel Ball Valves with Full Port, Class 150:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. FNW; Ferguson Enterprises, Inc.
 - c. Jamesbury; Metso.
 - d. NIBCO INC.
- 2. Description:
 - a. Standard: MSS SP-72.
 - b. CWP Rating: 285 psig.
 - c. Body Design: Split body.
 - d. Body Material: Carbon steel, ASTM A 216, Type WCB.
 - e. Ends: Flanged or threaded.
 - f. Seats: PTFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel, vented.
 - i. Port: Full.

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 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- B. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Brass ball valves, two-piece with full port and stainless steel trim. Provide with threaded or solder-joint ends.

END OF SECTION

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

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. Metal pipe hangers and supports.
 - 2. Thermal hanger-shield inserts.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe and Tube Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.3 THERMAL HANGER-SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C 533, Type I calcium silicate with 100-psig, ASTM C 552, Type II cellular glass with 100-psig, or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.5 MATERIALS

- A. Aluminum: ASTM B 221.
- B. Carbon Steel: ASTM A 1011/A 1011M.
- C. Structural Steel: ASTM A 36/A 36M carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A 240/A 240M.
- E. Grout: ASTM C 1107/C 1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. 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.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- C. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

- D. Install hangers and supports to allow controlled thermal and seismic movement 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.
- E. Install lateral bracing with pipe hangers and supports to prevent swaying.
- F. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger 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.
- G. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- H. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- I. Insulated Piping:
 - 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.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. 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.
 - 5. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- B. Field Welding: Comply with AWS D1.1/D1.1M 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 so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

- A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those 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 a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A 780/A 780M.

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems, and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal hanger-shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 3. 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.
 - 4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
 - 6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 9. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.

10. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 11. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 13. 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 or carbon-steel plate.
 14. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 15. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 16. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.
 17. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
 18. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
 19. 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 occurs and vertical adjustment is unnecessary.
 20. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment of 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.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system 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-joint 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 headroom is limited.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system 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. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- O. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

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SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Valve tags.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve-numbering scheme.
- D. Valve Schedules: For each piping system. Include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch stainless steel, 0.025-inch aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
2. Letter and Background Color: As indicated for specific application under Part 3.
3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Fasteners: Stainless steel rivets or self-tapping screws.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.
 2. Letter and Background Color: As indicated for specific application under Part 3.
 3. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 6. Fasteners: Stainless steel rivets or self-tapping screws.
 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
1. Pipe size.
 2. Flow-Direction Arrows: Include flow-direction arrows on distribution piping. Arrows may be either integral with label or applied separately.
 3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

2.3 VALVE TAGS

- A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
1. Tag Material: Brass, 0.04-inch stainless steel, 0.024-inch aluminum, 0.031-inch or anodized aluminum, 0.031-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
- B. Letter and Background Color: As indicated for specific application under Part 3.

- C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch 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 modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Include valve-tag schedule in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate 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 locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of plumbing equipment.
- B. Sign and Label Colors.
 - 1. White letters on an ANSI Z535.1 safety-green background.
- C. Locate equipment labels where accessible and visible.

3.4 INSTALLATION OF PIPE LABELS

- A. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- B. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Within 3 ft. of 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. At every change of direction greater than 45 degrees.
 4. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 5. At access doors, manholes, and similar access points that permit view of concealed piping.
 6. Within 3 ft. of equipment items and other points of origination and termination.
 7. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.
 8. On piping above removable acoustical ceilings. Install pipe labels at a 45-deg angle down from horizontal on both sides of piping to permit view from under and side of piping.
- C. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- D. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. Pipe-Label Color Schedule:
1. Low-Pressure Compressed-Air Piping: White letters on an ANSI Z535.1 safety-blue background.
 2. Domestic Cold-Water Piping: White letters on an ANSI Z535.1 safety-green background.
 3. Domestic Hot-Water Piping: White letters on an ANSI Z535.1 safety-green background.
 4. Sanitary Waste Piping: White letters on a black background.

3.5 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, 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 in the operating and maintenance manual.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:
1. Valve-Tag Size and Shape:
 - a. Domestic Cold Water: 1-1/2 inches, round.
 - b. Domestic Hot Water: 1-1/2 inches, round.
 - c. Low-Pressure Compressed Air: 1-1/2 inches, round.
 2. Valve-Tag Colors:

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SECTION 220553

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- a. For each piping system, use the same lettering and background coloring system on valve tags as used in the piping system labels and background.

END OF SECTION 220553

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SECTION 220719 - PLUMBING PIPING INSULATION**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 the following plumbing piping services:
 - 1. Domestic cold-water piping.
 - 2. Domestic hot-water piping.
 - 3. Domestic recirculating hot-water piping.
 - 4. Supplies and drains for handicap-accessible lavatories and sinks.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

1.4 INFORMATIONAL SUBMITTALS

- A. 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.

1.5 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less and smoke-developed index of 50 or less.
- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

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 specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping 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.

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 "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

- F. Mineral-Fiber, Preformed Pipe: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. Knauf Insulation.
 - c. Manson Insulation Inc.
 - d. Owens Corning.
 2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ-SSL.
 3. 850 deg F.
 4. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
 5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C195.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- C. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.

2.4 MASTICS AND COATINGS

- A. Materials shall be compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
 1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
 2. Service Temperature Range: 0 to plus 180 deg F.
 3. Color: White.
- C. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.

1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
2. Service Temperature Range: 0 to 180 deg F.
3. Color: White.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
2. Service Temperature Range: 0 to plus 180 deg F.
3. Color: White.

2.5 SEALANTS

A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:

1. Permanently flexible, elastomeric sealant.
2. Service Temperature Range: Minus 58 to plus 176 deg F.
3. Color: White or gray.

C. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Fire- and water-resistant, flexible, elastomeric sealant.
2. Service Temperature Range: Minus 40 to plus 250 deg F.
3. 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-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.

B. Metal Jacket:

1. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing.

- b. Finish and thickness are indicated in field-applied jacket schedules.
- c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
- d. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed two-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 C1136.
 - 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.

2.9 SECUREMENTS

- A. Bands:
 - 1. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing seal or closed seal.
 - 2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.
- B. Wire: 0.062-inch soft-annealed, stainless steel.

2.10 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
 - 1. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:

1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

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 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. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. 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 piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of 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 storage, application, and finishing. Replace insulation materials that get wet.

- 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 attached to structure with vapor-barrier mastic.
 - 3. Install insert materials and 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- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches 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 4 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, in accordance with 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 25 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 in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof 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 roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. 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.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

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, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, 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 that of 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 that 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 that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 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 strainers 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 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
7. 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.
8. 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 thermometers, pressure gages, pressure temperature taps, test connections, flow meters, 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.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

- 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 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 that of 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 that of 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.

3.7 FIELD-APPLIED JACKET INSTALLATION

- A.** 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.

3.8 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 - 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.

3.9 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. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 - 1. NPS 1 and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
 - 2. NPS 1-1/4 and Larger: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
 - 1. NPS 1-1/4 and Smaller: Insulation shall be the following:

- a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- 2. NPS 1-1/2 and Larger: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.
- C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
 - 1. See Plumbing Fixture Schedule' on plans.

3.11 INDOOR, 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. Piping, Concealed:
 - 1. None.
- C. Piping, Exposed To View In Public Spaces :
 - 1. Aluminum

END OF SECTION 220719

SECTION 221116 - DOMESTIC WATER 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. Copper tube and fittings.
 - 2. Piping joining materials.
 - 3. Encasement for piping.
 - 4. Transition fittings.
 - 5. Dielectric fittings

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Pipe and tube.
 - 2. Fittings.
 - 3. Joining materials.
 - 4. Transition fittings.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. System purging and disinfecting activities report.
- C. Field quality-control reports.

PART 2 - PRODUCTS**2.1 PIPING MATERIALS**

- A. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372.

2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tube: ASTM B88, Type L.
- B. Annealed-Temper Copper Tube: ASTM B88, Type K.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- G. Wrought Copper Unions: ASME B16.22.

2.3 PIPING JOINING MATERIALS

- A. Solder Filler Metals: ASTM B32, lead-free alloys.
- B. Flux: ASTM B813, water flushable.
- C. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 ENCASEMENT FOR PIPING

- A. Standard: ASTM A674 or AWWA C105/A21.5.
- B. Form: Sheet or tube.
- C. Color: Black or natural.

2.5 TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.

2.6 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. Standard: ASSE 1079.
 - 2. Pressure Rating: 125 psig minimum at 180 deg F.
 - 3. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Standard: ASSE 1079.
 - 2. Factory-fabricated, bolted, companion-flange assembly.
 - 3. Pressure Rating: 125 psig minimum at 180 deg F.
 - 4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
 - 1. Nonconducting materials for field assembly of companion flanges.
 - 2. Pressure Rating: 150 psig.
 - 3. Gasket: Neoprene or phenolic.
 - 4. Bolt Sleeves: Phenolic or polyethylene.
 - 5. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples:
 - 1. Standard: IAPMO PS 66.
 - 2. Electroplated steel nipple complying with ASTM F1545.
 - 3. Pressure Rating and Temperature: 300 psig at 225 deg F.
 - 4. End Connections: Male threaded or grooved.
 - 5. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION**3.1 PIPING APPLICATIONS**

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be the following:

1. Annealed-temper copper tube, ASTM B88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
 - D. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
 1. Drawn-temper copper tube, ASTM B88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.
 - E. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:
 1. Drawn-temper copper tube, ASTM B88, Type L; cast- or wrought-copper, solder-joint fittings; and brazed joints.
- 3.2 EARTHWORK
- A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.
- 3.3 INSTALLATION OF PIPING
- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. 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.
 - B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
 - C. Install underground copper tube in PE encasement according to ASTM A674 or AWWA C105/A21.5.
 - D. Install valves according to the following:
 1. Section 220523.12 "Ball Valves for Plumbing Piping."
 - E. Install domestic water piping level and plumb.
 - F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
 - G. 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.
 - H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
 - I. Install piping to permit valve servicing.

- J. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- K. Install piping free of sags and bends.
- L. Install fittings for changes in direction and branch connections.
- M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- N. Install thermometers on outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
- O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- P. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. 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.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's "Copper Tube Handbook."
- F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.5 INSTALLATION OF TRANSITION FITTINGS

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.6 INSTALLATION OF DIELECTRIC FITTINGS

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.7 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Install hangers for copper, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping within 12 inches of each fitting.
- D. Support vertical runs of copper to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

3.9 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

3.10 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 valves to proper setting.
 - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 - 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 - 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 - 7. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities 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 authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
- b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
- c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
- e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.12 CLEANING

A. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

B. Protect piping during construction period to avoid clogging with dirt and debris and to prevent damage from construction work.

C. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

- d. Submit water samples in sterile bottles to authorities having jurisdiction.
 - e. Repeat procedures if biological examination shows contamination.
- D. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

END OF SECTION 221116

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SECTION 221316 - SANITARY WASTE AND VENT 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. Hub-and-spigot, cast-iron soil pipe and fittings.
 - 2. Hubless, cast-iron soil pipe and fittings.
 - 3. PVC pipe and fittings.
 - 4. Specialty pipe fittings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For hubless, single-stack drainage system. Include plans, elevations, sections, and details.

1.4 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

2.2 PIPING MATERIALS

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service and Extra Heavy class(es).
- B. Gaskets: ASTM C 564, rubber.
- C. Caulking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Heavy-Duty, Hubless-Piping Couplings:
 - 1. Standards: ASTM C 1277 and ASTM C 1540.
 - 2. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- C. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.5 PVC PIPE AND FITTINGS

- A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.
- B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- D. Adhesive Primer: ASTM F 656.
- E. Solvent Cement: ASTM D 2564.

2.6 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 - 1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
 - 2. Unshielded, Nonpressure Transition Couplings:

- a. Standard: ASTM C 1173.
 - b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - c. End Connections: Same size as and compatible with pipes to be joined.
 - d. 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.
3. Shielded, Nonpressure Transition Couplings:
- a. Standard: ASTM C 1460.
 - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - c. End Connections: Same size as and compatible with pipes to be joined.
4. Pressure Transition Couplings:
- a. Standard: AWWA C219.
 - b. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
 - c. Center-Sleeve Material: Manufacturer's standard.
 - d. Gasket Material: Natural or synthetic rubber.
 - e. Metal Component Finish: Corrosion-resistant coating or material.
- B. Dielectric Fittings:
1. Dielectric Unions:
- a. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: 125 psig minimum at 180 deg F.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
2. Dielectric Nipples:
- a. Description:
 - 1) Standard: IAPMO PS 66.
 - 2) Electroplated steel nipple.
 - 3) Pressure Rating: 300 psig at 225 deg F.
 - 4) End Connections: Male threaded or grooved.
 - 5) Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION**3.1 EARTH MOVING**

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
 - 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 - 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- 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 above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
 - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
 - 2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
 - a. Straight tees, elbows, and crosses may be used on vent lines.

3. Do not change direction of flow more than 90 degrees.
 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of waste piping in direction of flow is prohibited.
- K. Lay buried building waste piping beginning at low point of each system.
1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 3. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent 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.
- M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- N. Install steel piping according to applicable plumbing code.
- O. Install underground PVC piping according to ASTM D 2321.
- P. Install engineered soil and waste and vent piping systems as follows:
1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
- Q. Plumbing Specialties:
1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
 - a. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
 2. Install drains in sanitary waste gravity-flow piping.
 - a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
 1. Cut threads full and clean using sharp dies.
 2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
 - c. Do not use pipe sections that have cracked or open welds.
- D. Plastic, Nonpressure-Piping, Solvent-Cement 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. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 1. Install transition couplings at joints of piping with small differences in ODs.
 2. In Waste Drainage Piping: Unshielded or Shielded, nonpressure transition couplings.
 3. In Aboveground Force Main Piping: Fitting-type transition couplings.
 4. In Underground Force Main Piping:
 - a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
 - b. NPS 2 and Larger: Pressure transition couplings.
- B. Dielectric Fittings:
 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric nipples.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
 6. Install individual, straight, horizontal piping runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install hangers for soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- D. Support vertical runs of soil piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
 1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.

4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
6. Equipment: Connect waste piping as indicated.
 - a. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. 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.

3.7 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities 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 authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
 - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
 - a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
 - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
 - c. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
 - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
 - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
 - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
 - d. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.9 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping 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.
- D. Repair damage to adjacent materials caused by waste and vent piping installation.

3.10 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil, waste, and vent piping shall be any of the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

2. Hubless, cast-iron soil pipe and fittings heavy-duty hubless-piping couplings; and coupled joints.
 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Underground, soil, waste, and vent piping shall be any of the following:
1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
 3. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION

SECTION 221319 - SANITARY WASTE PIPING 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. Section Includes:
 - 1. Cleanouts.
 - 2. Miscellaneous sanitary drainage piping specialties.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Show fabrication and installation details for frost-resistant vent terminals.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS**2.1 CLEANOUTS**

- A. Cast-Iron Exposed Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Tyler Pipe; a subsidiary of McWane Inc.
 - e. WATTS.
 - f. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M.
 3. Size: Same as connected drainage piping
 4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
 5. Closure: Countersunk, cast-iron plug.
 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Sioux Chief Manufacturing Company, Inc.
 - e. WATTS.
 - f. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Body or Ferrule: Cast iron.
5. Closure: Brass plug with tapered threads.
6. Adjustable Housing Material: Cast iron with threads.
7. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.
8. See Plumbing Fixture Schedule on plans for more details.

2.2 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A74, Service Class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C564 rubber gaskets.
2. Size: Same as connected waste piping.

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

- a. NPS 2: 4-inch- minimum water seal.
- b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

C. Floor-Drain, Inline Trap Seal:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Rectorseal Plumbing; A CSW Industrials Company.
- 2. Description: Inline floor drain trap seal, forming a physical barrier to slow trap evaporation while not impeding flow from drain.
- 3. Material: Polymer.
- 4. Standard: Tested and certified in accordance with ASSE 1072.
- 5. Listing: ICC-ES or IAPMO listed.
- 6. Size: Same as floor drain outlet or strainer throat.

D. Air-Gap Fittings:

- 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
- 2. Body: Bronze or cast iron.
- 3. Inlet: Opening in top of body.
- 4. Outlet: Larger than inlet.
- 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

E. Sleeve Flashing Device:

- 1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
- 2. Size: As required for close fit to riser or stack piping.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. 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 for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Assemble open drain fittings and install with top of hub 2 inches above floor.
- E. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- F. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- G. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- H. Install wood-blocking reinforcement for wall-mounting-type specialties.
- I. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 PIPING CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, to allow service and maintenance.

3.3 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 221513 - GENERAL-SERVICE COMPRESSED-AIR PIPING**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes: Piping and related specialties for general-service compressed-air systems, as follows:
 - 1. Pipes, tubes, and fittings.
 - 2. Joining materials.
 - 3. Valves.
 - 4. Dielectric fittings.
 - 5. Flexible pipe connectors.
 - 6. Specialties.
 - 7. Quick couplings.

1.2 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. HDPE: High-density polyethylene plastic.
- D. High-Pressure, Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures between 150 and 200 psig.
- E. Low-Pressure, Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of 150 psig or less.
- F. NBR: Nitrile butadiene rubber.
- G. PE: Polyethylene plastic.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Dielectric fittings.
 - 2. Pressure regulators. Include rated capacities and operating characteristics.
 - 3. Quick couplings.

PART 2 - PRODUCTS**2.1 SOURCE LIMITATIONS**

- A. Obtain each product type from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. ASME Compliance:

- 1. Comply with ASME B31.9, "Building Services Piping," for low-pressure, compressed-air piping.

2.3 PIPES, TUBES, AND FITTINGS

- A. Schedule 40, Steel Pipe: ASTM A53/A53M, Type E or S, Grade B, black or hot-dip zinc coated with ends threaded in accordance with ASME B1.20.1.

- 1. Steel Nipples: ASTM A733, made of ASTM A53/A53M or ASTM A106, Schedule 40, galvanized seamless steel pipe. Include ends matching joining method.
 - 2. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded.
 - 3. Malleable-Iron Unions: ASME B16.39, Class 150 or 300, threaded.
 - 4. Steel Flanges, Threaded: ASME B16.5, Class 150 or 300, carbon steel, threaded.
 - 5. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel.

- B. Transition Couplings for Metal Piping: Metal coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.4 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for compressed-air 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.

- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

2.5 VALVES

- A. Metal Ball, Butterfly, Check, and Gate Valves: Comply with requirements in Section 220523 "General-Duty Valves for Plumbing Piping."

2.6 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 of the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. Capitol Manufacturing Company.
 - c. GF Piping Systems: Georg Fischer LLC.
 - d. HART Industrial Unions, LLC.
 - e. Jomar Valve.
 - f. Matco-Norca.
 - g. Viega LLC.
 - h. WATTS; A Watts Water Technologies Company.
 - i. Wilkins.
 - 2. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 250 psig.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.

2.7 FLEXIBLE PIPE CONNECTORS

- A. Stainless Steel-Hose Flexible Pipe Connectors: Corrugated, stainless steel tubing with stainless steel wire-braid covering and ends welded to inner tubing.
 - 1. Working-Pressure Rating: 200 psig minimum.
 - 2. End Connections, NPS 2 and Smaller: Threaded steel pipe nipple.

2.8 SPECIALTIES

- A. Air-Line Pressure Regulators, Bronze Body: Diaphragm operated, bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200 psig minimum inlet pressure, unless otherwise indicated.

2.9 QUICK COUPLINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Aeroquip Performance Products; Eaton, Hydraulics Sector.
 - 2. Bowes Manufacturing Inc.
 - 3. Foster Manufacturing, Inc.
 - 4. Milton Industries, Inc.
 - 5. Parker (Parker Hannifin).
 - 6. Rectus Corp.
 - 7. Schrader-Bridgeport/Standard Thomson.
 - 8. TOMCO Products Inc.
 - 9. Tuthill Corporation.
- B. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.
- C. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless steel or nickel-plated-steel operating parts.
 - 1. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Low-Pressure Compressed-Air Distribution Piping: Use the following piping materials for each size range:
 - 1. NPS 2 and Smaller, Threaded: Schedule 40, black -steel pipe; threaded, malleable-iron fittings; and threaded joints.

3.2 VALVE APPLICATIONS

- A. Metal General-Duty Valves: Comply with requirements and use valve types specified in "Valve Applications" Article in Section 220523 "General-Duty Valves for Plumbing Piping," according to the following:
 - 1. Low-Pressure Compressed Air: Valve types specified for low-pressure compressed air.
 - 2. High-Pressure Compressed Air: Valve types specified for high-pressure compressed air.

3.3 INSTALLATION OF PIPING, GENERAL

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping concealed from view and protected from physical contact by building occupants, unless otherwise indicated and except in equipment rooms and service areas.
- 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 otherwise indicated.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and to coordinate with other services occupying that space.
- E. Where installing piping adjacent to equipment and machines, allow space for service and maintenance.
- F. Install air and drain piping with 1 percent slope downward in direction of flow.
- G. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating unless otherwise indicated.
- H. Equipment and Specialty Flanged Connections:
 - 1. Use steel companion flange with gasket for connection to steel pipe.
- I. Extended-tee outlets with brazed branch connection may be used for copper tubing, within extruded-tee connection diameter to run tube diameter ratio for tube type, in accordance with Extruded Tee Connections Sizes and Wall Thickness for Copper Tube (Inches) Table in ASTM F2014.
- J. Install eccentric reducers where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- K. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.
- L. Install pressure gauge on discharge piping from each air compressor and on each receiver. Comply with requirements in Section 220500 "Common Work Results for Plumbing."
- M. Install piping to permit valve servicing.
- N. Install piping free of sags and bends.
- O. Install fittings for changes in direction and branch connections.

3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads in accordance with 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.
- D. Flanged Joints: Use asbestos-free, nonmetallic gasket suitable for compressed air. Join flanges with gasket and bolts in accordance with ASME B31.9 for bolting procedure.
- E. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

3.5 INSTALLATION OF VALVES

- A. General-Duty Valves: Comply with requirements in Section 220523 "General-Duty Valves for Plumbing Piping."

3.6 INSTALLATION OF DIELECTRIC FITTINGS

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. NPS 2 and Smaller: Use dielectric unions.

3.7 INSTALLATION OF SPECIALTIES

- A. Install air-line pressure regulators in branch piping to equipment and tools.
- B. Install quick couplings at piping terminals for hose connections.

3.8 PIPING CONNECTIONS

- A. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment and machine.

3.9 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
- B. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for hangers, supports, and anchor devices.
- C. Install hangers for steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping within 12 inches of each fitting and coupling.
- E. Support vertical runs of steel piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- F. Individual, Straight, Horizontal Piping Runs:
 - 1. 100 Ft. or Less: MSS Type 1, adjustable, steel clevis hangers.
 - 2. Longer Than 100 Ft.: MSS Type 43, adjustable roller hangers.
- G. Multiple, Straight, Horizontal Piping Runs 100 Ft. or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
- H. Base of Vertical Piping: MSS Type 52, spring hangers.

3.10 LABELING AND IDENTIFICATION

- A. Install identifying labels and devices for general-service compressed-air piping, valves, and specialties. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment."

3.11 FIELD QUALITY CONTROL

- A. Perform field tests and inspections.
- B. Tests and Inspections:
 - 1. Piping Leak Tests for Metal Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
 - 2. Repair leaks and retest until no leaks exist.
 - 3. Inspect pressure regulators for proper operation.

- C. Prepare test and inspection reports.

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, direct-vent, gas-fired, storage, domestic-water heater.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS**2.1 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS**

- A. Commercial, Direct-Vent, Gas-Fired, Storage, Domestic-Water Heaters:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Water Heaters.
 - b. Bradford White Corporation.
 - c. GSW Water Heating.
 - d. Lochinvar, LLC.
 - e. State Industries.
 - 2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
 - 3. Standard: ANSI Z21.10.1/CSA 4.1.

4. Storage-Tank Construction: Steel.
 - a. Tappings: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.
5. 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 with hose-end connection.
 - d. Insulation: Comply with ASHRAE/IES 90.1.
 - e. Jacket: Steel with enameled finish.
 - f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - g. Burner: For use with direct-vent, gas-fired, domestic-water heaters and natural-gas fuel.
 - h. Ignition: Standing pilot or ANSI Z21.20/CSA C22.2 No. 60730-2-5, electric, automatic, gas-ignition system.
 - i. Temperature Control: Adjustable thermostat.
 - j. Combination Temperature-and-Pressure Relief Valve: ANSI Z21.22/CSA 4.4. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valve with sensing element that extends into storage tank.
6. Direct-Vent System: Through-wall, coaxial- or double-channel vent assembly with domestic-water heater manufacturers' outside intake/exhaust screen.

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 base specified in Section 033000 "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.
 4. 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 concrete base.
 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 7. Install anchor bolts to elevations required for proper attachment to supported equipment.

8. Anchor domestic-water heaters to substrate.
 - B. Install domestic-water heaters level and plumb, in accordance with 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 220523.12 "Ball Valves for Plumbing Piping."
 - C. Install gas-fired, domestic-water heaters in accordance with 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 231123 "Facility Natural-Gas Piping."
 - D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-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 domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
 - F. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
 - G. Fill domestic-water heaters with water.
 - H. Charge domestic-water expansion tanks with air to required system pressure.
 - I. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.
- 3.2 PIPING CONNECTIONS
- A. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."

- B. Comply with requirements for gas piping specified in Section 231123 "Facility 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 220553 "Identification for Plumbing Piping and Equipment."

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage, domestic-water heaters. Training shall be a minimum of one hour(s).

END OF SECTION

SECTION 224213.13 - COMMERCIAL WATER CLOSETS**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. Water closets.
 - 2. Flushometer valves and tanks.
 - 3. Toilet seats.
 - 4. Supports.

1.3 DEFINITIONS

- A. Effective Flush Volume: Average of two reduced flushes and one full flush per fixture.
- B. Remote Water Closet: Located more than 30 feet from other drain line connections or fixture and where less than 1.5 drainage fixture units are upstream of the drain line connection.

1.4 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 water closets.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

PART 2 - PRODUCTS**2.1 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS****A. Water Closets: Floor mounted, back outlet, top spud.**

1. See Plumbing Fixture Schedule on plans for more details.

B. Water Closets: Wall mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard America.
 - b. Crane Plumbing, L.L.C.
 - c. Kohler Co.
 - d. TOTO USA, INC.
 - e. Zurn Industries, LLC.
2. Bowl:
 - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
 - b. Material: Vitreous china.
 - c. Type: Siphon jet.
 - d. Style: Flushometer valve.
3. See Plumbing Fixture Schedule on plans for more details.

2.2 FLUSHOMETER VALVES**A. Diaphragm Flushometer Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sloan Valve Company.
 - b. Zurn Industries, LLC.
2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. See Plumbing Fixture Schedule on plans for more details.

2.3 TOILET SEATS**A. Toilet Seats:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard America.
 - b. Bemis Manufacturing Company.
 - c. Church Seats; Bemis Manufacturing Company.
 - d. Kohler Co.
 - e. Olsonite Seat Co.
 - f. TOTO USA, INC.
 - g. Zurn Industries, LLC.
2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Hinge Material: Noncorroding metal.
5. See Plumbing Fixture Schedule on plans for more details.

2.4 SUPPORTS**A. Water Closet Carrier:**

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Zurn Industries, LLC.
2. Standard: ASME A112.6.1M.
3. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space where distance from face of wall to face of carrier exceed 7".

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.
- B. Examine walls and floors for suitable conditions where water closets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
2. Use carrier supports with waste-fitting assembly and seal.
3. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
4. Provide additional support legs on carriers that exceed seven inches in length from face of carrier to face of restroom wall.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations that are easy for people with disabilities to reach.
5. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

- A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

- A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed water closets and fittings.
- C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

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SECTION 224213.16 - COMMERCIAL URINALS**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. Wall-hung urinals.
 - 2. Urinal flushometer valves.
 - 3. Supports.

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 urinals.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

PART 2 - PRODUCTS**2.1 WALL-HUNG URINALS**

- A. Urinals - Wall Hung, Back Outlet, Washout:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Standard.
- b. Kohler Co.
- c. TOTO USA, INC.
- d. Zurn Industries, LLC.

2. Fixture:

- a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5/CSA B45.15.
- b. Material: Vitreous china.
- c. Type: Washout with extended shields.

2.2 URINAL FLUSHOMETER VALVES

A. Hard-Wired, Solenoid-Actuator, Piston Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sloan Valve Company.
 - b. TOTO USA, INC.
 - c. Zurn Industries, LLC.
2. Standard: ASSE 1037/ASME 112.1037/CSA B125.37.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Panel Finish: Chrome plated or stainless steel.
8. Style: Exposed.
9. See Plumbing Fixture Schedule on plans for more details.

2.3 SUPPORTS

A. Type I Urinal Carrier:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Wade Drains.
 - e. WATTS.
 - f. Zurn Industries, LLC.
2. Standard: ASME A112.6.1M.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before urinal installation.
- B. Examine walls and floors for suitable conditions where urinals will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION**A. Urinal Installation:**

- 1. Install urinals level and plumb according to rough-in drawings.
- 2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
- 3. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.
- 4. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC A117.1.
- 5. Install trap-seal liquid in waterless urinals.

B. Support Installation:

- 1. Install supports, affixed to building substrate, for wall-hung urinals.
- 2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
- 3. Use carriers without waste fitting for urinals with tubular waste piping.
- 4. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.

C. Flushometer-Valve Installation:

- 1. Install flushometer-valve water-supply fitting on each supply to each urinal.
- 2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
- 3. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.

D. Wall Flange and Escutcheon Installation:

- 1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
- 2. Install deep-pattern escutcheons if required to conceal protruding fittings.

E. Joint Sealing:

- 1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.

2. Match sealant color to urinal color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 PIPING CONNECTIONS

- A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to urinals, allow space for service and maintenance.

3.4 ADJUSTING

- A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

- A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed urinals and fittings.
- C. Do not allow use of urinals for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 224216.13 - COMMERCIAL LAVATORIES**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Enameled, cast-iron, counter-mounted lavatories.
2. Vitreous-china, counter-mounted lavatories.
3. Enameled, cast-iron, wall-mounted lavatories.
4. Vitreous-china, wall-mounted lavatories.
5. Automatically operated lavatory faucets.
6. Supply fittings.
7. Waste fittings.
8. Lavatory supports.

1.2 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 lavatories.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.**1.3 CLOSEOUT SUBMITTALS****A. Operation and Maintenance Data:** For lavatories and faucets to include in operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Servicing and adjustments of automatic faucets.

PART 2 - PRODUCTS**2.1 VITREOUS-CHINA, COUNTER-MOUNTED LAVATORIES****A. Lavatory - Vitreous China, Undercounter Mounted:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard.
 - b. Kohler Co.
 - c. TOTO USA, INC.
 - d. Zurn Industries, LLC.
2. Fixture:
 - a. Standard: ASME A112.19.2/CSA B45.1.
 - b. Type: For undercounter mounting.
 - c. Faucet-Hole Location: On countertop.
 - d. Mounting Material: Sealant and undercounter mounting kit.
3. See Plumbing Fixture Schedule on plans for more details.

2.2 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory - Ledge Back, Vitreous China, Wall Mounted:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard.
 - b. Kohler Co.
2. Fixture:
 - a. Standard: ASME A112.19.2/CSA B45.1.
 - b. Type: For wall hanging.
 - c. Faucet-Hole Location: Top.
 - d. Mounting Material: Chair carrier.
3. See Plumbing Fixture Schedule on plans for more details.

2.3 MANUALLY OPERATED LAVATORY FAUCETS

- A. Lavatory faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61/NSF 372, or be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI) accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Lavatory Faucets - Manual Type: , Commercial,:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard.
 - b. Chicago Faucets; Geberit Company.
 - c. Delta Faucet Company.
 - d. Elkay Manufacturing Co.
 - e. GROHE America, Inc.
 - f. Just Manufacturing.
 - g. Kohler Co.
 - h. Moen Incorporated.
 - i. Speakman Company.
 - j. T&S Brass and Bronze Works, Inc.
 - k. Zurn Industries, LLC.
2. Standard: ASME A112.18.1/CSA B125.1.
3. See Plumbing Fixture Schedule on plans for more details.

2.4 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless steel wall flange.
- D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Wheel handle.
- F. Risers:
 1. NPS 1/2.
 2. ASME A112.18.6/CSA B125.6, braided- or corrugated-stainless steel, flexible hose riser.

2.5 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.
- C. Trap:

1. Size: NPS 1-1/2 by NPS 1-1/4.
2. Material:
 - a. Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- thick brass tube to wall; and chrome-plated, brass or steel wall flange.

2.6 LAVATORY SUPPORTS

A. Lavatory Carrier:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Wade; a subsidiary of McWane Inc.
 - e. WATTS.
 - f. Zurn Industries, LLC.
2. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.
- B. Examine counters and walls for suitable conditions where lavatories will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install lavatories level and plumb in accordance with roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted lavatories.
- C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, in accordance with ICC A117.1.
- D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

- E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
- B. Install new batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

- A. After completing installation of lavatories, inspect and repair damaged finishes.
- B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed lavatories and fittings.
- D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13

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SECTION 224216.16 - COMMERCIAL SINKS**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. Service sinks.
 - 2. Kitchen/utility sinks.
 - 3. Manually operated sink faucets.
 - 4. Supply fittings.
 - 5. Waste fittings.

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 sinks.
 - 2. Include rated capacities, operating characteristics and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted sinks.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sinks and faucets to include in operation and maintenance manuals.

PART 2 - PRODUCTS**2.1 SERVICE SINKS****A. Service Sinks - Molded Stone, Floor Mounted:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fiat Products.
 - b. Florestone Products Co., Inc.
2. Source Limitations: Obtain sinks from single source from single manufacturer.
3. Fixture:
 - a. Standard: ASME A112.18.2/CSA B125.2.
4. Mounting: On floor and flush to wall.
5. See Plumbing Fixture Schedule on plans for more details.

2.2 KITCHEN/UTILITY SINKS**A. Kitchen/Utility Sinks - Stainless Steel, Counter Mounted:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Tabco.
 - b. Eagle Group.
 - c. Elkay Manufacturing Co.
 - d. Franke.
 - e. Just Manufacturing.
2. Source Limitations: Obtain sinks from single source from single manufacturer.
3. Fixture:
 - a. Standard: ASME A112.19.3/CSA B45.4.
 - b. Type: Stainless steel, self-rimming, sound-deadened unit less ledge back.
4. See Plumbing Fixture Schedule on plans for more details.

B. Kitchen/Utility Sinks - Stainless Steel, Freestanding:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Advance Tabco.
 - b. AERO Manufacturing Company.
 - c. Amtekco Industries, Inc; a Wasserstrom Company.
 - d. Eagle Group.
 - e. Elkay Manufacturing Co.
 - f. Franke.
 - g. Griffin Products, Inc.
 - h. Just Manufacturing.
2. Source Limitations: Obtain sinks from single source from single manufacturer.
3. Fixture:
 - a. Standards:
 - 1) ASME A112.19.3/CSA B45.4.
 - 2) NSF 2.
 - b. Type: Stainless steel, freestanding, sound-deadened unit with backsplash.
4. See Plumbing Fixture Schedule on plans for more details.

2.3 MANUALLY OPERATED SINK FAUCETS

- A. Sink faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Commercial Sink Faucets - Manual Type: Single-control mixing .
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard.
 - b. Chicago Faucets; Geberit Company.
 - c. Elkay Manufacturing Co.
 - d. Just Manufacturing.
 - e. Kohler Co.
 - f. Speakman Company.
 - g. T&S Brass and Bronze Works, Inc.
 - h. Zurn Industries, LLC.
 2. Source Limitations: Obtain sink faucets from single source from single manufacturer.
 3. Standard: ASME A112.18.1/CSA B125.1.
 4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
 5. See Plumbing Fixture Schedule on plans for more details.

C. Commercial Service Sink Faucets - Manual Type:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company; a Division of Morris Group International.
 - b. American Standard.
 - c. Chicago Faucets; Geberit Company.
 - d. Fiat Products.
 - e. Kohler Co.
 - f. Speakman Company.
 - g. Stern-Williams Co., Inc.
 - h. T&S Brass and Bronze Works, Inc.
 - i. Zurn Industries, LLC.
2. Source Limitations: Obtain sink faucets from single source from single manufacturer.
3. Description: Wall/back mounted, brass body, with integral service stops, checks, spout with bucket/pail hook, 3/4-inch hose thread end, integral vacuum breaker, inlets 8 inches o.c., and two-handle mixing.
4. Faucet:
 - a. Standards:
 - 1) ASME A112.18.1/CSA B125.1.
 - 2) NSF 61 and NSF 372.
 - 3) ICC A117.1.
 - 4) ASSE 1001 (VB).
5. See Plumbing Fixture Schedule on plans for more details.

2.4 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless steel wall flange.
- D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Wheel handle.
- F. Risers:
 1. NPS 1/2.

2. ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel flexible hose.

2.5 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.
- C. Trap:
 1. Size: NPS 1-1/2.
 2. Material:
 - a. Chrome-plated, two-piece, cast-brass trap and swivel elbow with 17-gauge brass tube to wall; and chrome-plated brass or steel wall flange.
 - b. Refer to Section 226600 for acid waste applications.

2.6 SINK SUPPORTS

- A. Sink Carrier:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Wade Drains.
 - e. WATTS.
 - f. Zurn Industries, LLC.
 2. Source Limitations: Obtain sink supports from single source from single manufacturer.
 3. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.
- B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sinks level and plumb in accordance with rough-in drawings.
- B. Install water-supply piping with stop on each supply to each sink faucet.
 - 1. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping".
 - 2. Install stops in locations where they can be easily reached for operation.
- C. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings.
- D. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- E. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.
- B. Install new batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

- A. After completing installation of sinks, inspect and repair damaged finishes.
- B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

- C. Provide protective covering for installed sinks and fittings.
- D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 224716 - PRESSURE WATER COOLERS**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. Pressure water coolers.
 - 2. Supports.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of pressure water cooler and bottle filling station.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Include diagrams for power wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For pressure water coolers and bottle filling stations to include in maintenance manuals.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. Standards:

1. Pressure water coolers and bottle filling stations intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 or NSF 372, or be certified in compliance with NSF 61 or NSF 372 by an ANSI-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
2. Comply with ASHRAE 34 for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.
3. Comply with UL 399.
4. Comply with ASME A112.19.3/CSA B45.4.
5. 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.
6. Comply with NSF 42 and NSF 53 for water filters for water coolers and bottle filling stations.
7. Comply with ICC A117.1 for accessible water coolers and bottle filling stations.

2.2 PRESSURE WATER COOLERS

A. Pressure Water Coolers - Surface Wall-Mounted, Stainless Steel:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay.
 - b. Halsey Taylor.
 - c. Murdock Manufacturing; A Division of Morris Group International.
 - d. Oasis International.
2. Source Limitations: Obtain surface wall-mounted, stainless steel, pressure water coolers from single source from single manufacturer.
3. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
4. See Plumbing Fixture Schedule on plans for more details.

2.3 SUPPORTS

A. Water-Cooler Carrier:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Wade Drains.
 - e. Zurn Industries, LLC.
2. Standard: ASME A112.6.1M.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Set freestanding, pressure water coolers on floor.
- C. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- D. Install mounting frames, affixed to building construction, and attach recessed, pressure water coolers, and bottle filling stations to mounting frames.
- E. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523.12 "Ball Valves for Plumbing Piping"
- F. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- G. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings.
- H. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

- C. Install ball shutoff valve on water supply to each fixture. Install valve upstream from filter for water cooler. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping"
- D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ELECTRICAL CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

3.5 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust pressure water-cooler temperature settings.

3.6 CLEANING

- A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

BASIC MECHANICAL REQUIREMENTS FOR HVAC

LXT Eastside Development

SECTION 230010

Project #47732472
Permit Set 09/29/23

SECTION 230010 - BASIC MECHANICAL REQUIREMENTS FOR HVAC

PART 1 - GENERAL

1.1 Refer to requirements listed in section 220010.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 Refer to requirements listed in section 220010.

END OF SECTION 230010

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**BASIC MECHANICAL REQUIREMENTS FOR
HVAC**

LXT Eastside Development

SECTION 230010

Project #47732472
Permit Set 09/29/23

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SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

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. Metal pipe hangers and supports.
2. Fastener systems.
3. Pipe stands.
4. Equipment supports.

B. Related Requirements:

- 1.
2. Section 230548.13 "Vibration Controls for HVAC" for vibration isolation devices.
3. Section 233113 "Metal Ducts" for duct hangers and supports.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated, or epoxy powder-coated.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.

2.3 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type anchors for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. Indoor Applications: Zinc-coated or stainless steel.
 2. Outdoor Applications: Stainless steel.

2.4 PIPE STANDS

- A. C-Series rubber support blocks with strut by C-Port or equal.

2.5 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.6 MATERIALS

- A. Aluminum: ASTM B221.

- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Threaded Rods: Continuously threaded. Zinc-plated or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar materials as rods.

PART 3 - EXECUTION

3.1 APPLICATION

- A. 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.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick 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.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- C. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- D. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- E. Install hangers and supports to allow controlled thermal and seismic movement 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.
- F. Install lateral bracing with pipe hangers and supports to prevent swaying.

- G. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger 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.
- H. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- I. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers 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/D1.1M 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 so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 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 a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and attachments for general service applications.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, 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 36, 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. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. 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 or carbon-steel plate.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is unnecessary.
 20. 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 unnecessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system 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.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system 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-joint 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 headroom is limited.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system 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. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- L. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION

SECTION 230548.13 - VIBRATION 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. Section Includes:
 - 1. Elastomeric isolation pads.
 - 2. Spring hangers.
 - 3. Snubbers.

1.3 DEFINITIONS

- A. IBC: International Building Code.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Include load rating for each wind-force-restraint fitting and assembly.
 - 3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device component.
 - 4. Annotate to indicate application of each product submitted and compliance with requirements.
 - 5. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Shop Drawings:
 - 1. Detail fabrication and assembly of equipment bases.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. Fire/Smoke Resistance: All components that are not constructed of ferrous metals must have a maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by an NRTL in accordance with ASTM E84 or UL 723, and be so labeled.
- B. Component Supports:
 - 1. Load ratings, features, and applications of all reinforcement components must be based on testing standards of a nationally recognized testing agency.

2.2 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. CADDY; a brand of nVent.
 - c. California Dynamics Corporation.
 - d. Isolation Technology, Inc.
 - e. Kinetics Noise Control, Inc.
 - f. Korfund.
 - g. Mason Industries, Inc.
 - h. Novia; A Division of C&P.
 - i. Vibration Eliminator Co., Inc.
 - j. Vibration Management Corp.
 - k. Vibration Mountings & Controls, Inc.
 - 2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
 - 3. Size: Factory or field cut to match requirements of supported equipment.
 - 4. Minimum deflection as indicated on Drawings.
 - 5. Pad Material: Oil- and water-resistant rubber.
 - 6. Sandwich-Core Material: Resilient and elastomeric.

2.3 SPRING HANGERS

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. CADDY; a brand of nVent.
 - c. California Dynamics Corporation.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Novia; A Division of C&P.
 - g. Vibration Eliminator Co., Inc.
 - h. Vibration Isolation.
 - i. Vibration Management Corp.
 - j. Vibration Mountings & Controls, Inc.
2. 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.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Minimum deflection as indicated on Drawings.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
8. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
9. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
10. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.4 SNUBBERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. CADDY; a brand of nVent.
 2. Kinetics Noise Control, Inc.
 3. Mason Industries, Inc.
 4. Vibration Management Corp.
 5. Vibration Mountings & Controls, Inc.
- B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Post-Installed Concrete Anchor Bolts: Secure to concrete surface with post-installed concrete anchors. Anchors to be prequalified in accordance with ACI 355.2 testing and designated in accordance with ACI 318-14 Ch. 17 for 2015 or 2018 IBC.
2. Preset Concrete Inserts: Prequalified in accordance with ICC-ES AC446 testing.
3. Anchors in Masonry: Design in accordance with TMS 402.
4. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
5. Resilient Cushion: Maximum 1/4-inch air gap, and minimum 1/4 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation 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. Strength of Support Assemblies: Where not indicated, select sizes of components so strength is adequate to carry static and wind force loads within specified loading limits.

3.3 INSTALLATION OF VIBRATION CONTROL DEVICES

- A. Provide vibration control devices for systems and equipment where indicated in Equipment Schedules or Vibration-Control Device Schedules on Drawings, where Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.
- B. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- C. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- D. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- E. Equipment Restraints:

1. Install snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
- F. 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.
- G. 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.

3.4 ADJUSTING

- A. Adjust isolators after 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 230548.13

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SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Duct labels.
4. Stencils.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch stainless steel, 0.025-inch aluminum, 0.032-inch anodized aluminum, 0.032-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
2. Letter and Background Color: As indicated for specific application under Part 3.
3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Fasteners: Stainless steel rivets or self-tapping screws.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
 - 1. Pipe size.
 - 2. Flow-Direction Arrows: Include flow-direction arrows on distribution piping. Arrows may be either integral with label or applied separately.
 - 3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

2.3 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- F. Fasteners: Stainless steel rivets or self-tapping screws.
- G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings. Also include the following:
 - 1. Duct size.

2. Flow-Direction Arrows: Include flow-direction arrows on distribution ducts. Arrows may be either integral with label or may be applied separately.
3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

2.4 STENCILS

A. Stencils for Ducts:

1. Lettering Size: Minimum letter height of 1-1/4 inches for viewing distances of up to 15 ft. and proportionately larger lettering for greater viewing distances.
2. Stencil Material: Fiberboard or metal.
3. Stencil Paint: Exterior, gloss, acrylic enamel. Paint may be in pressurized spray-can form.
4. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.
5. Letter and Background Color: Color as indicated for specific application under Part 3.

B. Stencils for Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:

1. Lettering Size: Minimum letter height of 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.
2. Stencil Material: Fiberboard or metal.
3. Stencil Paint: Exterior, gloss, acrylic enamel. Paint may be in pressurized spray-can form.
4. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.
5. Letter and Background Color: As indicated for specific application under Part 3.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate 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 locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of mechanical equipment.
- B. Sign and Label Colors:
 - 1. White letters on an ANSI Z535.1 safety-blue background.
- C. Locate equipment labels where accessible and visible.

3.4 INSTALLATION OF PIPE LABELS

- A. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- B. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Within 3 ft. of 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. At every change of direction greater than 45-degrees.
 - 4. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 5. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 6. Within 3 ft. of equipment items and other points of origination and termination.
 - 7. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping, ductwork, and equipment.
 - 8. On piping above removable acoustical ceilings. Install pipe labels at a 45-deg angle down from horizontal on both sides of piping to permit view from under and side of piping.
- C. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- D. Flow-Direction Arrows: Use arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. Pipe-Label Color Schedule:
 - 1. Refrigerant Piping: White letters on an ANSI Z535.1 safety-blue background.

3.5 INSTALLATION OF DUCT LABELS

- A. Install plastic-laminated or self-adhesive duct labels showing service and flow direction with permanent adhesive on air ducts.
 - 1. Provide labels in the following color codes:
 - a. For air supply ducts: White letters on blue background.
 - b. For air return ducts: White letters on blue background.
 - c. For exhaust-, outside-, relief-, return-, and mixed-air ducts: White letters on blue background.
- B. Stenciled Duct-Label Option: Stenciled labels showing service and flow direction may be provided instead of plastic-laminated duct labels, at Installer's option.
 - 1. For all air ducts: Black letters on white background.
- C. Locate label near each point where ducts enter into and exit from concealed spaces and at maximum intervals of 50 ft. where concealed by removable ceiling system.
- D. Stenciled Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:
 - 1. Black letters on White background.

END OF SECTION 230553

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SECTION 230713 - DUCT INSULATION**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 the following duct services:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, return air.
 - 4. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
- B. Related Sections:
 - 1. Section 233113 "Metal Ducts" for duct liners.

1.3 ACTION 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 insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
 - 3. Detail application of field-applied jackets.
 - 4. Detail application at linkages of control devices.

1.4 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.

1.5 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.6 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 "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation 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. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.
 - e. Owens Corning.
- G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.
 - e. Owens Corning.

2.2 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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

2.3 MASTICS AND COATINGS

- A. Materials shall be compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic: Water based; suitable for indoor use on below ambient services.
 - 1. Water-Vapor Permeance: Comply with ASTM C 755, Section 7.2.2, Table 2, for insulation type and service conditions.
 - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 3. Color: White.
- C. Vapor-Retarder Mastic: Solvent based; suitable for indoor use on below ambient services.
 - 1. Water-Vapor Permeance: Comply with ASTM C 755, Section 7.2.2, Table 2, for insulation type and service conditions.
 - 2. Service Temperature Range: 0 to 180 deg F.
 - 3. Color: White.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Water-Vapor Permeance: ASTM E 96, greater than 1.0 perm at manufacturer's recommended dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Color: White.

2.4 SEALANTS

A. 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 deg F.
4. Color: Aluminum.

2.5 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. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.6 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering ducts.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.

2.7 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

2.8 TAPES

- A. FSK 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.

B. 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/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing seal or closed seal.
2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal closed seal.
3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
3. 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. Comply with the following requirements:
 - a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - b. Spindle: Copper- or zinc-coated, low-carbon 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.

4. 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. Comply with the following requirements:
 - a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - b. Spindle: Copper- or zinc-coated, low-carbon 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.
 5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel, 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.
 6. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, galvanized steel.

2.10 CORNER ANGLES

- A. 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.
- B. 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 Type 316.

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 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.

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 ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct 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. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. 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.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. 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 duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. 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 Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof 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 roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof 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.

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, 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 either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. 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.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. 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 section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
 5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. 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.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. 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 section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 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. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint aluminum or stainless-steel jackets.

3.7 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. Inspect ductwork, 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 one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, return air.
 - 4. Indoor, concealed exhaust between isolation damper and penetration of building exterior and all exhaust ductwork downstream of energy recovery ventilator.
- B. Items Not Insulated:
 - 1. Fibrous-glass ducts.
 - 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 - 3. Factory-insulated flexible ducts.
 - 4. Factory-insulated plenums and casings.
 - 5. Flexible connectors.
 - 6. Vibration-control devices.
 - 7. Factory-insulated access panels and doors.

3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, round and flat-oval, supply-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density minimum R-5.0 installed.
- B. Concealed, round and flat-oval, return-air duct insulation shall be the following:
 - 1. Lined: Refer to 23 31 13.
- C. Concealed, round and flat-oval, outdoor-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density minimum R-5.0 installed.
- D. Concealed, rectangular, supply-air duct insulation shall be one of the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density minimum R-5.0 installed.
 - 2. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density minimum R-5.0.
- E. Concealed, rectangular, return-air duct insulation shall be one of the following:
 - 1. Lined: Refer to 23 31 13.
- F. Concealed, rectangular, outdoor-air duct insulation shall be one of the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density minimum R-5.0 installed.
 - 2. Mineral-Fiber Blanket: 2 inches thick and 3-lb/cu. ft. nominal density minimum R-5.0.
- G. Concealed, round/rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior and all exhaust ductwork downstream of energy recovery ventilator shall be one of the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 3-lb/cu. ft. nominal density minimum R-5.0 installed.
 - 2. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density minimum R-5.0.

END OF SECTION

SECTION 231123 - FACILITY NATURAL-GAS PIPING**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Joining materials.
4. Manual gas shutoff valves.
5. Pressure regulators.
6. Dielectric fittings.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. An example includes rooftop locations.
- C. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- D. 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.

1.3 ACTION SUBMITTALS**A. Product Data:**

1. Piping specialties.
2. Corrugated, stainless steel tubing with associated components.
3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
4. Pressure regulators. Indicate pressure ratings and capacities.
5. Dielectric fittings.

- B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1. Shop Drawing Scale: 1/4 inch per foot
2. Detail mounting, supports, and valve arrangements for pressure regulator assembly.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping in accordance with requirements of authorities 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 PE pipes and valves from direct sunlight.

1.5 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.
- B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide purging and startup of natural-gas supply in accordance with requirements indicated:
 1. Notify Owner no fewer than two days in advance of proposed interruption of natural-gas service.
 2. Do not proceed with interruption of natural-gas service without Owner's written permission.

1.6 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed and concealed behind finished surfaces. Comply with requirements in Section 083113 "Access Doors and Frames."
- C. Coordinate requirements for piping identification for natural-gas piping. Comply with requirements in Section 220553 "Identification of Plumbing Piping and Equipment."

PART 2 - PRODUCTS**2.1 SOURCE LIMITATIONS**

- A. Obtain each product type from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Comply with the International Fuel Gas Code.
- B. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
- C. Natural-Gas System Pressure within Buildings:
 - 1. Two pressure ranges. Primary pressure is more than 0.5 psig, but not more than 2 psig, and is reduced to secondary pressure of 0.5 psig or less.
- D. 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.

2.3 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A53/A53M, 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 A234/A234M 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. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

- a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

2.4 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
3. Corrugated, stainless steel tubing with polymer coating.
4. Operating-Pressure Rating: 0.5 psig.
5. End Fittings: Zinc-coated steel.
6. Threaded Ends: Comply with ASME B1.20.1.
7. Maximum Length: 72 inches.

B. Y-Pattern Strainers:

1. Body: ASTM A126, 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.

2.5 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.

2.6 MANUAL GAS SHUTOFF VALVES

- A. See "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles for where each valve type is applied in various services.

B. 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 indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves NPS 1-1/4 to NPS 2 having initials "WOG" permanently marked on valve body.

- C. 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 indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
 4. Service Mark: Initials "WOG" permanently marked on valve body.
- D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - c. BrassCraft Manufacturing Co.; a Masco company.
 - d. Lyall, R. W. & Company, Inc.
 - e. Perfection Corporation.
 2. Body: Bronze, complying with ASTM B584.
 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 indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
 8. CWP Rating: 600 psig.
 9. Listing: Valves NPS 1 and smaller are to 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.

2.7 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 Z21.80A.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Actaris.
 - b. American Meter Company.
 - c. Dormont; a WATTS brand.
 - d. Eclipse Innovative Thermal Technologies.
 - e. Fisher Control Valves & Instruments; a brand of Emerson Process Management.
 - f. Invensys.
 - g. Itron Gas.
 - h. Maxitrol Company.
 - i. 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: NBR; resistant to gas impurities, abrasion, and deformation at the valve port.
 6. Orifice: Aluminum; interchangeable.
 7. Seal Plug: UV-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 regulator.
 9. Pressure regulator is to maintain discharge pressure setting downstream and is to 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: 5 psig.
- C. Appliance Pressure Regulators: Comply with ANSI Z21.18.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a.
 - b. Dormont; a WATTS brand.
 - c. Eaton.
 - d. Harper Wyman Co.
 - e. Maxitrol Company.
 - f. 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: NBR.
 6. Seal Plug: UV-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 of the following:

- a. A.Y. McDonald Mfg. Co.
- b. Capitol Manufacturing Company.
- c. Central Plastics Company.
- d. HART Industrial Unions, LLC.
- e. Jomar Valve.
- 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 deg 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 of the following:

- a. Capitol Manufacturing Company.
- 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 deg 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 of the following:
 - a. Advance Products & 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 in accordance with the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with the International Fuel Gas Code requirements for preventing accidental ignition.

3.3 INSTALLATION OF OUTDOOR PIPING

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Steel Piping with Protective Coating:
 1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
 3. Replace pipe having damaged PE coating with new pipe.

- C. Install fittings for changes in direction and branch connections.

3.4 INSTALLATION OF INDOOR PIPING

- A. Comply with the International Fuel Gas Code 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. Do not install piping in concealed locations unless sleeved with the sleeve open at both ends.
- 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. Where installing piping above accessible ceilings, allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access. Do not locate valves within return air plenums.
- 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 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.
 - 2. Install sediment trap on both sides of regulators for gas reduction to 2 psig with valve and capped.

- N. Extend relief vent connections for service regulators, 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 welded joints as described in Part 2. 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 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.
 - 3. 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 sleeves for piping penetrations of walls, ceilings, and floors.
- W. Install sleeve seals for piping penetrations of concrete walls and slabs.
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.5 INSTALLATION OF VALVES

- 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 earthquake valves aboveground outside buildings according to listing.
- E. Install anode for metallic valves in underground PE piping.
- F. Do not install valves in return-air plenums.

3.6 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. 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.
- D. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
- E. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, and then use wrench. Do not overtighten.

3.7 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.

- B. Install hangers for steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Install hangers for corrugated stainless steel tubing, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping within 12 inches of each fitting.
- E. Support vertical runs of steel piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- F. Support vertical runs of corrugated stainless steel tubing to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.8 PIPING CONNECTIONS

- A. Connect to utility's gas main according to utility'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 in accordance with NFPA 70.
- C. Where installing piping adjacent to appliances, allow space for 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.

3.9 LABELING AND IDENTIFICATION

- A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.

3.10 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Test, inspect, and purge natural gas in accordance with the International Fuel Gas Code and authorities having jurisdiction.
 - 2. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- B. Prepare test and inspection reports.

3.11 OUTDOOR PIPING SCHEDULE

A. Aboveground natural-gas piping is to be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

3.12 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

A. Aboveground, branch piping NPS 1 and smaller is to be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping is to be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

3.13 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG AND LESS THAN 5 PSIG

A. Aboveground, branch piping NPS 1 and smaller is to be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping is to be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

3.14 ABOVEGROUND, MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2-1/2 and larger at service meter are to be the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.

B. Distribution piping valves for pipe sizes NPS 2 and smaller are to be the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.

C. Distribution piping valves for pipe sizes NPS 2-1/2 and larger are to be the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.

D. Valves in branch piping for single appliance are to be the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.

END OF SECTION 231123

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SECTION 233113 - METAL DUCTS**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-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Double-wall round ducts and fittings.
4. Sheet metal materials.
5. Duct liner.
6. Sealants and gaskets.
7. Hangers and supports.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 ACTION SUBMITTALS**A. Product Data:** For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

B. Sustainable Design Submittals:

1. Product Data: For ventilation equipment, indicating compliance with ASHRAE 62.1, Section 5 - "Systems and Equipment."

C. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.

3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top and bottom of ducts.
5. Dimensions of all duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. Welding certificates.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 3. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" . .
- B. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."
- D. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

- E. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
 - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
 - 2. For ducts exposed to weather, construct of Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.
- B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
 - 2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
 - 3. Where specified for specific applications, all joints shall be welded.
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Where specified for specific applications, all joints shall be welded.
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ductmate Industries, Inc.
 - b. Elgen Manufacturing.
 - c. Linx Industries (formerly Lindab).
 - d. McGill AirFlow LLC.
 - e. MKT Metal Manufacturing.
 - f. Nordfab Ducting.
 - g. SEMCO LLC.
 - h. Set Duct Manufacturing.
 - i. Sheet Metal Connectors, Inc.
 - j. Spiral Manufacturing Co., Inc.
 - k. Spiral Pipe of Texas.
 - l. Stamped Fittings Inc.
 - m. Wichita Sheet Metal Supply, Inc.
 - B. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
 - C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - D. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- 2.4 DOUBLE-WALL ROUND[AND FLAT-OVAL] DUCTS AND FITTINGS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Linx Industries (formerly Lindab).
 2. McGill AirFlow LLC.
 3. MKT Metal Manufacturing.

4. SEMCO LLC.
 5. Set Duct Manufacturing.
 6. Sheet Metal Connectors, Inc.
 7. Spiral Pipe of Texas.
 8. Wichita Sheet Metal Supply. Inc.
- B. Inner Duct: Minimum 24-gauge perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.
- C. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 3. Coat insulation with antimicrobial coating.
 4. Cover insulation with polyester film complying with UL 181, Class 1.

2.5 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with 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: Comply with ASTM A 653/A 653M.
1. Galvanized Coating Designation: G90.
 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- G. 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.

2.6 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Owens Corning.
 2. Maximum Thermal Conductivity:
 - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
- B. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized steel; with beveled edge sized as required to hold insulation securely in place, but not less than 1-1/2 inches in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
1. 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.
 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
 3. Butt transverse joints without gaps, and coat joint with adhesive.
 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
 6. 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.

7. 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:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
8. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.7 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 2. Tape Width: 4 inches.
 3. Sealant: Modified styrene acrylic.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
 7. Service: Indoor and outdoor.
 8. Service Temperature: Minus 40 to plus 200 deg F.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
- C. Water-Based Joint and Seam Sealant:
 1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. VOC: Maximum 75 g/L (less water).
 7. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

- D. Flanged Joint Sealant: Comply with ASTM C 920.
 - 1. General: Single-component, acid-curing, silicone, elastomeric.
 - 2. Type: S.
 - 3. Grade: NS.
 - 4. Class: 25.
 - 5. Use: O.
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- F. Round Duct Joint O-Ring Seals:
 - 1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 - 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 - 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.8 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION**3.1 DUCT INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.
- B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths with fewest possible joints.
- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- J. Install fire, combination fire/smoke, and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.
- K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation.
- M. Elbows: Use long-radius elbows wherever they fit.

1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.

N. Branch Connections: Use lateral or conical branch connections.

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

- A. Seal all ducts to minimum SMACNA Seal Class A.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 1. Where practical, install concrete inserts before placing concrete.
 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

3.8 STARTUP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.9 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
 - 1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.
- B. Supply Ducts:
 - 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

- a. Pressure Class: Positive 1- inch wg.
 - b. SMACNA Leakage Class for Rectangular: 4.
 - c. SMACNA Leakage Class for Round and Flat Oval: 2.
- 2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive 2- inch wg.
 - b. SMACNA Leakage Class for Rectangular: 4.
 - c. SMACNA Leakage Class for Round and Flat Oval: 2.
- C. Return Ducts:
 - 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or negative 1- inch wg.
 - b. SMACNA Leakage Class for Rectangular: 4.
 - c. SMACNA Leakage Class for Round and Flat Oval: 2.
- D. Exhaust Ducts:
 - 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 2- inch wg.
 - b. SMACNA Leakage Class for Rectangular: 4.
 - c. SMACNA Leakage Class for Round and Flat Oval: 2.
 - 2. Ducts Connected to Equipment Not Listed above:
 - a. Pressure Class: Positive or negative 2- inch wg.
 - b. SMACNA Leakage Class for Rectangular: 2.
- E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
 - 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or negative 2- inch wg.
 - b. SMACNA Leakage Class for Rectangular: 8.
 - 2. SMACNA Leakage Class for Round and Flat Oval: 8.
- F. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.
- G. Liner:
 - 1. Supply-Air Ducts: Fibrous glass, Type I, 1 inch(es) thick.
 - a. Exposed rectangular ductwork.

- b. Exposed round ductwork.
 - c. First 15 feet of ductwork downstream of equipment outlets.
 - 2. Return-Air Ducts: Fibrous glass, Type I, 1 inch(es) thick.
 - 3. Transfer Ducts: Fibrous glass, Type I, 1 inch(es) thick.
- H. Double-Wall Duct Interstitial Insulation:
 - 1. Supply-Air Ducts: 1 inch(es) thick.
 - 2. Return-Air Ducts: 1 inch(es) thick.
- I. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.

- 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.
- J. Branch Configuration:
- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Conical spin in.
 - 2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300 - AIR DUCT 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. Manual volume dampers.
 - 2. Control dampers.
 - 3. Fire dampers.
 - 4. Turning vanes.
 - 5. Duct-mounted access doors.
 - 6. Duct access panel assemblies.
 - 7. Flexible connectors.
 - 8. Duct accessory hardware.

- B. Related Requirements:

- 1. Section 233346 "Flexible Ducts" for insulated and non-insulated flexible ducts.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details, and attachments to other work.

- 1. Detail duct accessories' fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control-damper installations.
 - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor-damper installations, including sleeves; and duct-mounted access doors and remote damper operators.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, or BIM model, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 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. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. Comply with NFPA 90A and NFPA 90B.
- B. Comply with 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.

2.2 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance; a division of MESTEK, Inc.
 - b. Aire Technologies.
 - c. American Warming and Ventilating; a Mestek Architectural Group company.
 - d. Arrow United Industries.
 - e. Cesco Products; a division of MESTEK, Inc.
 - f. Greenheck Fan Corporation.
 - g. Lloyd Industries, Inc.

- h. McGill AirFlow LLC.
 - i. Nailor Industries Inc.
 - j. Pottorff.
 - k. Ruskin Company.
 - l. Safe Air - Dowco Products.
 - m. United Enertech.
 - n. Vent Products Co., Inc.
- 2. Performance:
 - a. Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. against 1-inch wg differential static pressure.
- 3. Construction:
 - a. Linkage out of airstream.
 - b. Suitable for horizontal or vertical airflow applications.
- 4. Frames:
 - a. Hat-shaped, 16-gauge- thick, galvanized sheet steel.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
- 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized steel; 16 gauge thick.
- 6. Blade Axles: Stainless steel.
- 7. Bearings:
 - a. Stainless steel sleeve.
 - b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.
- 8. Tie Bars and Brackets: Galvanized steel.
- 9. Locking device to hold damper blades in a fixed position without vibration.
- B. Jackshaft:
 - 1. Size: 1-inch diameter.
 - 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle, made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.3 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Warming and Ventilating; a Mestek Architectural Group company.
2. Arrow United Industries.
3. Carnes Company.
4. Cesco Products; a division of MESTEK, Inc.
5. Greenheck Fan Corporation.
6. Lloyd Industries, Inc.
7. McGill AirFlow LLC.
8. Metal Form Manufacturing, Inc.
9. Nailor Industries Inc.
10. NCA Manufacturing, Inc.
11. Pottorff.
12. Ruskin Company.
13. Safe Air - Dowco Products.
14. United Enertech.
15. Vent Products Co., Inc.
16. Young Regulator Company.

- B. General Requirements:

1. Unless otherwise indicated, use parallel-blade configuration for two-position control, equipment isolation service, and when mixing two airstreams. For other applications, use opposed-blade configuration.
2. Factory or field assemble multiple damper sections to provide a single damper assembly of size required by the application.

- C. Performance:

1. AMCA Certification: Test and rate in accordance with AMCA 511.
2. Leakage:
 - a. Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.
3. Pressure Drop: 0.05 inch wg at 1500 fpm across a 24-by-24-inch damper when tested in accordance with AMCA 500-D, Figure 5.3.
4. Velocity: Up to 2000 fpm .
5. Temperature: Minus 25 to plus 180 deg F.

6. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.

D. Construction:

1. Linkage out of airstream.
2. Suitable for horizontal or vertical airflow applications.
3. Frames:
 - a. Hat, U, or angle shaped.
 - b. 0.08-inch- thick extruded aluminum.
 - c. Mitered and welded corners.
 - d. Flanges for attaching to walls and flangeless frames for installing in ducts.
4. Blades:
 - a. Multiple blade with maximum blade width of 6 inches.
 - b. Opposed-blade design.
 - c. Galvanized steel.
 - d. 16-gauge- thick single skin.
5. Blade Edging Seals:
 - a. Replaceable Closed-cell neoprene.
 - b. Inflatable seal blade edging, or replaceable rubber seals.
6. Blade Jamb Seal: Flexible stainless steel, compression type.
7. Blade Axles: 1/2-inch diameter; galvanized steel.
8. Blade-Linkage Hardware: Zinc-plated steel and brass; ends sealed against blade bearings. Linkage mounted out of air stream.
9. Bearings:
 - a. Oil-impregnated stainless steel sleeve.
 - b. Dampers mounted with vertical blades to have thrust bearings at each end of every blade.

E. Damper Actuator - Electric:

1. Electric - 120 V ac.
2. UL 873, plenum rated.
3. Two position, , or modulating with fail-safe spring return as indicated on controls drawings.
 - a. Sufficient motor torque and spring torque to drive damper fully open and fully closed with adequate force to achieve required damper seal.
 - b. Minimum 90-degree drive rotation.
4. Clockwise or counterclockwise drive rotation as required for application.
5. Environmental Operating Range:

- a. Temperature: Minus 40 to plus 130 deg F.
 - b. Humidity: 5 to 95 percent relative humidity noncondensing.
- 6. Environmental enclosure: NEMA 2.
 - 7. Actuator to be factory mounted and provided with a single-point wiring connection.

2.4 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Aire Technologies.
 - 2. Arrow United Industries.
 - 3. Greenheck Fan Corporation.
 - 4. NCA Manufacturing, Inc.
 - 5. Pottorff.
 - 6. Prefco.
 - 7. Ruskin Company.
 - 8. Safe Air - Dowco Products.
 - 9. United Enertech.
 - 10. Vent Products Co., Inc.
- B. Type: Static; rated and labeled in accordance with UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000 fpm velocity.
- D. Fire Rating: 1-1/2 hours.
- E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed galvanized steel; with mitered and interlocking corners; gauge in accordance with UL listing.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel; gauge in accordance with UL listing.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed galvanized sheet steel, interlocking. Material gauge is to be in accordance with UL listing.
- I. Heat-Responsive Device:
 - 1. Replaceable, 165 deg F rated, fusible links.

2.5 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aero-Dyne Sound Control Co.
2. Ductmate Industries, Inc.
3. Duro Dyne Inc.
4. Elgen Manufacturing.

B. Manufactured Turning Vanes for Metal Ducts: Fabricate curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

D. Vane Construction:

1. Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.6 REMOTE DAMPER OPERATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. DynAir; a Carlisle Company.
2. METALAIRE, Inc.
3. United Enertech.
4. Young Regulator Company.

B. Description: Cable system designed for remote manual damper adjustment.

C. Cable: Steel.

2.7 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Flexmaster U.S.A., Inc.
4. McGill AirFlow LLC.
5. Ruskin Company.
6. United Enertech.

B. Duct-Mounted Access Doors: Fabricate access panels in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 7-2, "Duct Access Doors and Panels," and Figure 7-3, "Access Doors - Round Duct."

1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. 24-gauge- thick galvanized steel door panel.
 - d. Vision panel.
 - e. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - f. Fabricate doors airtight and suitable for duct pressure class.
2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - a. 24-gauge- thick galvanized steel or 0.032-inch- thick aluminum frame.
3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.8 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. Elgen Manufacturing.
 4. Ventfabrics, Inc.
 5. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Fire-Performance Characteristics: Adhesives, sealants, fabric materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Materials: Flame-retardant or noncombustible fabrics.
- E. Coatings and Adhesives: Comply with UL 181, Class 1.
- F. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches 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. Provide metal compatible with connected ducts.

- G. 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.
- H. 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.

2.9 DUCT ACCESSORY HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CL WARD & Family Inc.
 - 2. Ductmate Industries, Inc.
 - 3. Duro Dyne Inc.
 - 4. DynAir; a Carlisle Company.
 - 5. Elgen Manufacturing.
 - 6. Hardcast; a Carlisle Company.
 - 7. United Enertech.
 - 8. Ventfabrics, Inc.
 - 9. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- C. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.10 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless Steel Sheets: Comply with ASTM A480/A480M, Type 304, and having a No. 2 finish.
- C. Aluminum Sheets: Comply with ASTM B209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, one-side bright finish for exposed ducts.

- D. Extruded Aluminum: Comply with ASTM B221, Alloy 6063, Temper T6.
- 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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories in accordance with applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116 for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.
- C. Install control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Where multiple damper sections are necessary to achieve required dimensions, provide reinforcement to fully support damper assembly when fully closed at full system design static pressure.
- E. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- F. Set dampers to fully open position before testing, adjusting, and balancing.
- G. Install test holes at fan inlets and outlets and elsewhere as indicated and as needed for testing and balancing.
- H. Install fire dampers in accordance with UL listing.
- I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Upstream and downstream from duct filters.
 - 3. At outdoor-air intakes and mixed-air plenums.

4. At drain pans and seals.
5. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
6. At each change in direction and at maximum 50-ft. spacing.
7. Upstream and downstream from turning vanes.
8. Control devices requiring inspection.
9. Elsewhere as indicated.

J. Install access doors with swing against duct static pressure.

K. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

L. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

M. Install flexible connectors to connect ducts to equipment.

N. For fans developing static pressures of 5 inches wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

O. Install duct test holes where required for testing and balancing purposes.

P. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors, and verify that size and location of access doors are adequate to perform required operation.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation, and verify that vanes do not move or rattle.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233346 - FLEXIBLE DUCTS**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. Insulated flexible ducts.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS**2.1 INSULATED FLEXIBLE DUCTS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flexmaster U.S.A., Inc.
 - 2. JP Lamborn Co..
 - 3. McGill AirFlow LLC.
 - 4. Thermaflex; a Flex-Tek Group company.
 - 5. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, two-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene aluminized vapor-barrier film.
 - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 - 2. Maximum Air Velocity: 4000 fpm.
 - 3. Temperature Range: Minus 10 to plus 160 deg F.
 - 4. Insulation R-Value: R6.

2.2 FLEXIBLE DUCT CONNECTORS

- A. 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.
- B. Non-Clamp Connectors: Adhesive plus sheet metal screws.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install flexible ducts according to applicable details in 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. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.
- C. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- D. Connect flexible ducts to metal ducts with liquid adhesive plus tape.
- E. Install duct test holes where required for testing and balancing purposes.
- F. Installation:
 - 1. Install ducts fully extended.
 - 2. Do not bend ducts across sharp corners.
 - 3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
 - 4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
 - 5. Install flexible ducts in a direct line, without sags, twists, or turns.
- G. Supporting Flexible Ducts:
 - 1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
 - 2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
 - 3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
 - 4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION

SECTION 233416 - CENTRIFUGAL HVAC FANS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Square in-line centrifugal fans.

1.2 ACTION SUBMITTALS**A. Product Data:** For each type of product.

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
2. Rated capacities, operating characteristics, and furnished specialties and accessories.
3. Certified fan performance curves with system operating conditions indicated.
4. Certified fan sound-power ratings.
5. Motor ratings and electrical characteristics, plus motor and electrical accessories.
6. Material thickness and finishes, including color charts.
7. Dampers, including housings, linkages, and operators.
8. Fan speed controllers.

1.3 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. Belts: One set(s) for each belt-driven unit.

PART 2 - PRODUCTS**2.1 SQUARE IN-LINE CENTRIFUGAL FANS****A. Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

1. Carnes Company.
2. Greenheck Fan Corporation.
3. Loren Cook Company.
4. PennBarry; division of Air System Components.

- B. Description: Square in-line centrifugal fans.
- C. Housing:
 - 1. Housing Material: Reinforced steel.
 - 2. Housing Coating: See schedule.
 - 3. Housing Construction: Side panels shall be easily removable for service. Include inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
- D. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing; with wheel, inlet cone, and motor on swing-out service door.
- E. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosures around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
- F. Fan Wheels: Aluminum airfoil blades welded to aluminum hub.
- G. Motor Enclosure: Open, dripproof.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install centrifugal fans level and plumb.
- B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.
- D. Equipment Mounting:
 - 1. Support duct-mounted and other hanging centrifugal fans directly from the building structure, using suitable hanging systems as specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
 - 2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- E. Install units with clearances for service and maintenance.
- F. Label fans according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 DUCTWORK AND PIPING CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."
- B. Install ducts adjacent to fans to allow service and maintenance.
- C. Install piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain with pipe sizes matching the drain connection.

3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- D. 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 Section 260553 "Identification for Electrical Systems."
 - 2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.4 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.

3.5 STARTUP SERVICE:

- A. Perform startup service.
 - 1. Complete installation and startup checks in accordance with manufacturer's written instructions.
 - 2. Verify that shipping, blocking, and bracing are removed.
 - 3. 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.
 - 4. Verify that cleaning and adjusting are complete.

5. For direct-drive fans, verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation.
6. For belt-drive fans, 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.
7. Adjust belt tension.
8. Adjust damper linkages for proper damper operation.
9. Verify lubrication for bearings and other moving parts.
10. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
11. Disable automatic temperature-control operators, energize motor and confirm proper motor rotation and unit operation, adjust fan to indicated rpm, and measure and record motor voltage and amperage.
12. Shut unit down and reconnect automatic temperature-control operators.
13. Remove and replace malfunctioning units and retest as specified above.

3.6 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Lubricate bearings.
- D. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 1. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 3. Fans and components will be considered defective if they do not pass tests and inspections.
- B. Prepare test and inspection reports.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION

SECTION 233439 - HIGH-VOLUME, LOW-SPEED FANS**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 high-volume, low-speed fans.

1.3 DEFINITIONS

- A. HVLS - High volume, low speed.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, furnished specialties, and accessories for each fan.
 - 2. Certified fan performance curves with system operating conditions indicated.
 - 3. Certified fan sound-power ratings.
 - 4. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 5. Material thickness and finishes, including color charts.
 - 6. Fan speed controllers.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in a clean and dry place.
- B. Comply with manufacturer's written rigging and installation instructions for unloading and moving to final installed location.
- C. Handle products carefully to prevent damage, breaking, denting, and scoring. Do not install damaged products.
- D. Protect products from weather, dirt, dust, water, construction debris, and physical damage.
 - 1. Retain factory-applied coverings on equipment to protect finishes during construction and remove just prior to operating unit.

2. Cover unit openings before installation to prevent dirt and dust from entering inside of units. If required to remove coverings during unit installation, reapply coverings over openings after unit installation and remove just prior to operating unit.
- E. Replace installed products damaged during construction.

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: Listed and labeled to UL 507.
- C. CSA Compliance: Listed and labeled to CSA C22.2, No. 113.
- D. Comply with NFPA 13 requirements for HVLS fans.
- E. AMCA Compliance:
 1. Test HVLS fans according to AMCA 230.
 2. Certify HVLS fan performance according to AMCA 211.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Big Ass Fans.
 2. MacroAir.
 3. Greenheck.
- B. Source Limitations: Obtain HVLS fans from single source from single manufacturer.

2.3 HIGH-VOLUME, LOW-SPEED FANS

- A. Description: Factory-assembled and -tested horizontal, non-ducted fan unit, consisting of large-diameter blade set, direct-drive electric motor, with speed-reducing gearbox variable-speed motor controller.
 1. Provide fan designed to circulate large air volume, vertically, at low velocity.
 2. Maximum Operating Temperature: 122 deg F.
 3. Frame:
 - a. Material: Galvanized steel.

- 1) Finish: Paint .
4. Blades: Airfoil type.
 - a. Material: Aluminum.
 - 1) Blade Finish: Anodized.
5. Motor: , integral to fan frame .
6. Controls: Provide wall-mounted keypad.
 - a. Provide automatic variable speed motor controller speed control.
7. Standard Mounting Bracket: Steel beam/steel angle.
8. Accessories:
 - a. Mounting extension tube.
 - b. .

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with requirements for installation tolerances and other conditions affecting HVLS fan performance, maintenance, and operations.
 1. Fan locations indicated on Drawings are approximate. Determine exact locations before roughing-in for mounting, control, and electrical connections.
- B. Examine roughing-in for mounting location, anchor-bolt sizes, and locations, to verify actual locations for mounting connections before installation of fan.
- C. Examine areas for suitable conditions where fan will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF HIGH-VOLUME LOW-SPEED FANS

- A. Install fan according to manufacturer's published instructions.
- B. Comply with NECA 1 and NFPA 70.
- C. Comply with NFPA 13 for installation of HVLS fans and maximum allowable fan diameter. Center HVLS fans between four adjacent sprinklers. Minimum vertical clearance from HVLS fan to sprinkler deflector is 3 feet.

- D. Comply with NFPA 72 and interlock HVLS fans to shut down upon receiving an alarm from fire alarm system.
- E. Equipment Mounting:
 - 1. Anchor fan to building structure with manufacturer's recommended mounting bracket for installed condition.
 - 2. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
 - 3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- F. Install unit to permit access for maintenance.
- G. Install parts and accessories shipped loose.

3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- D. 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 Section 260553 "Identification for Electrical Systems."
- E. Install power wiring to field-mounted electrical devices, furnished by fan manufacturer, but not factory mounted.

3.4 CONTROL CONNECTIONS

- A. Connect control wiring to field-mounted control devices.
- B. Connect control interlock wiring between HVLS fan and other equipment to provide a complete and functioning system.
- C. Install control devices furnished by manufacturer, but not factory mounted.
- D. Install control wiring to field-mounted control devices, furnished by fan manufacturer, but not factory mounted.

- E. Protect installed units from damage caused by other work.

3.5 CLEANING

- A. Clean equipment externally; remove coatings applied for protection during shipping and storage, foreign material, and oily residue according to manufacturer's written instructions. Following manufacturer's cleaning procedures, and clean with manufacturer-recommended cleaning products.

END OF SECTION 233439

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SECTION 233700 - AIR INLETS AND OUTLETS**PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Grilles And Registers.
- B. Louvers.
- C. Roof Hoods.

1.2 QUALITY ASSURANCE

- A. Test and rate performance of air inlets and outlets per ASHRAE 70.
- B. Test and rate performance of louvers per AMCA 500L-99.

1.3 REFERENCES

- A. AMCA 500-L-12 - Laboratory Methods of Testing Louvers for Rating.
- B. ANSI/ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Inlets and Outlets.
- C. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- D. SMACNA - Duct Construction Standards.

1.4 SUBMITTALS

- A. Submit schedule of inlets and outlets indicating type, size, location, application, and noise level.
- B. Review requirements of inlets and outlets as to size, finish, and type of mounting prior to submitting product data and schedules of inlets and outlets.
- C. Submit manufacturer's installation instructions.
- D. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.

1.5 REGULATORY REQUIREMENTS

- A. Conform to ANSI/NFPA 90A.
- B. Conform to ASHRAE 90.1.

PART 2 - PRODUCTS**2.1 AIR TERMINALS - GRILLES, REGISTERS, AND DIFFUSERS**

- A. The type of unit, margin, material, finish, etc., shall be as shown on the drawing schedule and suitable for the intended use.
- B. All margins shall be compatible with ceiling types specified (including 'Thin-Line' T-bar lay-in grid system). Any discrepancies in contract documents shall be brought to the attention of the Architect/Engineer, in writing, prior to Bid Date. Submission of Bid indicates ceiling and air inlet and outlet types have been coordinated.
- C. The capacity and size of the unit shall be as shown on the drawings.
- D. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25, referenced to 10^{-12} watts with a 10 dB room effect. .
- E. Refer to the drawings for construction material, color and finish, margin style, deflection, and sizes of grilles and registers.
- F. Screw holes for surface fasteners shall be countersunk for a neat appearance. Provide concealed fasteners for installation in lay-in ceilings and as specified on the drawings.
- G. Manufacturers:
 - 1. Tuttle & Bailey
 - 2. Titus
 - 3. Price
 - 4. Nailor
 - 5. Carnes
 - 6. Metalaire
 - 7. Krueger

2.2 LOUVERS - FIXED - ALUMINUM

- A. Louvers shall be minimum 4" deep and constructed of extruded aluminum. Blade, jamb and sill thickness shall be minimum 0.081". Blades shall be spaced at a maximum of 5.1" apart.

- B. Louvers shall be of the drainable blade design with water collected on the leading edge of the blade and diverted to the jamb.
- C. Louvers shall be furnished with aluminum bird screen mounted on the inside surface.
- D. Size, cfm, finish and pressure drop for louvers shall be as scheduled on the drawings.
- E. AMCA Certified performance for 48" x 48" samples with intake airflow of 8,000 cfm shall not exhibit more than 0.19" pressure drop. Maximum water penetration shall be 0.01 ounces per square foot at the scheduled intake velocity based on 15 minute test duration when subjected to a water flow rate of 0.25 gal/min as described under the Water Penetration Test in AMCA 500-L-07.
- F. Contractor shall provide the General Contractor with the correct sizes and locations of all louvers required in masonry walls.
- G. Louvers shall be sealed around perimeter to avoid moisture penetration between the louver frame and wall.
- H. Louvers shall be suitable for duct connection.
- I. Manufacturers:
 - 1. Ruskin - "ELF375DX"
 - 2. Greenheck - ESD "403"
 - 3. Pottorff - EFD

2.3 ROOF HOODS

- A. Hoods shall be constructed of roll formed, interlocking aluminum panels. Vertical end panels are fully locked into hood.
- B. Top of curb to hood inlet shall be minimum of 5" .
- C. Curb cap shall be of 14 gauge formed aluminum with mitered corners continuously heliarc-welded. Hood shall be of the same material and cross-braced for added strength..
- D. Hoods shall be furnished with aluminum bird screen.
- E. Hood and throat shall be reinforced with extruded aluminum angle and have a minimum snow load rating of 30 lbs. per square foot.
- F. Size, cfm, finish and pressure drop for hoods shall be as scheduled on the drawings.
- G. Inlet area shall be minimum 150% of throat area for intake hoods. Outlet area shall be minimum 125% of throat area for exhaust hoods and relief vents.

- H. Hoods shall be furnished with 12" high curb (above top of roof) and be of the size and type as shown on the drawings.
- I. Hood shall be furnished with motorized damper unless otherwise noted on the drawings.
- J. Manufacturers:
 - 1. Cook
 - 2. Greenheck
 - 3. PennBarry
 - 4. Twin City Fan & Blower

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General Installation Requirements:
 - 1. Install items in accordance with manufacturers' instructions.
 - 2. Check location of inlets and outlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.
 - 3. Install diffusers to ductwork with air tight connections.
 - 4. Flexible ducts shall NOT be joined to flat-oval connections. Provide sheet metal oval-to-round transitions where required.
 - 5. Supply grille and register blades shall be aimed in the field to provide adequate air distribution in the space. All return grilles and registers blades shall be oriented to minimize sight distance beyond installed device.
- B. Volume Damper:
 - 1. Provide manual volume dampers on duct take-off to diffusers when there are multiple connections to a common duct. Locate volume dampers as far as possible from the air inlet or outlet.
- C. Roof Hood and Louvered Penthouse:
 - 1. If manufacturer has no recommendations, secure roof hoods and louvered penthouses to curbs with 1/4" lag bolts on 8" maximum centers.
 - 2. Provide 20 gauge sheet metal duct blank-off behind louvers at unused portions of louver openings in exterior walls. Back with 2" rigid 3# density fiberglass board insulation with foil scrim facing the room. Seal watertight.

END OF SECTION

SECTION 235416.13 - GAS-FIRED FURNACES**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. Gas-fired, condensing furnaces and accessories complete with controls.
 - 2. Refrigeration components.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

PART 2 - PRODUCTS**2.1 GAS-FIRED FURNACES, CONDENSING**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Arcoaire Air Conditioning & Heating; an International Comfort Products brand; a unit of United Technologies Corp.
 - 2. Carrier Corporation; a unit of United Technologies Corp.
 - 3. Lennox Industries, Inc.; Lennox International.
 - 4. Trane.
 - 5. YORK; a Johnson Controls company.
 - 6. Daikin.
- B. Cabinet: Steel.
 - 1. Cabinet interior around heat exchanger shall be factory-installed insulation.
 - 2. Lift-out panels shall expose burners and all other items requiring access for maintenance.
 - 3. Factory paint external cabinets in manufacturer's standard color.

- C. Fan: Centrifugal, factory balanced, resilient mounted, direct drive.
- D. Type of Gas: Natural.
- E. Heat Exchanger:
 - 1. Primary: Stainless steel.
 - 2. Secondary: Stainless steel.
- F. Burner:
 - 1. Gas Valve: 100 percent safety modulating main gas valve, main shutoff valve, pressure regulator, safety pilot with electronic flame sensor, limit control, transformer, and combination ignition/fan timer control board.
 - 2. Ignition: Electric pilot ignition, with hot-surface igniter or electric spark ignition.
- G. Gas-Burner Safety Controls:
 - 1. Electronic Flame Sensor: Prevents gas valve from opening until pilot flame is proven; stops gas flow on ignition failure.
 - 2. Flame Rollout Switch: Installed on burner box; prevents burner operation.
 - 3. Limit Control: Fixed stop at maximum permissible setting; de-energizes burner on excessive bonnet temperature; automatic reset.
- H. Combustion-Air Inducer: Centrifugal fan with thermally protected motor and sleeve bearings prepurges heat exchanger and vents combustion products; pressure switch prevents furnace operation if combustion-air inlet or flue outlet is blocked.
- I. Furnace Controls: Solid-state board integrates ignition, heat, cooling, and fan speeds; adjustable fan-on and fan-off timing; terminals for connection to accessories; diagnostic light with viewport.

2.2 REFRIGERATION COMPONENTS

- A. Refrigerant Coil: Copper tubes mechanically expanded into aluminum fins. Comply with AHRI 210/240. Match size with furnace. Include condensate drain pan with accessible drain outlet complying with ASHRAE 62.1.
 - 1. Refrigerant Coil Enclosure: Steel, matching furnace and evaporator coil, with access panel and flanges for integral mounting at or on furnace cabinet and galvanized sheet metal drain pan coated with black asphaltic base paint.

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 factory-installed insulation before furnace installation. Reject units that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for gas and refrigerant piping systems to verify actual locations of piping connections before equipment installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install gas-fired furnaces and associated fuel and vent features and systems according to NFPA 54.
- B. Base-Mounted Units: Secure units to substrate. Provide optional bottom closure base if required by installation conditions.
- C. Controls: Install thermostats and humidistats at mounting height of 60 inches above floor.
- D. Wiring Method: Install control wiring in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal control wiring except in unfinished spaces.

3.3 PIPING CONNECTIONS

- A. Gas piping installation requirements are specified in Section 231123 "Facility Natural-Gas Piping." Drawings indicate general arrangement of piping, fittings, and specialties. Connect gas piping with union or flange and appliance connector valve.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.4 DUCTWORK CONNECTIONS

- A. Connect ducts to furnace with flexible connector. Comply with requirements in Section 233300 "Air Duct Accessories."

3.5 ELECTRICAL CONNECTIONS

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- D. 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 Section 260553 "Identification for Electrical Systems."

3.6 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."

3.7 STARTUP SERVICE

- A. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
 - 1. Inspect for physical damage to unit casings.
 - 2. Verify that access doors move freely and are weathertight.
 - 3. Clean units and inspect for construction debris.
 - 4. Verify that all bolts and screws are tight.
 - 5. Adjust vibration isolation and flexible connections.
 - 6. Verify that controls are connected and operational.
- B. Adjust fan belts to proper alignment and tension.
- C. Start unit according to manufacturer's written instructions and complete manufacturer's operational checklist.
- D. Measure and record airflows.
- E. Verify proper operation of capacity control device.

3.8 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Set controls, burner, and other adjustments for optimum heating performance and efficiency. Adjust heat-distribution features, including shutters, dampers, and relays, to provide optimum heating performance and system efficiency.

3.9 CLEANING

- A. After completing installation, clean furnaces internally according to manufacturer's written instructions.
- B. Install new filters in each furnace within 14 days after Substantial Completion.

END OF SECTION 235416.13

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SECTION 235533.16 - GAS-FIRED UNIT 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 gas-fired unit heaters.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of gas-fired unit heater.
 - 1. Include rated capacities, operating characteristics, and accessories.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- B.

- 1. Lennox International, Inc; Lennox International.
 - 2. Modine Manufacturing Company.
 - 3. Reznor/Thomas & Betts Corporation.
 - 4. Sterling HVAC Products; Div. of Mestek Technology Inc.
 - 5. Trane; a brand of Ingersoll Rand.

2.2 MANUFACTURED UNITS

- A. Description: Factory assembled, piped, and wired, and complying with ANSI Z83.8/CSA 2.6.
- B. Gas Type: Design burner for natural gas having characteristics same as those of gas available at Project site.
- C. Type of Venting: Gravity vented. AL29-4C material.

- D. Housing: Steel, with integral draft hood and inserts for suspension mounting rods.
 - 1. External Casings and Cabinets: Baked enamel over corrosion-resistant-treated surface.
 - 2. Discharge Louvers: Independently adjustable, horizontal blades.
 - 3. Discharge Nozzle: Discharge at 25 to 65 degrees from horizontal.
- E. Accessories:
 - 1. Four-point suspension kit.
- F. Heat Exchanger: Aluminized steel.
- G. Burner Material: Aluminized steel with stainless-steel inserts.
- H. Propeller Unit Fan:
 - 1. Formed-steel propeller blades riveted to heavy-gage steel spider bolted to cast-iron hub, dynamically balanced, and resiliently mounted.
 - 2. Fan-Blade Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
- I. Controls: Regulated redundant gas valve containing pilot solenoid valve, electric gas valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.
 - 1. Gas Control Valve: Single stage.
 - 2. Ignition: Electronically controlled electric spark with flame sensor.
 - 3. Fan Thermal Switch: Operates fan on heat-exchanger temperature.
 - 4. Vent Flow Verification: Flame rollout switch.
 - 5. Control transformer.
 - 6. High Limit: Thermal switch or fuse to stop burner.
 - 7. Unit-Mounted Thermostat:
 - a. Single stage.
 - b. Fan on-off-automatic switch.
 - c. 24-V ac.
 - d. 50 to 90 deg F operating range.
- J. Electrical Connection: Factory wire motors and controls for a single electrical connection.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and connect gas-fired unit heaters and associated gas and vent features and systems according to NFPA 54, applicable local codes and regulations, and manufacturer's written instructions.

3.2 EQUIPMENT MOUNTING

- A. Suspended Units: Suspend from substrate using threaded rods, spring hangers, and building attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is level and plumb.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to gas-fired unit heater, allow space for service and maintenance.
- C. Gas Piping: Comply with Section 231123 "Facility Natural-Gas Piping." Connect gas piping to gas train inlet; provide union with enough clearance for burner removal and service.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Adjust burner and other unit components for optimum heating performance and efficiency.

END OF SECTION 235533.16

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SECTION 237223.19 - INDOOR FIXED PLATE ENERGY RECOVERY 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:

- 1. Fixed-plate, total heat exchangers in packaged, indoor, energy-recovery units.

1.3 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- B. ASHRAE Compliance:
 - 1. Applicable requirements in ASHRAE 62.1.
 - 2. Capacity ratings for fixed-plate energy-recovery units shall comply with ASHRAE 84.
- C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.
- D. UL Compliance:
 - 1. Packaged heat-recovery ventilators shall comply with requirements in UL 1812 or UL 1815.
- E. Comply with ASTM E84.

2.2 PACKAGED, INDOOR, FIXED-PLATE TOTAL ENERGY RECOVERY UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carnes Company.
 - 2. Greenheck Fan Corporation.
 - 3. Multistack, LLC.
 - 4. RenewAire LLC.
 - 5. Systemair USA.
 - 6. Source Limitations: Obtain from single source from single manufacturer.
- B. Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Housing: Manufacturer's standard construction with corrosion-protection coating and exterior finish, hinged access doors with neoprene gaskets for inspection and access to internal parts, minimum 1- inch- thick thermal insulation, knockouts for electrical connections, exterior drain connection, and lifting lugs.
- D. Fixed-Plate Total Heat Exchanger:
 - 1. Casing: Galvanized steel.
 - 2. Plates: Evenly spaced and sealed and arranged for counter- flow.
 - a. Plate Material: Chemically treated paper or polymer membrane with selective hydroscopicity and moisture permeability, and gas barrier properties.
 - 3. Bypass Plenum: Within casing, with gasketed face-and-bypass dampers having operating rods extended outside casing.
- E. Supply and Exhaust Fans: Forward-curved centrifugal fan with spring isolators of 1- inch static deflection.
 - 1. Motor and Drive: Direct driven.
 - 2. 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.
- F. Filters:
 - 1. Description: Pleated factory-fabricated, self-supported, disposable air filters with holding frames.
 - 2. UL Compliance: Comply with UL 900.
 - 3. Media: Interlaced glass fibers sprayed with nonflammable adhesive[and antimicrobial agent].
 - 4. Filter Media Frame: Beverage board with perforated metal retainer, or metal grid, on outlet side.

- 5. Filter Mounting Frames: Arranged with access doors or panels on both sides of unit. Filters shall be removable from one side or lift out from access plenum.
- G. Wiring: Fabricate units with space within housing for electrical conduits. Wire motors and controls, so only external connections are required during installation.
 - 1. Indoor Enclosure: NEMA 250, Type 12 enclosure contains relays, starters, and terminal strip.
 - 2. Include nonfused disconnect switches.

2.3 SOURCE QUALITY CONTROL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- B. AHRI Compliance: Capacity ratings for air-to-air energy-recovery equipment certified as complying with AHRI 1060.
- C. Fan Performance Rating: Comply with AMCA 211 and label fans with AMCA-certified rating seal. Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency according to AMCA 210/ASHRAE 51.
- D. Fan Sound Ratings: Comply with AMCA 301 or AHRI 260 (IP). Air-handling unit fan sound ratings shall comply with AMCA 301 or AHRI 260 (IP).
- E. UL Compliance:
 - 1. Packaged fixed plate energy recovery units shall comply with requirements in UL 1812; or UL 1815.
 - 2. Electric Coils: Comply with UL 1995.

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 casing insulation materials and filter media before packaged, indoor, fixed-plate, energy-recovery unit installation. Replace with new insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install packaged, indoor, fixed-plate, energy-recovery units, so supply and exhaust airstreams flow in opposite directions.
 - 1. Install access doors in both supply and exhaust ducts, both upstream and downstream, for access to interior components.
 - 2. Install removable panels or access doors between supply and exhaust ducts on building side for bypass during startup.
 - 3. Access doors and panels are specified in Section 233300 "Air Duct Accessories."
- B. Suspended Units: Suspend units from structural-steel support frame, using threaded steel rods and spring hangers. Comply with requirements for vibration-isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- C. Install units with clearances for service and maintenance.
- D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.

3.3 ELECTRICAL CONNECTIONS

- A. Install electrical devices furnished with units but not factory mounted.
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- E. 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 Section 260553 "Identification for Electrical Systems."

3.4 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."

3.5 **STARTUP SERVICE**

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.6 **ADJUSTING**

A. Adjust moving parts to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature and humidity setpoints.

C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 237223.19

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SECTION 238129 - VARIABLE-REFRIGERANT-FLOW HVAC SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: VRF HVAC systems.
 - 1. Indoor, concealed, floor-mounted units for ducting.
 - 2. Outdoor, air-source heat-pump units.
 - 3. System controls.
 - 4. System refrigerant and oil.
 - 5. System condensate drain piping.
 - 6. System refrigerant piping.
 - 7. Metal hangers and supports.
 - 8. Pipe stands.
 - 9. Outdoor equipment stands.
 - 10. Piping and tubing insulation.

1.2 DEFINITIONS

- A. Air-Conditioning System Operation: System capable of operation with all zones in cooling only.
- B. Heat-Pump System Operation: System capable of operation with all zones in either heating or cooling, but not with simultaneous heating and cooling zones that transfer heat between zones.
- C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- D. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.
- E. Three-Pipe System Design: One high pressure refrigerant vapor line, one low pressure refrigerant vapor line, and one refrigerant liquid line connect a single outdoor unit or multiple manifold outdoor units in a single system to associated system HRCUs. One liquid line and refrigerant vapor line connect HRCUs to associated indoor units.
- F. Two-Pipe System Design: One refrigerant vapor line and one refrigerant liquid line connect a single outdoor unit or multiple manifold outdoor units in a single system to associated system HRCUs. One refrigerant liquid line and refrigerant vapor line connect HRCUs to associated indoor units. HRCUs used in two pipe systems act as an intermediate heat exchanger and include diverting valves and gas/liquid separators to move high and low pressure refrigerant between indoor units.

- G. VRF: Variable refrigerant flow.

1.3 ACTION SUBMITTALS

- A. Product Data: For VRF HVAC system components.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for indoor and outdoor units.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 3. Include operating performance at design conditions and at extreme maximum and minimum outdoor ambient conditions.
 - 4. Include description of system controllers, dimensions, features, control interfaces and connections, power requirements, and connections.
 - 5. Include system operating sequence of operation in narrative form for each unique indoor- and outdoor-unit control.
 - 6. Include description of control software features.
 - 7. Include total refrigerant required and a comprehensive breakdown of refrigerant required by each system installed.
 - 8. Include refrigerant type and data sheets showing compliance with requirements indicated.
 - 9. Indicate location and type of service access.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
 - 1. For Installer: Certificate from VRF HVAC system manufacturer certifying that Installer has successfully completed prerequisite training administered by manufacturer for proper installation of systems, including but not limited to, equipment, piping, controls, and accessories indicated and furnished for installation.
 - a. Retain copies of Installer certificates on-site and make available on request.
 - 2. For VRF HVAC system manufacturer.
 - 3. For VRF HVAC system provider.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in a clean and dry place.
- B. Comply with manufacturer's written rigging and installation instructions for unloading and moving to final installed location.
- C. Handle products carefully to prevent damage, breaking, denting, and scoring. Do not install damaged products.

- D. Protect products from weather, dirt, dust, water, construction debris, and physical damage.
 - 1. Retain factory-applied coverings on equipment to protect finishes during construction and remove just prior to operating unit.
 - 2. Cover unit openings before installation to prevent dirt and dust from entering inside of units. If required to remove coverings during unit installation, reapply coverings over openings after unit installation and remove just prior to operating unit.
- E. Replace installed products damaged during construction.

PART 2 - PRODUCTS

2.1 VRF HVAC SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Daikin Applied.
 - 2. LG Electronics USA, Inc.; LG Electronics Inc.
 - 3. Mitsubishi Electric & Electronics USA, Inc.
 - 4. Trane Inc.
- B. Source Limitations: Obtain products from single source from single manufacturer including, but not limited to, the following:
 - 1. Indoor and outdoor units, including accessories.
 - 2. Controls and software.
 - 3. HRCUs.
 - 4. Refrigerant isolation valves.
 - 5. Specialty refrigerant pipe fittings.

2.2 SYSTEM DESCRIPTION

- A. Direct-expansion (DX) VRF HVAC system(s) with variable capacity in response to varying cooling and heating loads. System shall consist of multiple indoor units, HRCUs, outdoor unit(s), piping, controls, and electrical power to make complete operating system(s) complying with requirements indicated.
 - 1. Two-pipe or three-pipe system design.
 - 2. System(s) operation, heat pump as indicated on Drawings.
 - 3. Each system with one refrigerant circuit shared by all indoor units connected to system.
- 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.

- C. AHRI Compliance: System and equipment performance certified according to AHRI 1230 and products listed in AHRI directory.
- D. ASHRAE Compliance:
 - 1. ASHRAE 15: For safety code for mechanical refrigeration.
 - 2. ASHRAE 62.1: For indoor air quality.
 - 3. ASHRAE 135: For control network protocol with remote communication.
 - 4. ASHRAE/IES 90.1 Compliance: For system and component energy efficiency.
- E. UL Compliance: Comply with UL 1995.

2.3 PERFORMANCE REQUIREMENTS

- A. Service Access:
 - 1. Provide and document service access requirements.
 - 2. Locate equipment, system isolation valves, and other system components that require service and inspection in easily accessible locations. Avoid locations that are difficult to access if possible.
 - 3. Where serviceable components are installed behind walls and above inaccessible ceilings, provide finished assembly with access doors or panels to gain access. Properly size the openings to allow for service, removal, and replacement.
 - 4. If less than full and unrestricted access is provided, locate components within an 18-inch reach of the finished assembly.
 - 5. Where ladder access is required to service elevated components, provide an installation that provides for sufficient access within ladder manufacturer's written instructions for use.
 - 6. Comply with OSHA regulations.
- B. System Design and Installation Requirements:
 - 1. Design and install systems indicated according to manufacturer's recommendations and written instructions.
 - 2. Where manufacturer's requirements differ from requirements indicated, contact Architect for direction. The most stringent requirements should apply unless otherwise directed in writing by Architect.
- C. Isolation of Equipment: Provide isolation valves to isolate each indoor unit and outdoor unit for service, removal, and replacement without interrupting system operation.
- D. System Capacity Ratio: The sum of connected capacity of all indoor units shall be within the following range of outdoor-unit rated capacity:
 - 1. As scheduled on drawings.
- E. System Turndown: Stable operation down to 20 percent of outdoor-unit capacity.

F. System Auto Refrigerant Charge: Each system shall have an automatic refrigerant charge function to ensure the proper amount of refrigerant is installed in system.

G. Outdoor Conditions:

1. Suitable for outdoor ambient conditions encountered.
2. Maximum System Operating Outdoor Temperature: See Drawings.
3. Minimum System Operating Outdoor Temperature: See Drawings.

H. Thermal Movements: Allow for controlled thermal movements from ambient, surface, and system temperature changes.

I. Capacities and Characteristics: As indicated on Drawings.

2.4 INDOOR, CONCEALED, FLOOR-MOUNTED UNITS FOR DUCTING

A. Description: Factory-assembled complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.

B. Cabinet:

1. Material: Galvanized or painted steel.
2. Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
3. Duct Connections: Extended collar or flange, or designated exterior cabinet surface, designed for attaching field-installed ductwork.
4. Mounting: Manufacturer-designed provisions for field installation.
5. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. DX Coil Assembly:

1. Coil Casing: Aluminum, galvanized, or stainless steel.
2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
3. Coil Tubes: Copper, of diameter and thickness required by performance.
4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
5. Unit Internal Tubing: Copper tubing with brazed joints.
6. Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
7. Field Piping Connections: Manufacturer's standard.
8. Factory Charge: Dehydrated air or nitrogen.
9. Testing: Factory pressure tested and verified to be without leaks.

D. Drain Assembly:

1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
2. Condensate Removal: Unit-mounted pump or other integral lifting mechanism, capable of lifting drain water to an elevation above top of cabinet.
3. Field Piping Connection: Non-ferrous material with threaded NPT.

E. Fan and Motor Assembly:

1. Fan(s):
 - a. Direct-drive arrangement.
 - b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
 - c. Materials: Non-ferrous components or ferrous components with corrosion resistant finish.
 - d. Statically and dynamically balanced.
2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
4. 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.
5. Vibration Control: Integral isolation to dampen vibration transmission.

F. Filter Assembly:

1. Access: Bottom, side, or rear to accommodate field installation without removing ductwork and to accommodate filter replacement without need for tools.
2. Efficiency: ASHRAE 52.2, MERV 7.
3. Media:
 - a. Replaceable: Extended surface, panel, or cartridge with antimicrobial treatment fiber media.

G. Unit Accessories:

1. Remote Room Temperature Sensor Kit: Wall-mounted, hardwired room temperature sensor kit for use in rooms that do not have room temperature measurement.

H. Unit Controls:

1. Enclosure: Metal, suitable for indoor locations.
2. Factory-Installed Controller: Configurable digital control.
3. Factory-Installed Sensors:
 - a. Unit inlet air temperature.
 - b. Coil entering refrigerant temperature.
 - c. Coil leaving refrigerant temperature.
4. Features and Functions:

- a. Self-diagnostics.
 - b. Time delay, auto-restart.
 - c. External static pressure control.
 - d. Auto operation mode.
 - e. Manual operation mode.
 - f. Filter service notification.
 - g. Power consumption display.
 - h. Drain assembly high water level safety shutdown and notification.
 - i. Run test switch.
5. Communication: Network communication with other indoor units and outdoor unit(s).
6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

2.5 OUTDOOR, AIR-SOURCE HEAT-PUMP UNITS

- A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.
 1. Specially designed for use in systems with either all heating or all cooling demands, but not for use in systems with simultaneous heating and cooling.
 2. Systems shall consist of one unit, or multiple unit modules that are designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit that connects multiple indoor units.
 3. All units installed shall be from the same product development generation.
- B. Cabinet:
 1. Galvanized steel and coated with a corrosion-resistant finish.
 - a. Coating with documented salt spray test performance of 1000 hours according ASTM B117 surface scratch test (SST) procedure.
 2. Mounting: Manufacturer-designed provisions for field installation.
 3. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.
- C. Compressor and Motor Assembly:
 1. One or more positive-displacement, direct-drive and hermetically sealed scroll compressor(s) with inverter drive and turndown to 15 percent of rated capacity.
 2. Protection: Integral protection against the following:
 - a. High refrigerant pressure.
 - b. Low oil level.

- c. High oil temperature.
 - d. Thermal and overload.
 - e. Voltage fluctuations.
 - f. Phase failure and phase reversal.
 - g. Short cycling.
 - 3. Speed Control: Variable to automatically maintain refrigerant suction and condensing pressures while varying refrigerant flow to satisfy system cooling and heating loads.
 - 4. Vibration Control: Integral isolation to dampen vibration transmission.
 - 5. Oil management system to ensure safe and proper lubrication over entire operating range.
 - 6. Crankcase heaters with integral control to maintain safe operating temperature.
 - 7. Fusible plug.
- D. Condenser Coil Assembly:
- 1. Plate Fin Coils:
 - a. Casing: Aluminum, galvanized, or stainless steel.
 - b. Fins: Aluminum or copper, mechanically bonded to tubes, with arrangement required by performance.
 - c. Tubes: Copper, of diameter and thickness required by performance.
 - 2. Aluminum Microchannel Coils:
 - a. Series of flat tubes containing a series of multiple, parallel-flow microchannels layered between refrigerant header manifolds.
 - b. Single- or multiple-pass arrangement.
 - c. Construct fins, tubes, and header manifolds of aluminum alloy.
 - 3. Coating: Corrosion resistant.
 - 4. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.
- E. Condenser Fan and Motor Assembly:
- 1. Fan(s): Propeller type.
 - a. Direct-drive arrangement.
 - b. Fabricated from non-ferrous components or ferrous components with corrosion protection finish to match performance indicated for condenser coil.
 - c. Statically and dynamically balanced.
 - 2. Fan Guards: Removable safety guards complying with OSHA regulations. If using metal materials, coat with corrosion-resistant coating to match performance indicated for condenser coil.
 - 3. Motor(s): Brushless dc or electronically commutated with permanently lubricated bearings and rated for outdoor duty.
 - 4. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.

5. Speed Settings and Control: Variable speed with a speed range of least 75 percent.
 6. Vibration Control: Integral isolation to dampen vibration transmission.
- F. Drain Pan: If required by manufacturer's design, provide unit with non-ferrous drain pan with bottom sloped to a low point drain connection.
- G. Unit Controls:
1. Enclosure: Manufacturer's standard, and suitable for unprotected outdoor locations.
 2. Factory-Installed Controller: Configurable digital control.
 3. Factory-Installed Sensors:
 - a. Refrigerant suction temperature.
 - b. Refrigerant discharge temperature.
 - c. Outdoor air temperature.
 - d. Refrigerant high pressure.
 - e. Refrigerant low pressure.
 - f. Oil level.
 4. Features and Functions: Self-diagnostics, time delay, auto-restart, fuse protection, auto operation mode.
 5. Communication: Network communication with indoor units and other outdoor unit(s).
 6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
 7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
- H. Unit Electrical:
1. Enclosure: Metal, similar to enclosure, and suitable for unprotected outdoor locations.
 2. Field Connection: Single point connection to power entire unit and integral controls.
 3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
 4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
 5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
 6. Raceways: Enclose line voltage wiring in metal raceways to comply with NFPA 70.
- I. Unit Hardware: Zinc-plated steel, or stainless steel. Coat exposed surfaces with additional corrosion-resistant coating if required to prevent corrosion when exposed to salt spray test for 1000 hours according ASTM B117.
- J. Unit Piping:
1. Unit Tubing: Copper tubing with brazed joints.
 2. Unit Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.

3. Field Piping Connections: Manufacturer's standard.
4. Factory Charge: Dehydrated air or nitrogen.
5. Testing: Factory pressure tested and verified to be without leaks.

2.6 SYSTEM CONTROLS

A. General Requirements:

1. Network: Indoor units, HRCUs, and outdoor units shall include integral controls and connect through a manufacturer-selected control network.
2. Network Communication Protocol: Manufacturer proprietary control communication between interconnected units.
3. Operator Interface:
 - a. Operators shall interface with system and unit controls through the following:
 - 1) Operator interfaces integral to controllers.
 - b. Users shall be capable of interface with controllers for indoor units control to extent privileges are enabled. Control features available to users shall include the following:
 - 1) On/off control.
 - 2) Temperature set-point adjustment.

B. Central Controllers:

1. Centralized control for all indoor and outdoor units from a single central controller location.
2. Controls operation mode of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units. Operation modes available through central controller shall match those operation modes of controllers for indoor units.
3. Schedule operation of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
 - a. Sets schedule for daily, weekly, and annual events.
 - b. Schedule options available through central controller shall at least include the schedule options of controllers for indoor units.
4. Changes operating set points of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
5. Optimized start feature to start indoor units before scheduled time to reach temperature set-point at scheduled time based on operating history.
6. Night setback feature to operate indoor units at energy-conserving heating and cooling temperature set-points during unoccupied periods.
7. Service diagnostics tool.
8. Able to disable and enable operation of individual controllers for indoor units.

9. Information displayed on individual controllers shall also be available for display through central controller.
10. Information displayed for outdoor units, including refrigerant high and low pressures percent capacity.
11. Multiple RJ-45 ports for direct connection to a local PC and an Ethernet network switch.
12. Operator interface through a backlit, high-resolution color display touch panel.

C. Wired Controllers for Indoor Units:

1. Single controller capable of controlling multiple indoor units as group.
2. Auto Timeout Touch Screen LCD: Timeout duration shall be adjustable.
3. On/Off: Turns indoor unit on or off.
4. Hold: Hold operation settings until hold is released.
5. Operation Mode: Cool, Heat, Auto, Dehumidification, Fan Only, and Setback.
6. Temperature Display: 1-degree increments.
7. Temperature Set-Point: Separate set points for Cooling, Heating, and Setback. Adjustable in 1-degree increments between .
8. Relative Humidity Display: 1 percent increments.
9. Fan Speed Setting: Select between available options furnished with the unit.
10. Airflow Direction Setting: If applicable to unit, select between available options furnished with the unit.
11. Auto Off Timer: Operates unit for an adjustable time duration and then turns unit off.
12. Occupancy detection.
13. Service Run Tests: Limit use by service personnel to troubleshoot operation.
14. Error Code Notification Display: Used by service personnel to troubleshoot abnormal operation and equipment failure.
15. User and Service Passwords: Capable of preventing adjustments by unauthorized users.
16. Setting stored in nonvolatile memory to ensure that settings are not lost if power is lost. Battery backup for date and time only.
17. Low-voltage power required for controller shall be powered through non-polar connections to indoor unit.

2.7 SYSTEM REFRIGERANT AND OIL

A. Refrigerant:

1. As required by VRF HVAC system manufacturer for system to comply with performance requirements indicated.
2. R-410a.

B. Oil:

1. As required by VRF HVAC system manufacturer and to comply with performance requirements indicated.

2.8 SYSTEM CONDENSATE DRAIN PIPING

- A. If more than one material is listed, material selection is Contractor's option.
- B. Copper Tubing:
 - 1. Drawn-Temper Tubing: According to ASTM B88, Type L or Type DWV according to ASTM B306.
 - 2. Wrought-Copper Fittings: ASME B16.22.
 - 3. Wrought-Copper Unions: ASME B16.22.
 - 4. Solder Filler Metals: ASTM B32, lead-free alloys, and water-flushable flux according to ASTM B813.

2.9 SYSTEM REFRIGERANT PIPING

- A. Refrigerant Piping:
 - 1. Copper Tube: ASTM B280, Type ACR.
 - 2. Wrought-Copper Fittings: ASME B16.22.
 - 3. Brazing Filler Metals: AWS A5.8/A5.8M.
- B. Divided-Flow Specialty Fittings: Where required by VRF HVAC system manufacturer for proper system operation, VRF HVAC system manufacturer shall furnish specialty fittings with identification and instructions for proper installation by Installer.
- C. Refrigerant Isolation Ball Valves:
 - 1. Description: Uni-body full port design, rated for maximum system temperature and pressure, and factory tested under pressure to ensure tight shutoff. Designed for valve operation without removing seal cap.
 - 2. Seals: Compatible with system refrigerant and oil. Seal service life of at least 20 years.
 - 3. Valve Connections: Flare or sweat depending on size.

2.10 METAL HANGERS AND SUPPORTS

- A. Copper Tube Hangers:
 - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
 - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized or copper-coated steel.

2.11 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIRO Industries.
 - b. PHP Systems/Design.
 - c. RectorSeal HVAC; a CSW Industrials Company.
 - d. Rooftop Support Systems; Eberl Iron Works, Inc.
 - 2. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
 - 3. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
 - 4. Hardware: Galvanized steel or polycarbonate.
 - 5. Accessories: Protection pads.

2.12 OUTDOOR EQUIPMENT STANDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. MIRO Industries.
 - 2. RectorSeal HVAC; a CSW Industrials Company.
 - 3. Rooftop Support Systems; Eberl Iron Works, Inc.
- B. Description: Individual foot supports with elevated adjustable channel cross bars and clamps/fasteners/bolts for ground or roof-supported outdoor equipment components, without roof membrane penetration, in a prefabricated system that can be modularly assembled on-site.
- C. Foot Material: Rubber or polypropylene.
- D. Rails Material: Hot-dip galvanized carbon steel.

2.13 PIPING AND TUBING INSULATION

- A. Condensate Drain Piping and Tubing Insulation and Jacket Requirements:
 - 1. Flexible Elastomeric Insulation:

- a. Closed-cell, sponge- or expanded-rubber materials, complying with ASTM C534, Type I for tubular materials.
 - b. Indoors: 1/2 inch thick.
- B. Refrigerant Tubing Insulation and Jacket Requirements:
 - 1. Flexible Elastomeric Insulation:
 - a. Closed-cell, sponge- or expanded-rubber materials, complying with ASTM C534, Type I for tubular materials.
 - b. Indoors: 1 inch thick.
 - c. Outdoors: 1 inch thick.
 - 2. Field-Applied Jacket:
 - a. Concealed: None required.
 - b. Outdoors or Indoors, Exposed to View: Aluminum, smooth, 0.020 inch thick.
- C. Flexible Elastomeric Insulation Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- D. 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 deg F.
 - 4. Color: Aluminum.

2.14 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect factory-assembled equipment.
- B. Equipment will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports for historical record. Submit reports only if requested.

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 products before installation. Reject products that are wet, moisture damaged, or mold damaged.

- C. Examine roughing-in for piping and tubing to verify actual locations of connections before equipment installation.
- D. Examine roughing-in for ductwork to verify actual locations of connections before equipment installation.
- E. Examine roughing-in for wiring and conduit to verify actual locations of connections before equipment installation.
- F. Examine walls, floors, roofs, and outdoor pads for suitable conditions where equipment will be installed.
- G. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- H. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION, GENERAL

- A. Clearance:
 - 1. Maintain manufacturer's recommended clearances for service and maintenance.
 - 2. Maintain clearances required by governing code.
- B. Loose Components: Install components, devices, and accessories furnished by manufacturer, with equipment, that are not factory mounted.
 - 1. Loose components shall be installed by system Installer under supervision of manufacturer's service representative.

3.3 INSTALLATION OF INDOOR UNITS

- A. Install units to be level and plumb while providing a neat and finished appearance.
- B. Unless otherwise required by VRF HVAC system manufacturer, support ceiling-mounted units from structure above using threaded rods; minimum rod size of 3/8 inch.
- C. Adjust supports of exposed and recessed units to draw units tight to adjoining surfaces.
- D. Protect finished surfaces of ceilings, floors, and walls that come in direct contact with units. Refinish or replaced damaged areas after units are installed.
- E. In rooms with ceilings, conceal piping and tubing, controls, and electrical power serving units above ceilings.

- F. In rooms without ceiling, arrange piping and tubing, controls, and electrical power serving units to provide a neat and finished appearance.
- G. For floor- and wall-mounted units that are exposed, conceal piping and tubing, controls, and electrical power serving units within walls.
- H. Install floor-mounted units on support structure indicated on Drawings.
- I. Attachment: Install hardware for proper attachment to supported equipment.
- J. Grouting: Place grout under equipment supports and make bearing surface smooth.

3.4 INSTALLATION OF OUTDOOR UNITS

- A. Install units to be level and plumb while providing a neat and finished appearance.
- B. Pad-Mounted Installations: Install outdoor units on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 - 1. Attachment: Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 2. Grouting: Place grout under equipment supports and make bearing surface smooth.

3.5 GENERAL REQUIREMENTS FOR PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping and tubing systems. Install piping and tubing as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping and tubing in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping and tubing at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping and tubing above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping and tubing to permit valve servicing.
- F. Install piping and tubing at indicated slopes.
- G. Install piping and tubing free of sags.
- H. Install fittings for changes in direction and branch connections.

- I. Install piping and tubing to allow application of insulation.
- J. Install groups of pipes and tubing parallel to each other, spaced to permit applying insulation with service access between insulated piping and tubing.
- K. Install sleeves for piping and tubing penetrations of walls, ceilings, and floors.
- L. Install escutcheons for piping and tubing penetrations of walls, ceilings, and floors.

3.6 INSTALLATION OF SYSTEM CONDENSATE DRAIN PIPING

A. General Requirements for Drain Piping and Tubing:

- 1. Install a union in piping at each threaded unit connection.
- 2. Install an adjustable stainless steel hose clamp with adjustable gear operator on unit hose connections. Tighten clamp to provide a leak-free installation.
- 3. If required for unit installation, provide a trap assembly in drain piping to prevent air circulated through unit from passing through drain piping. Comply with more stringent of the following:
 - a. Details indicated on Drawings.
 - b. Manufacturer's requirements.
 - c. Governing codes.
 - d. In the absence of requirements, comply with requirements of ASHRAE handbooks.
- 4. Extend drain piping from units with drain connections to drain receptors as indicated on Drawings. If not indicated on Drawings, terminate drain connection at nearest accessible location that is not exposed to view by occupants.
- 5. Provide each 90-degree change in direction with a Y- or T-fitting. Install a threaded plug connection in the dormant side of fitting or future use as a service cleanout.

B. Gravity Drains:

- 1. Slope piping from unit connection toward drain termination at a constant slope of not less than one percent.

C. Pumped Drains:

- 1. If unit condensate pump or lift mechanism is not included with an integral check valve, install a full-size check valve in each branch pipe near unit connection to prevent backflow into unit.

3.7 INSTALLATION OF REFRIGERANT PIPING

A. Refrigerant Tubing Kits:

1. Unroll and straighten tubing to suit installation. Deviations in straightness of exposed tubing shall be unnoticeable to observer.
 2. Support tubing using hangers and supports indicated at intervals not to exceed 5 feet. Minimum rod size, 1/4 inch.
 3. Prepare tubing ends and make mating connections to provide a pressure tight and leak-free installation.
- B. Install refrigerant piping according to ASHRAE 15 and governing codes.
- C. Select system components with pressure rating equal to or greater than system operating pressure.
- D. Install piping as short and direct as possible, with a minimum number of joints and fittings.
- E. Arrange piping to allow inspection and service of equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- F. Install refrigerant piping and tubing in protective conduit where installed belowground.
- G. Install refrigerant piping and tubing in rigid or flexible conduit in locations where exposed to mechanical damage.
- H. Unless otherwise required by VRF HVAC system manufacturer, slope refrigerant piping and tubing as follows:
1. Install horizontal hot-gas discharge piping and tubing with a uniform slope downward away from compressor.
 2. Install horizontal suction lines with a uniform slope downward to compressor.
 3. Install traps to entrain oil in vertical runs.
 4. Liquid lines may be installed level.
- I. When brazing, remove or protect components that could be damaged by heat.
- J. Before installation, clean piping, tubing, and fittings to cleanliness level required by VRF HVAC system manufacturer.
- K. Joint Construction:
1. Ream ends of tubes and remove burrs.
 2. Remove scale, slag, dirt, and debris from inside and outside of tube and fittings before assembly.
 3. Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
 - a. Use Type BCuP (copper-phosphorus) alloy for joining copper fittings with copper tubing.
 - b. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze.

3.8 INSTALLATION OF METAL HANGERS AND SUPPORTS

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- C. Comply with MFMA-103 for metal framing system selections and applications that are not specified.
- D. Fastener System Installation:
 - 1. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- E. Pipe Stand Installation:
 - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Install hangers and supports to allow controlled thermal and seismic movement 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.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. Install building attachments within concrete slabs or attach to structural steel.
 - 1. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- L. Piping and Tubing Insulation:
 - 1. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - 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.
- M. Horizontal-Piping Hangers and Supports: Install the following types:
- 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 3. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 - 4. Multiple horizontal pipes located indoors may use metal framing systems with split clamp attachment for each pipe in lieu of individual clevis hangers.
 - 5. Pipe stands for horizontal pipes located outdoors.
 - 6. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
 - 7. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- N. Horizontal Piping Hanger Spacing and Rod Size: Install hangers for drawn-temper copper piping with the following maximum horizontal spacing and minimum rod sizes:
- 1. Sizes through NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 - 2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 - 3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
 - 4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- O. Vertical-Piping Clamps: Install the following types:
- 1. Extension Pipe or Riser Clamps (MSS Type 8).
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): If longer ends are required for riser clamps.
- P. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified.
- Q. Use hangers, supports, and attachments with galvanized coatings unless otherwise indicated.
- R. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- S. Trim excess length of continuous-thread hanger and support rods to 1 inch.
- T. Hanger-Rod Attachments: 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. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

U. Building Attachments: 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-joint 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.
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 headroom is limited.

3.9 INSTALLATION OF PIPING AND TUBING INSULATION

- 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. Installation to maintain a continuous vapor barrier.
- B. 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.

- C. 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 unavailable, 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. 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.
- D. 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 INSTALLATION OF DUCT, ACCESSORIES, AND AIR OUTLETS

- A. Where installing ductwork adjacent to equipment, allow space for service and maintenance.
- B. Comply with requirements for metal ducts specified in Section 233113 "Metal Ducts."
- C. Comply with requirements for nonmetal ducts specified in Section 233116 "Nonmetal Ducts."
- D. Comply with requirements for air duct accessories specified in Section 233300 "Air Duct Accessories."
- E. Comply with requirements for flexible ducts specified in Section 233346 "Flexible Ducts."

3.11 ELECTRICAL CONNECTIONS

- A. Comply with requirements indicated on Drawings and in applicable Division 26 Sections.
- B. Connect field electrical power source to each separate electrical device requiring field electrical power. Coordinate termination point and connection type with Installer.
- C. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.
- D. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding connections.
- E. Install nameplate or acrylic label with self-adhesive back for each electrical connection indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate shall be laminated phenolic layers of black with engraved white letters. Letters at least 1/2 inch high.
2. Locate nameplate or label where easily visible.

- F. Comply with requirements in Section 260533.13 "Conduits for Electrical Systems" for raceway selection and installation requirements for conduits as supplemented or revised in this Section.
- G. Install manufactured conduit sweeps and long-radius elbows if possible.
- H. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

3.12 GROUNDING INSTALLATION

- A. For low-voltage control cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.13 IDENTIFICATION

- A. Identify system equipment, piping, tubing, and valves. Comply with requirements for identification specified in Section 230553 "Identification for HVAC Piping and Equipment."
- B. Identify system electrical and controls components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
1. Identify each control cable on each end and at each terminal with a number-coded identification tag. Each cable shall have a unique tag.

3.14 FIELD QUALITY CONTROL

- 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. 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. 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.
- c. 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.
- d. Inspection reports for indoor units shall include, but not be limited to, the following:
 - 1) Unit designation on Drawings.
 - 2) Manufacturer model number.
 - 3) Serial number.
 - 4) Network address, if applicable.
 - 5) Each equipment setting.
 - 6) Mounting, supports, and restraints properly installed.
 - 7) Proper service clearance provided.
 - 8) Wiring and power connections correct.
 - 9) Line-voltage reading(s) within acceptable range.
 - 10) Wiring and controls connections correct.
 - 11) Low-voltage reading(s) within an acceptable range.
 - 12) Controller type and model controlling unit.
 - 13) Controller location.
 - 14) Temperature settings and readings within an acceptable range.
 - 15) Humidity settings and readings within an acceptable range.
 - 16) Condensate removal acceptable.
 - 17) Fan settings and readings within an acceptable range.
 - 18) Unit airflow direction within an acceptable range.
 - 19) If applicable, fan external static pressure setting.
 - 20) Filter type and condition acceptable.
 - 21) Noise level within an acceptable range.
 - 22) Refrigerant piping properly connected and insulated.
 - 23) Condensate drain piping properly connected and insulated.
 - 24) If applicable, ductwork properly connected.
 - 25) If applicable, external interlocks properly connected.
 - 26) Remarks.
- e. Inspection reports for outdoor units shall include, but not be limited to, the following:
 - 1) Unit designation on Drawings.
 - 2) Manufacturer model number.
 - 3) Serial number.
 - 4) Network address, if applicable.
 - 5) Each equipment setting.
 - 6) Mounting, supports, and restraints properly installed.
 - 7) Proper service clearance provided.
 - 8) Wiring and power connections correct.
 - 9) Line-voltage reading(s) within acceptable range.

- 10) Wiring and controls connections correct.
 - 11) Low-voltage reading(s) within an acceptable range.
 - 12) Condensate removal acceptable.
 - 13) Noise level within an acceptable range.
 - 14) Refrigerant piping properly connected and insulated.
 - 15) Condensate drain piping properly connected and insulated.
 - 16) Remarks.
- f. Inspection reports for indoor, dedicated outdoor air ventilation units shall include, but not be limited to, the following:
- 1) Unit designation on Drawings.
 - 2) Manufacturer model number.
 - 3) Serial number.
 - 4) Network address, if applicable.
 - 5) Each equipment setting.
 - 6) Mounting, supports, and restraints properly installed.
 - 7) Proper service clearance provided.
 - 8) Wiring and power connections correct.
 - 9) Line-voltage reading(s) within acceptable range.
 - 10) Wiring and controls connections correct.
 - 11) Low-voltage reading(s) within an acceptable range.
 - 12) Controller type and model controlling unit.
 - 13) Controller location.
 - 14) Temperature settings and readings within an acceptable range.
 - 15) Humidity settings and readings within an acceptable range.
 - 16) Condensate removal acceptable.
 - 17) Fan settings and readings within an acceptable range.
 - 18) Fan external static pressure setting.
 - 19) Filter type and condition acceptable.
 - 20) Noise level within an acceptable range.
 - 21) Refrigerant piping properly connected and insulated.
 - 22) Condensate drain piping properly connected and insulated.
 - 23) Automatic dampers properly installed and operating.
 - 24) Ductwork properly connected.
 - 25) If applicable, external interlocks properly connected.
 - 26) Remarks.
- g. Inspection reports for energy recovery ventilators shall include, but not be limited to, the following:
- 1) Unit designation on Drawings.
 - 2) Manufacturer model number.
 - 3) Serial number.
 - 4) Network address, if applicable.
 - 5) Each equipment setting.
 - 6) Mounting, supports, and restraints properly installed.
 - 7) Proper service clearance provided.

- 8) Wiring and power connections correct.
 - 9) Line-voltage reading(s) within acceptable range.
 - 10) Wiring and controls connections correct.
 - 11) Low-voltage reading(s) within an acceptable range.
 - 12) Controller type and model controlling unit.
 - 13) Controller location.
 - 14) Temperature settings and readings within an acceptable range.
 - 15) Humidity readings.
 - 16) Condensate removal acceptable.
 - 17) Fan settings and readings within an acceptable range.
 - 18) Fan external static pressure setting.
 - 19) Filter type and condition acceptable.
 - 20) Noise level within an acceptable range.
 - 21) Automatic dampers properly installed and operating.
 - 22) Ductwork properly connected.
 - 23) If applicable, external interlocks properly connected.
 - 24) Remarks.
- h. Inspection reports for hydronic units shall include, but not be limited to, the following:
- 1) Unit designation on Drawings.
 - 2) Manufacturer model number.
 - 3) Serial number.
 - 4) Network address, if applicable.
 - 5) Each equipment setting.
 - 6) Mounting, supports, and restraints properly installed.
 - 7) Proper service clearance provided.
 - 8) Wiring and power connections correct.
 - 9) Line-voltage reading(s) within acceptable range.
 - 10) Wiring and controls connections correct.
 - 11) Low-voltage reading(s) within an acceptable range.
 - 12) Controller type and model controlling unit.
 - 13) Controller location.
 - 14) Temperature settings and readings within an acceptable range.
 - 15) Condensate removal acceptable.
 - 16) Noise level within an acceptable range.
 - 17) Refrigerant piping properly connected and insulated.
 - 18) Hydronic piping properly connected and insulated.
 - 19) Proof of water flow checked for proper operation.
 - 20) Condensate drain piping properly connected and insulated.
 - 21) If applicable, external interlocks properly connected.
 - 22) Remarks.
- i. Installer shall provide manufacturer with the requested documentation and technical support during inspection.
- j. Installer shall correct observed deficiencies found by the inspection.

- k. 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.
 - l. 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.
 - m. Final report shall indicate the system(s) inspected are installed according to manufacturer's requirements and are 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:
 - 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 of not less than 1.5 times VRF HVAC system operating pressure, but not less than 600 psig, using dry nitrogen.
 - 3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of 24 hours. Allowance for pressure changes attributed to changes in ambient temperature are acceptable.
 - 4. Prepare test report to record the following information for each test:
 - a. Name of person starting test, company name, phone number, and e-mail address.
 - b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
 - c. Detailed description of extent of tubing tested.
 - d. Date and time at start of test.
 - e. Test pressure at start of test.
 - f. Outdoor temperature at start of test.
 - g. Name of person ending test, company name, phone number, and e-mail address.
 - h. Date and time at end of test.
 - i. Test pressure at end of test.
 - j. Outdoor temperature at end of test.
 - k. Remarks:
 - 5. Submit test reports for Project record.

D. Refrigerant Tubing Evacuation Testing:

1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
2. After completion of tubing positive-pressure testing, evacuate tubing systems to a pressure of 500 microns.
3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of one hour(s) with no change.
4. Prepare test report to record the following information for each test:
 - a. Name of person starting test, company name, phone number, and e-mail address.
 - b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
 - c. Detailed description of extent of tubing tested.
 - d. Date and time at start of test.
 - e. Test pressure at start of test.
 - f. Outdoor temperature at start of test.
 - g. Name of person ending test, company name, phone number, and e-mail address.
 - h. Date and time at end of test.
 - i. Test pressure at end of test.
 - j. Outdoor temperature at end of test.
 - k. Remarks:
5. Submit test reports for Project record.
6. Upon successful completion of evacuation testing, system shall be charged with refrigerant.

E. System Refrigerant Charge:

1. Using information collected from the refrigerant tubing evacuation testing, system Installer shall consult variable refrigerant system manufacturer to determine the correct system refrigerant charge.
2. Installer shall charge system following VRF HVAC system manufacturer's written instructions.
3. System refrigerant charging shall be witnessed by system manufacturer's representative.
4. Total refrigerant charge shall be recorded and permanently displayed at the system's outdoor unit.

F. Products will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.15 STARTUP SERVICE

- A. Engage a VRF HVAC system manufacturer's service representative to perform system(s) startup service.**

1. Service representative shall be a factory-trained and -authorized service representative of VRF HVAC system manufacturer.
 2. Complete startup service of each separate system.
 3. Complete system startup service according to manufacturer's written instructions.
- B. Startup checks shall include, but not be limited to, the following:
1. Check control communications of equipment and each operating component in system(s).
 2. Check each indoor unit's response to demand for cooling and heating.
 3. Check each indoor unit's response to changes in airflow settings.
 4. Check each indoor unit, HRCU, and outdoor unit for proper condensate removal.
- C. Installer shall accompany manufacturer's service representative during startup service and provide manufacturer's service representative with requested documentation and technical support during startup service.
1. Installer shall correct deficiencies found during startup service for reverification.
- D. System Operation Report:
1. After completion of startup service, manufacturer shall issue a report for each separate system.
 2. Report shall include complete documentation describing each startup check, the result, and any corrective action required.
 3. Manufacturer shall electronically record not less than two hours of continuous operation of each system and submit with report for historical reference.
 - a. All available system operating parameters shall be included in the information submitted.
- E. Witness:
1. Invite Engineer to witness startup service procedures.
 2. Provide written notice not less than 20 business days before start of startup service.
- 3.16 ADJUSTING
- 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: 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.

3.17 PROTECTION

- A. Protect products from moisture and water damage. Remove and replace products that are wet, moisture damaged, or mold damaged.
- B. Protect equipment from physical damage. Replace equipment with physical damage that cannot be repaired to new condition. Observable surface imperfections shall be grounds for removal and replacement.
- C. Protect equipment from electrical damage. Replace equipment suffering electrical damage.
- D. Cover and seal openings of equipment to keep inside of equipment clean. Do not remove covers until finish work is complete.

3.18 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by manufacturer's authorized service representative. Include two service visits for preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper equipment and system operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.19 DEMONSTRATION

- 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.

END OF SECTION

SECTION 238239.19 - WALL AND CEILING UNIT 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 wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and 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 details of anchorages and attachments to structure and to supported equipment.
 - 4. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
 - 5. Wiring Diagrams: Power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wall and ceiling unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Berko; Marley Engineered Products.
2. Chromalox, Inc.
3. INDEECO.
4. Marley Engineered Products.
5. QMark; Marley Engineered Products.
6. Trane.
7. TPI Corporation.

2.2 DESCRIPTION

- A. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.
- 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.

2.3 CABINET

- A. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners.
- B. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

2.4 COIL

- A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection. Provide integral circuit breaker for overcurrent protection.

2.5 FAN AND MOTOR

- A. Fan: Aluminum propeller directly connected to motor.
- B. Motor: Permanently lubricated. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine areas to receive wall and ceiling unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- 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 wall and ceiling unit heaters to comply with NFPA 90A.
- B. Install wall and ceiling unit heaters level and plumb.
- C. 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.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 238239.19

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SECTION 260100 - BASIC ELECTRICAL REQUIREMENTS**PART 1 - GENERAL****1.1 WORK INCLUDED**

- A. The General and Supplemental General Conditions of the Contract and Division 1 of the specifications shall apply to this Division.
- B. This Section 260100 shall be part of each section of Division 26 - Electrical.

1.2 RELATED WORK

- A. All sections of Division 26 - Electrical.
- B. All sections of Division 1 - 48.
- C. All addenda issued.
- D. The complete installation of the electrical systems as indicated on the drawings, including details not specifically mentioned or shown that may be necessary to complete the systems.

1.3 QUALITY ASSURANCE

- A. Conform to the Uniform Building Codes.
- B. Conform to the State Building Codes.
- C. Conform to the Local Building Codes.
- D. Conform to the National Fire Protection Association.
- E. Conform to the State Fire Codes.
- F. Conform to the Local Fire Codes.
- G. Conform to the State Health Department.
- H. Conform to the Local Utility Company (gas, water, sewer, storm sewer and electric) Rules and Regulations.
- I. Conform to the National Electric Code.

- J. These codes, rules and regulations shall take precedence if the drawings and specifications are not in conformance therewith, except that where the drawings and specifications exceed minimum code requirements the drawings and specifications shall take precedence.

1.4 SUBMITTALS

- A. Refer to front portion of the specifications.
- B. Submit minimum of one (1) electronic copy or more if specified in another section, of shop drawings and product data on all electrical equipment to be provided by the Contractor.
- C. Title each drawing with project name and number; identify each element of drawings by reference to sheet number and detail, schedule or room number of Contract Documents.
- D. Sequentially number submittals according their specification section number. Revised submittals should include original number and a sequential alphabetic suffix.
- E. Contractor and supplier shall review and stamp and sign submittals prior to transmittal; determine and verify field measurements, field construction criteria, manufacturers catalog numbers and conformance of submittal with requirements of Contract Documents. Identify in writing at time of submittal of any deviations from requirements of Contract Documents.
- F. Mark dimensions and values in units to match those specified.
- G. Do not fabricate or order products or begin work that requires submittals until approval of submittal.
- H. Approval of equipment does not construe approval of equipment, components, etc., that no information is furnished to show compliance with contract documents.

1.5 SCOPE OF THE WORK

- A. The work covered by this specification shall include all labor, material, equipment and services necessary for and reasonably incidental to proper completion of all electrical work as shown on the drawings and hereinafter specified, except work or material specified to be furnished and performed by others. The work shall include but not be limited to the following:
 - 1. Electrical service.
 - 2. Electrical equipment, materials and work, connection of pumps, and miscellaneous equipment.

1.6 CHANGE ORDERS

- A. Refer to front portion of the specifications.

- B. The Contractor shall, in no instance, commence work on or provide materials for or make changes in, the work for this project which will require additional payment from the Owner to the Contractor until he has requested and obtained, in writing, either a signed written Change Order or a signed written notice to proceed with the extra work.
- C. Each request for approval of additional work that is to require additional payment from the Owner or in instances where credit is to be allowed to the Owner for omission of certain work or materials, shall be accompanied by a price quotation, including a complete cost breakdown of materials, labor, overhead and profit.

1.7 AS-BUILT DRAWINGS

- A. Refer to front portion of the specifications.
- B. This Contractor shall prepare as-built drawings for the various component portions of the electrical installations. These drawings shall be furnished to the Owner after completion of the work. These drawings shall be prepared by marking up a set of contract drawings with colored pencils to show changes made during construction after the various installations have been completed.
- C. At completion of project, Contractor shall provide equipment identification as directed in Section 260553.

1.8 PERMITS, LICENSES AND FEES

- A. The Contractor shall familiarize himself with all requirements as to permits, licenses, fees, codes and ordinances and arrange to comply with them. All permits, licenses, fees and inspections required for the work under this Contract shall be obtained and paid for by the Contractor unless otherwise specified.

1.9 DATA AND MEASUREMENTS

- A. The information given herein and on the drawings is as exact as could be secured, but its extreme accuracy is not guaranteed. The Electrical Contractor must examine the locations carefully and verify all measurements, distances, levels, conduit, wire sizes, obstructions, remodeling work, work of other trades, etc., before submitting bids and before starting work. The Contractor shall satisfactorily adapt his work to the actual conditions at the building.
- B. Electrical drawings are of small scale, it is not possible to show all necessary conduit, junction boxes, fittings and accessories. Furnish items as necessary for completion. Examine drawings and specifications and obtain exact locations, measurements, levels, etc. at site for placement of equipment.

1.10 COORDINATION OF WORK

- A. Refer to front portion of the specifications.
- B. The Contractor shall plan all work so that it proceeds with a minimum of interference between trades. It shall also be the responsibility of the Contractor to provide all openings required in the building construction for the installation of electrical work. Provisions shall be made for all special frames, openings and pipe sleeves as required. The Contractor shall do all extra cutting and patching made necessary by his failure to properly direct such work at the correct time.

1.11 QUALIFICATIONS OF INSTALLERS

- A. Refer to front portion of the specifications.
- B. All work shall be performed by worker skilled in the respective trade required by each part of the work. Helpers and apprentices used for any part of the work shall be under the full supervision of a thoroughly trained and skilled worker of the trade required for that part of the work. No allowance will be made for lack of skill in the acceptance or rejection of any work.

1.12 QUALITY OF WORK

- A. All work shall be of the best quality free from defects in workmanship, materials and performance.

1.13 GUARANTEE

- A. Refer to front portion of the specifications.
- B. The Contractor shall guarantee that all electrical systems shall be free from defects in workmanship, materials and performance and that if such defects shall appear during a period of one year or as specified in another section, from date of final acceptance, he will remedy such defects to the satisfaction of the Owner at no extra cost.

1.14 PROJECT/SITE 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 in work specified in other sections. Obtain permission of engineer before proceeding.

1.15 PACKING, TRANSPORTATION

- A. Require supplier to package finished products in boxes or crates for protection during shipment, handling and storage. Protect sensitive products against exposure to elements and moisture.
- B. Protect sensitive equipment and finishes against impact, abrasion and other damage.

1.16 DELIVERY AND RECEIVING

- A. Arrange deliveries of products in accordance with construction progress schedules. Allow time for inspection prior to installation.
- B. Coordinate deliveries to avoid conflict with work and conditions at site, work of other contractors, limitations on storage space, availability of personnel and handling equipment.
- C. Deliver products in undamaged, dry condition, in original unopened containers or packaging with identifying labels intact and legible.
- D. Clearly mark partial deliveries of component parts of equipment to identify equipment and contents to permit easy accumulation of parts and to facilitate assembly.
- E. Immediately on delivery, inspect shipment to assure:
 - 1. Products comply with requirements of contract documents and reviewed submittals.
 - 2. Quantities are correct.
 - 3. Accessories and installation hardware are correct.
 - 4. Containers and packages are intact and labels legible.
 - 5. Products are protected and undamaged.

1.17 PRODUCT HANDLING

- A. Provide equipment and personnel to handle products, including those provided by Owner, by methods to prevent soiling and damage.
- B. Provide additional protection during handling to prevent marring and otherwise damaging products, packaging and surrounding surfaces.
- C. Handle product by methods to avoid bending or over stressing. Lift large and heavy components only at designated lift points.

1.18 OPERATING AND MAINTENANCE MANUAL

- A. Refer to front portion of the specifications and to each Section of Division 26 Electrical.

- B. The Contractor shall furnish three (3) Operating and Maintenance Manuals to the Owner after all tests and adjustments have been completed. Final payment will not be made until this manual has been submitted and approved. In addition to the requirements of Section 01700, The manual shall include, but is not limited to:
1. Name, Address and Telephone of the Manufacturer and Local Representative: Include a list of all suppliers and representatives of products supplied on the project shall be included in the manual.
 2. Manufacturers' Manuals and Parts Lists: Operating and maintenance manuals and parts lists furnished by equipment manufacturers shall be included in the manual.
 3. Manufacturers Start-up of Equipment Documentation: Documents shall include date and time of start-up, name of authorized personnel who performed start-up, any required settings and notes concerning start-up shall be included in the manual.
 4. State or City Tests, Approval or Acceptance of Equipment and/or systems: This shall include date, time, name of authorized personnel and any other notes. Documentation of domestic water sterilization and equipment approved installation start-ups shall be included in the manual.
 5. Shop Drawings: One copy of each approved shop drawing shall be included in the manual.
 6. Index: A complete index shall be included at the front of the manual.
 7. Binder: All of the above-described items shall be assembled in a three-ring binder with a hard cover and durable cloth or plastic finish.

1.19 STORAGE, GENERAL

- A. Store products, immediately on delivery, in accordance with manufacturer's instructions, with seals and labels intact. Protect until installed.
- B. Arrange storage in a manner to provide access for maintenance of stored items and for inspection.

1.20 CONFLICTS

- A. Conflicts between contract documents, codes ordinances or manufacturer's installation shall be brought to the attention of the Contracting Officer before installation for clarification.
- B. Conflicts not resolved prior to bid, the Contractor shall bid the larger quantity, more stringent or better quality of work.
- C. Where the codes or Utility Company requirements conflict with the drawings or specifications, the code shall have precedence only when it is more stringent than the item specified or shown. The item specified and/or shown on the drawings shall be followed when the item meets or exceed the required codes or Utility Company requirements.

PART 2 - PRODUCTS**PART 3 - EXECUTION****3.1 TESTS AND ADJUSTMENTS**

- A. After completion of the work, but before final payment is made, the Contractor shall run a test over a sufficient period of time to prove the proper operation and performance of all apparatus, etc. and of the system as a whole.

3.2 OPERATING INSTRUCTIONS

- A. After all tests and adjustments are completed, the Contractor shall give complete operating and maintenance instructions to the Owner's operating personnel. The Operating and Maintenance Manual shall be used as the basis of instructions.
- B. The Contractor shall notify Owner and Engineer seven (7) days prior to instructions.

3.3 CLEANING

- A. The Contractor shall maintain all areas free from hazardous or obstructive rubbish and debris due to installation of the electrical work during construction. When the electrical systems have been installed, the Contractor shall remove all rubbish and debris resulting from his work from the building and site and remove all paint, plaster and accumulated dirt from all electrical equipment, fixtures and conduit.
- B. After all equipment has been installed, the electrical contractor shall remove all stickers, rust stain labels, temporary covers, plaster marks, paint spots, etc. All foreign matter shall be blown out or flushed out of all piping, fans, motors, devices, switches, panels, etc.
- C. Identification plates on all equipment shall be free of excess paint and shall be varnished.
- D. The Contractor shall leave the electrical portion of the work in a safe, clean and very neat condition ready for operation.
- E. At completion of project, Contractor shall provide equipment identifications as directed in Section 260553.

3.4 PAINTING

- A. All painting shall be done pursuant to front portion of the specifications.

- B. Damage and Touch-up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.5 EQUIPMENT INSTALLATION

- 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.

3.6 ELECTRICAL WORK

- A. The Mechanical Contractor shall set in place all motors they are to furnish. All starters, switches, controls, etc., scheduled or provided with manufacturer equipment shall be turned over to the Electrical Contractor and they will be responsible for electrical connection.

3.7 UTILITY SERVICES

- A. Provide temporary services and utilities to allow for construction of facility prior to installation of electrical service as required.

END OF SECTION

SECTION 260150 - BASIC ELECTRICAL MATERIALS AND METHODS

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. This Section includes the following:
 - 1. Concrete equipment bases.
 - 2. Electrical demolition.
 - 3. Cutting and patching for electrical construction.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. IMC: Intermediate metal conduit.
- D. LFMC: Liquidtight flexible metal conduit.
- E. RNC: Rigid nonmetallic conduit.

1.4 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
 - 1. Set inserts and sleeves in poured-in-place concrete, masonry work and other structural components as they are constructed.
- B. Sequence, coordinate and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before installing doors or closing up openings.
- C. Coordinate electrical service connections to components provided by utility companies.

1. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.

PART 2 - PRODUCTS

2.1 CONCRETE BASES

- A. Concrete Forms and Reinforcement Materials: As specified in Division 3 Section "Cast-in-Place Concrete."
- B. Concrete: 3000-psi, 28-day compressive strength as specified in Division 3 Section "Cast-in-Place Concrete."

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
- B. Materials and Components: Install level, plumb and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Equipment: Install to facilitate service, maintenance and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 WIRING INSTALLATION

- A. Install splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- B. Install wiring at outlets with at least 12 inches of slack conductor at each outlet.
- C. Connect outlet and component connections to wiring systems and to ground. 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.

3.3 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.4 DEMOLITION

- A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality and functionality.
- B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.
- C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.
- D. Remove demolished material from Project site.
- E. Remove, store, clean, reinstall, reconnect and make operational components indicated for relocation.

3.5 CUTTING AND PATCHING

- A. Cut, channel, chase and drill floors, walls, partitions, ceilings and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.6 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings and devices, inspect exposed finish. Remove burrs, dirt, paint spots and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes and cabinets are without damage or deterioration at time of Substantial Completion.

BASIC ELECTRICAL MATERIALS AND METHODS

LXT Eastside Development

SECTION 260150

Project #47732472
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END OF SECTION

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Copper building wire.
2. Aluminum building wire.
3. Tray cable, Type TC.
4. Fire-alarm wire and cable.
5. Connectors and splices.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

B. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

C. Conductor Insulation:

1. Type THHN. Comply with UL 83.
2. Type XHHW-2. Comply with UL 44.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders:
 - 1. Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
 - 2. Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Conductors must be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits:
 - 1. Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
 - 2. Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
- C. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.
- D. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW-2, single conductors in raceway.
- B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway .
- C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
- D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- E. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
- F. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION, GENERAL

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 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-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inch of slack.
- D. Comply with requirements in Section 284621.11 "Addressable Fire-Alarm Systems" for connecting, terminating, and identifying wires and cables.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

**LOW-VOLTAGE ELECTRICAL POWER
CONDUCTORS AND CABLES**

LXT Eastside Development

SECTION 260519

Project #47732472
Permit Set 09/29/23

END OF SECTION

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
 - 1. Underground distribution grounding.
 - 2. Ground bonding common with lightning protection system.
 - 3. Foundation steel electrodes.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SYSTEM 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 application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B3.
 - 2. Stranded Conductors: ASTM B8.
 - 3. Tinned Conductors: ASTM B33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.

7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.

2.3 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Mechanical-Type Bus-Bar Connectors: Cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- C. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- D. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- E. Straps: Solid copper, cast-bronze clamp. Rated for 600 A.
- F. Water Pipe Clamps:
 1. Mechanical type, two pieces with zinc-plated bolts.
 - a. Material: Die-cast zinc alloy.
 - b. Listed for direct burial.
 2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 ft..

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
 1. Bury at least 30 inch below grade.
 2. Duct-Bank Grounding Conductor: Bury 12 inch above duct bank when indicated as part of duct-bank installation.

- C. Grounding Conductors: Green-colored insulation with continuous yellow stripe.
- D. Isolated Grounding Conductors: Green-colored insulation with more than one continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- E. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inch minimum from wall, 6 inch above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- F. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors must be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Generator: Install grounding electrode(s) at the generator location. The electrode must be connected to the equipment grounding conductor and to the frame of the generator.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inch will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inch above to 6 inch below concrete. Seal floor opening with waterproof, nonshrink grout.

- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inch from the foundation.

3.5 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Armored and metal-clad cable runs.
 - 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 - 9. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

- F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- G. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.6 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 6 inch below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. Use exothermic welds for all below-grade connections.
 - 3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and must be at least 12 inch deep, with cover.
 - 1. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- F. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 ft. apart.
- I. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 ft. of bare copper conductor not smaller than No. 4 AWG.
1. If concrete foundation is less than 20 ft. long, coil excess conductor within base of foundation.
 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

END OF SECTION

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Type EMT-S raceways and elbows.
2. Type EPEC raceways and fittings.
3. Type ERMCA and Type ERMCA-SS raceways, elbows, couplings, and nipples.
4. Type FMC-S and Type FMC-A raceways.
5. Type FMT raceways.
6. Type IMC raceways.
7. Type LFMC raceways.
8. Type LFNC raceways.
9. Type PVC raceways and fittings.
10. Fittings for conduit, tubing, and cable.
11. Threaded metal joint compound.
12. Surface metal raceways and fittings.
13. Surface nonmetallic raceways.
14. Metallic outlet boxes, device boxes, rings, and covers.
15. Cover plates for device boxes.
16. Hoods for outlet boxes.

1.2 ACTION SUBMITTALS

- A. Shop Drawings:** For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details. Show that floor boxes are located to avoid interferences and are structurally allowable. Indicate floor thickness at location where boxes are embedded in concrete floors and underfloor clearances where boxes are installed in raised floors.

PART 2 - PRODUCTS

2.1 TYPE EMT-S RACEWAYS AND ELBOWS

A. Steel Electrical Metal Tubing (EMT-S) and Elbows:

1. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:

- 1) Reference Standards: UL 797 and UL Category Control Number FJMX.
- 2) Exterior Coating: Zinc.
- 3) Interior Coating: Zinc with organic top coating.

c. Options:

- 1) Minimum Trade Size: 3/4 inch.
- 2) Colors: As indicated on Drawings.

2.2 TYPE EPEC RACEWAYS AND FITTINGS

A. Schedule 40 Electrical HDPE Underground Conduit (EPEC-40):

1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:
 - 1) Reference Standards: UL 651A and UL Category Control Number EAZX.
 - 2) Dimensional Specifications: Schedule 40.
- c. Options:
 - 1) Minimum Trade Size: 3/4 inch.

B. Schedule 80 Electrical HDPE Underground Conduit (EPEC-80):

1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:
 - 1) Reference Standards: UL 651A and UL Category Control Number EAZX.
 - 2) Dimensional Specifications: Schedule 80.
- c. Options:
 - 1) Minimum Trade Size: 3/4 inch.

2.3 TYPE FMC-S AND TYPE FMC-A RACEWAYS

A. Steel Flexible Metal Conduit (FMC-S):

1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:
 - 1) Reference Standard: UL 1 and UL Category Control Number DXUZ.
 - 2) Material: Steel.
- c. Options:
 - 1) Minimum Trade Size: 3/4 inch.
 - 2) Colors: As indicated on Drawings.

B. Aluminum Flexible Metal Conduit (FMC-A):

- 1. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standard: UL 1 and UL Category Control Number DXUZ.
 - 2) Material: Aluminum.
 - c. Options:
 - 1) Minimum Trade Size: 3/4 inch.

2.4 TYPE FMT RACEWAYS

A. Steel Flexible Metallic Tubing (FMT):

- 1. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standard: UL 1652 and UL Category Control Number ILJW.
 - c. Options:
 - 1) Minimum Trade Size: 3/4 inch.
 - 2) Colors: As indicated on Drawings.

2.5 TYPE IMC RACEWAYS

A. Steel Electrical Intermediate Metal Conduit (IMC):

1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:
 - 1) Reference Standard: UL 1242 and UL Category Control Number DYBY.
 - 2) Exterior Coating: Zinc.
 - 3) Interior Coating: Zinc with organic top coating.
- c. Options:
 - 1) Minimum Trade Size: 3/4 inch.
 - 2) Colors: As indicated on Drawings.

2.6 TYPE LFMC RACEWAYS

A. Steel Liquidtight Flexible Metal Conduit (LFMC-S):

1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:
 - 1) Reference Standard: UL 360 and UL Category Control Number DXHR.
 - 2) Material: Steel.
- c. Options:
 - 1) Minimum Trade Size: 3/4 inch.
 - 2) Colors: As indicated on Drawings.

B. Stainless Steel Liquidtight Flexible Metal Conduit (LFMC-SS):

1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:
 - 1) Reference Standard: UL 360 and UL Category Control Number DXHR.

2) Material: Stainless steel.

c. Options:

1) Minimum Trade Size: 3/4 inch.

2.7 TYPE LFNC RACEWAYS

A. Layered (Type A) Liquidtight Flexible Nonmetallic Conduit (LFNC-A):

1. Applicable Standards:

a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

b. General Characteristics:

1) Reference Standard: UL 1660 and UL Category Control Number DXOQ, for Type A conduit with smooth seamless inner core and cover bonded together with one or more reinforcement layers between core and cover.

c. Options:

1) Minimum Trade Size: 3/4 inch.

B. Integral (Type B) Liquidtight Flexible Nonmetallic Conduit (LFNC-B):

1. Applicable Standards:

a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

b. General Characteristics:

1) Reference Standard: UL 1660 and UL Category Control Number DXOQ, for Type B conduit with smooth inner surface with integral reinforcement within conduit wall.

c. Options:

1) Minimum Trade Size: 3/4 inch.

2) Colors: As indicated on Drawings.

C. Corrugated (Type C) Liquidtight Flexible Nonmetallic Conduit (LFNC-C):

1. Applicable Standards:

a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

b. General Characteristics:

- 1) Reference Standard: UL 1660 and UL Category Control Number DXOQ, for Type C conduit with corrugated internal and external surfaces without integral reinforcement within conduit wall.

c. Options:

- 1) Minimum Trade Size: 3/4 inch.

2.8 TYPE PVC RACEWAYS AND FITTINGS

A. Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:

1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:

- 1) Reference Standards: UL 651 and UL Category Control Number DZYR.
- 2) Dimensional Specifications: Schedule 40.

c. Options:

- 1) Minimum Trade Size: 3/4 inch.

B. Schedule 80 Rigid PVC Conduit (PVC-80) and Fittings:

1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:

- 1) Reference Standards: UL 651 and UL Category Control Number DZYR.
- 2) Dimensional Specifications: Schedule 80.

c. Options:

- 1) Minimum Trade Size: 3/4 inch.

2.9 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Fittings for Type ERM, Type IMC, Type PVC, Type EPEC, and Type RTRC Raceways:

1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:
 - 1) Reference Standards: UL 514B and UL Category Control Number DWTT.
 - 2) Material: Steel.
 - 3) Coupling Method: Compression coupling.

B. Fittings for Type EMT Raceways:

- 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. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514B and UL Category Control Number FKAV.
 - 2) Material: Steel.
 - 3) Coupling Method: Compression coupling.

2.10 SURFACE METAL RACEWAYS AND FITTINGS

A. Surface Metal Raceways and Fittings with Metal Covers:

- 1. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 5 and UL Category Control Number RJBT.
 - c. Options:
 - 1) Galvanized steel base with snap-on covers.
 - 2) Manufacturer's standard enamel finish.

B. Surface Metal Raceways and Fittings with Nonmetallic Covers:

- 1. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

- b. General Characteristics:
 - 1) Reference Standards:
 - a) UL 5 and UL Category Control Number RJBT.
 - b) UL 94, V-0 requirements for self-extinguishing characteristics.
- c. Options:
 - 1) Galvanized steel base with snap-on covers.
 - 2) Provide texture and color selected by Architect from manufacturer's standard colors.
 - 3) Wiring Channels: Dual. Multiple channels must be capable of housing a standard 20 to 30 A NEMA device flush within the raceway.

2.11 SURFACE NONMETALLIC RACEWAYS

A. Surface Nonmetallic Raceways and Fittings with Nonmetallic Covers:

- 1. Applicable Standards:
 - a. Options:
 - 1) Provide texture and color selected by Architect from manufacturer's standard colors.
 - 2) Wiring Channels: Dual. Multiple channels must be capable of housing a standard 20 to 30 A NEMA device flush within the raceway.

2.12 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Metallic Outlet Boxes:

- 1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
- 2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514A and UL Category Control Number QCIT.
 - c. Options:

- 1) Sheet Metal Depth: Minimum 2 inch.
- 2) Cast-Metal Depth: Minimum 2.4 inch.
- 3) Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb.
- 4) Paddle Fan Outlet Boxes and Covers: Nonadjustable, designed for attachment of paddle fan weighing up to 70 lb.

B. Metallic Device Boxes:

1. Description: Box with provisions for mounting wiring device directly to box.
2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514A and UL Category Control Number QCIT.
 - c. Options:
 - 1) Sheet Metal Depth: minimum 2 inch.
 - 2) Cast-Metal Depth: minimum 2.4 inch.
 - 3) Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb.
 - 4) Paddle Fan Outlet Boxes and Covers: Nonadjustable, designed for attachment of paddle fan weighing up to 70 lb.

2.13 COVER PLATES FOR DEVICES BOXES**A. Metallic Cover Plates for Device Boxes:**

1. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514D and UL Category Control Numbers QCIT and QCMZ.
 - 2) Wallplate-Securing Screws: Metal with head color to match wallplate finish.
 - c. Options:
 - 1) Wallplate Material in finished area: 0.032 inch thick Type 302/304 non-magnetic stainless steel with brushed finish.
 - 2) Material in non-finished area: Galvanized steel

B. Nonmetallic Cover Plates for Device Boxes:

1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:
 - 1) Reference Standards: UL 514D and UL Category Control Numbers QCIT and QCMZ.
 - 2) Wallplate-Securing Screws: Metal with head color to match wallplate finish.
- c. Options:
 - 1) Wallplate Material: 0.060 inch thick high-impact thermoplastic (nylon) with smooth finish and color matching wiring device.
 - 2) Color: White.

2.14 HOODS FOR OUTLET BOXES

A. Extra-Duty, While-in-Use Hoods for Outlet Boxes:

1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:
 - 1) Reference Standards: UL 514D and UL Category Control Numbers QCIT and QCMZ.
 - 2) Marked "Extra-Duty" in accordance with UL 514D.
 - 3) Receptacle, hood, cover plate, gaskets, and seals comply with UL 498 Supplement SA when mated with box or enclosure complying with UL 514A, UL 514C, or UL 50E.
 - 4) Mounts to box using fasteners different from wiring device.
- c. Options:
 - 1) Provides gray, polycarbonate weatherproof, "while-in-use" cover.

PART 3 - EXECUTION**3.1 SELECTION OF RACEWAYS**

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of raceways. Consult Engineer for resolution of conflicting requirements.
- B. Outdoors:
 - 1. Exposed Conduit: IMC PVC-80.
 - 2. Concealed Conduit, Aboveground: IMC EMT PVC-80 PVC-40.
 - 3. Direct-Buried Conduit: PVC-80 PVC-40 EPEC-40.
 - 4. Concrete-Encased Conduit Not in Trench: PVC-80 PVC-40 PVC-A EPEC-40.
 - 5. Concrete-Encased Conduit in Trench: PVC-80 PVC-40 PVC-A PVC-EB EPEC-40.
 - 6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC LFNC-A.
- C. Indoors:
 - 1. Hazardous Classified Locations: IMC.
 - 2. Exposed and Subject to Physical Damage: IMC. Raceway locations include the following:
 - a. Loading docks.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Gymnasiums.
 - e. Locations less than 8 ft above finished floor.
 - 3. Exposed, Not Subject to Physical Damage: IMC PVC-80.
 - 4. Concealed in Ceilings and Interior Walls and Partitions: IMC EMT PVC-80 PVC-40.
 - 5. Damp or Wet Locations: IMC.
 - 6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC FMC LFNC-A LFNC-B.
 - 7. Circuits Operating Above 60 Hz: . Provide nonmetallic sleeve where aluminum raceways pass through concrete.
- D. Stub-ups to Above Recessed Ceilings: Provide EMT, IMC, or ERM for raceways.
- E. Raceway Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.
 - 1. ERM and IMC: Provide threaded type fittings unless otherwise indicated.

3.2 SELECTION OF BOXES AND ENCLOSURES

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Engineer for resolution of conflicting requirements.
- B. Degree of Protection:
 - 1. Outdoors:
 - a. Type 3R unless otherwise indicated.
 - b. Locations Exposed to Hosedown: Type 4.
 - c. Locations Subject to Potential Flooding: Type 6P.
 - d. Locations Aboveground Where Mechanism Must Operate When Ice Covered: Type 3S.
 - e. Locations in-Ground or Exposed to Corrosive Agents: Type 4X.
 - f. Locations in-Ground or Exposed to Corrosive Agents Where Mechanism Must Operate When Ice Covered: Type 3SX.
 - 2. Indoors:
 - a. Type 1 unless otherwise indicated.
 - b. Damp or Dusty Locations: Type 12.
 - c. Locations Exposed to Hosedown: Type 4.
 - d. Locations Exposed to Corrosive Agents: Type 4X.
- C. Exposed Boxes Installed Less Than 6.5 ft. Above Floor:
 - 1. Provide cast-metal boxes.
 - 2. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

3.3 INSTALLATION OF RACEWAYS

- A. Installation Standards:
 - 1. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for installation of raceways. Consult Engineer for resolution of conflicting requirements.
 - 2. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
 - 3. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
 - 4. Comply with NECA NEIS 101 for installation of steel raceways.
 - 5. Comply with NECA NEIS 102 for installation of aluminum raceways.
 - 6. Comply with NECA NEIS 111 for installation of nonmetallic raceways.

7. Install raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
8. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4 inch trade size and insulated throat metal bushings on 1-1/2 inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
9. Raceway Terminations at Locations Subject to Moisture or Vibration:
 - a. Provide insulating bushings to protect conductors, including conductors smaller than No. 4 AWG. Install insulated throat metal grounding bushings on service conduits.

B. General Requirements for Installation of Raceways:

1. Complete raceway installation before starting conductor installation.
2. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft. above finished floor.
3. Install no more than equivalent of three 90-degree bends in conduit run except for control wiring conduits, for which no more than equivalent of two 90-degree fewer bends are permitted. Support within 12 inch of changes in direction.
4. Make bends in raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
5. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
6. Support conduit within 12 inch of enclosures to which attached.
7. Install raceway sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings in accordance with NFPA 70.
8. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of raceways at the following points:
 - a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - b. Where an underground service raceway enters a building or structure.
 - c. Conduit extending from interior to exterior of building.
 - d. Conduit extending into pressurized duct and equipment.
 - e. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 - f. Where otherwise required by NFPA 70.
9. Do not install raceways or electrical items on "explosion-relief" walls or rotating equipment.
10. Do not install conduits within 2 inch of the bottom side of a metal deck roof.

11. Keep raceways at least 6 inch away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
12. Cut conduit perpendicular to the length. For conduits 2 inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
13. Install pull wires in empty raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb tensile strength. Leave at least 12 inch of slack at both ends of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

C. Requirements for Installation of Specific Raceway Types:

1. Types EMT-A, ERMC-A, and FMC-A:
 - a. Do not install aluminum raceways or fittings in contact with concrete or earth.
2. Types ERMC and IMC:
 - a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
3. Types FMC, LFMC, and LFNC:
 - a. Comply with NEMA RV 3. Provide a maximum of 36 inch of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
4. Types PVC and EPEC:
 - a. Do not install Type PVC or Type EPEC conduit where ambient temperature exceeds 122 deg F. Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.
 - b. Comply with manufacturer's written instructions for solvent welding and fittings.

D. Raceways Embedded in Slabs:

1. Run raceways larger than 1 inch trade size below concrete slab..
2. Arrange raceways to cross building expansion joints with expansion fittings at right angles to the joint.
3. Arrange raceways to ensure that each is surrounded by a minimum of 1 inch of concrete without voids.
4. Do not embed threadless fittings in concrete unless locations have been specifically approved by Architect.
5. Change from ENT to PVC-80, PVC-40, IMC before rising above floor.

- E. Stub-ups to Above Recessed Ceilings:
1. Provide EMT, IMC, or ERM C for raceways.
 2. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- F. Raceway Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.
1. EMT: Provide compression, steel fittings. Comply with NEMA FB 2.10.
 2. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.
- G. Expansion-Joint Fittings:
1. Install in runs of aboveground PVC that are located where environmental temperature change may exceed 30 deg F and that have straight-run length that exceeds 25 ft.. Install in runs of aboveground ERM C and EMT conduit that are located where environmental temperature change may exceed 100 deg F and that have straight-run length that exceeds 100 ft..
 2. Install type and quantity of fittings that accommodate temperature change listed for the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 - e. .
 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 4. Install expansion fittings at locations where conduits cross building or structure expansion joints.
 5. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- H. Raceways Penetrating Rooms or Walls with Acoustical Requirements:
1. Seal raceway openings on both sides of rooms or walls with acoustically rated putty or firestopping.

3.4 INSTALLATION OF SURFACE RACEWAYS

- A. Install surface raceways only where indicated on Drawings.

- B. Install surface raceway with a minimum 2 inch radius control at bend points.
- C. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inch and with no less than two supports per straight raceway section. Support surface raceway in accordance with manufacturer's written instructions. Tape and glue are unacceptable support methods.

3.5 INSTALLATION OF BOXES AND ENCLOSURES

- A. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
- B. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- C. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.
- D. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- E. Locate boxes so that cover or plate will not span different building finishes.
- F. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
- G. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
- H. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
- I. Set metal floor boxes level and flush with finished floor surface.
- J. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- K. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
- L. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.
- M. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:
 - 1. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.

2. Provide gaskets for wallplates and covers.

3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

3.8 CLEANING

- A. Boxes: Remove construction dust and debris from device boxes, outlet boxes, and floor-mounted enclosures before installing wallplates, covers, and hoods.

END OF SECTION 260533

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**SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND
CABLING**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Round sleeves.
2. Sleeve seal systems.

PART 2 - PRODUCTS

2.1 SLEEVE SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.

1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

3. Size pipe sleeves to provide 1/4 inch annular clear space between sleeve and raceway or cable, unless sleeve seal system is to be installed.
 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inch above finished floor level. Install sleeves during erection of floors.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:
1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 2. Seal space outside of sleeves with approved joint compound for wall assemblies.
- C. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- D. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seal systems. Size sleeves to allow for 1 inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- E. Underground, Exterior-Wall and Floor Penetrations:
1. Install steel pipe sleeves with integral waterstops. Size sleeves to allow for 1 inch annular clear space between raceway or cable and sleeve for installing sleeve seal system. Install sleeve during construction of floor or wall.
 2. Install steel pipe sleeves. Size sleeves to allow for 1 inch annular clear space between raceway or cable and sleeve for installing sleeve seal system. Grout sleeve into wall or floor opening.

3.2 INSTALLATION OF SLEEVE SEAL SYSTEMS

- A. Install sleeve seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install 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.

END OF SECTION

SECTION 260573.16 - COORDINATION STUDIES**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 computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.
 - 1. Study results shall be used to determine coordination of series-rated devices.

1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.
- B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.
- C. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- D. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- E. Power System Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- F. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.
- G. SCCR: Short-circuit current rating.
- H. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

- I. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

A. Product Data:

1. For computer software program to be used for studies.
2. Submit the following after the approval of system protective devices submittals. Submittals may be in digital form.
 - a. Coordination-study input data, including completed computer program input data sheets.
 - b. Study and equipment evaluation reports.
3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.
 - a. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Engineer for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For Power System Analysis Software Developer.
2. For Power Systems Analysis Specialist.
3. For Field Adjusting Agency.

- B. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For overcurrent protective devices to include in emergency, operation, and maintenance manuals.

1. The following are from the Coordination Study Report:
 - a. Final one-line diagram.
 - b. Final protective device coordination study.
 - c. Coordination study data files.
 - d. List of all protective device settings.
 - e. Time-current coordination curves.

- f. Power system data.
- 2. Provide electronic version of program files used to perform study for Owner's future use.

1.7 QUALITY ASSURANCE

- A. Studies shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
- D. Power System Analysis Software Qualifications:
 - 1. Computer program shall be designed to perform coordination studies or have a function, component, or add-on module designed to perform coordination studies.
 - 2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- E. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- F. Field Adjusting Agency Qualifications:
 - 1. Employer of a NETA ETT-Certified Technician Level III responsible for all field adjusting of the Work.
 - 2. A member company of NETA.
 - 3. Acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CGI CYME.
 - 2. EDSA Micro Corporation.
 - 3. ESA Inc.
 - 4. Operation Technology, Inc.
 - 5. Power Analytics, Corporation.
 - 6. SKM Systems Analysis, Inc.

- B. Comply with IEEE 242 and IEEE 399.
- C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
 - 1. Optional Features:
 - a. Arcing faults.
 - b. Simultaneous faults.
 - c. Explicit negative sequence.
 - d. Mutual coupling in zero sequence.

2.2 COORDINATION STUDY REPORT CONTENTS

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram of modeled power system, showing the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Conductor types, sizes, and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 - 4. Motor and generator designations and kVA ratings.
 - 5. Switchgear, switchboard, motor-control center, and panelboard designations.
 - 6. Any revisions to electrical equipment required by the study.
 - 7. Study Input Data: As described in "Power System Data" Article.
 - a. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
- D. Protective Device Coordination Study:
 - 1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.
 - a. Phase and Ground Relays:
 - 1) Device tag.

- 2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
 - 3) Recommendations on improved relaying systems, if applicable.
 - b. Circuit Breakers:
 - 1) Adjustable pickups and time delays (long time, short time, and ground).
 - 2) Adjustable time-current characteristic.
 - 3) Adjustable instantaneous pickup.
 - 4) Recommendations on improved trip systems, if applicable.
 - c. Fuses: Show current rating, voltage, and class.
- E. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
 2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
 3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
 4. Plot the following listed characteristic curves, as applicable:
 - a. Power utility's overcurrent protective device.
 - b. Medium-voltage equipment overcurrent relays.
 - c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
 - d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
 - e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
 - f. Cables and conductors damage curves.
 - g. Ground-fault protective devices.
 - h. Motor-starting characteristics and motor damage points.
 - i. Generator short-circuit decrement curve and generator damage point.
 - j. The largest feeder circuit breaker in each motor-control center and panelboard.
 5. Maintain selectivity for tripping currents caused by overloads.
 6. Maintain maximum achievable selectivity for tripping currents caused by overloads on series-rated devices.
 7. Provide adequate time margins between device characteristics such that selective operation is achieved.
 8. Comments and recommendations for system improvements.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance of the Work. Devices to be coordinated are indicated on Drawings.
 - 1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the overcurrent protective device study.
 - 1. Verify completeness of data supplied in one-line diagram on Drawings. Call any discrepancies to Engineer's attention.
 - 2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
 - 3. For equipment that is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. Qualifications of technicians and engineers shall be as defined by NFPA 70E.
- B. Gather and tabulate all required input data to support the coordination study. List below is a guide. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:
 - 1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Electrical power utility impedance at the service.
 - 3. Power sources and ties.
 - 4. Short-circuit current at each system bus (three phase and line to ground).
 - 5. Full-load current of all loads.
 - 6. Voltage level at each bus.
 - 7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
 - 8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.

9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Maximum demands from service meters.
13. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
14. Motor horsepower and NEMA MG 1 code letter designation.
15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
16. Medium-voltage cable sizes, lengths, conductor material, cable construction, metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).
17. Data sheets to supplement electrical distribution system one-line diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Generator thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Special overcurrent protective device settings or types stipulated by utility company.
 - g. Time-current-characteristic curves of devices indicated to be coordinated.
 - h. Manufacturer, frame size, interrupting rating in amperes root mean square (rms) symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
 - j. Switchgear, switchboards, motor-control centers, and panelboards ampacity, and SCCR in amperes rms symmetrical.
 - k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.3 COORDINATION STUDY

- A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

- B. Comply with IEEE 399 for general study procedures.
- C. Base study on device characteristics supplied by device manufacturer.
- D. Extent of electrical power system to be studied is indicated on Drawings.
- E. Begin analysis at the service, extending down to system overcurrent protective devices as follows:
 - 1. To normal system low-voltage load buses where fault current is 10 kA or less.
 - 2. Exclude equipment rated 240 V ac or less when supplied by a single transformer rated less than 125 kVA.
 - 3. .
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. Transformer Primary Overcurrent Protective Devices:
 - 1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 - 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- H. Motor Protection:
 - 1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
 - 2. Select protection for motors served at voltages more than 600 V according to IEEE 620.
- I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- J. Generator Protection: Select protection according to manufacturer's written instructions and to IEEE 242.

- K. Include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement, to address asymmetrical requirements of interrupting equipment.
- L. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.
 - 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- M. Protective Device Evaluation:
 - 1. Evaluate equipment and protective devices and compare to short-circuit ratings.
 - 2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
 - 3. Any application of series-rated devices shall be recertified, complying with requirements in NFPA 70.
 - 4. Include in the report identification of any protective device applied outside its capacity.

3.4 LOAD-FLOW AND VOLTAGE-DROP STUDY

- A. Perform a load-flow and voltage-drop study to determine the steady-state loading profile of the system. Analyze power system performance two times as follows:
 - 1. Determine load flow and voltage drop based on full-load currents obtained in "Power System Data" Article.
 - 2. Determine load flow and voltage drop based on 80 percent of the design capacity of load buses.
 - 3. Prepare load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

3.5 MOTOR-STARTING STUDY

- A. Perform a motor-starting study to analyze the transient effect of system's voltage profile during motor starting. Calculate significant motor-starting voltage profiles and analyze the effects of motor starting on the power system stability.
- B. Prepare the motor-starting study report, noting light flicker for limits proposed by IEEE 141, and , and voltage sags so as not to affect operation of other utilization equipment on system supplying the motor.

3.6 FIELD ADJUSTING

- A. Adjust relay and protective device settings according to recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of equipment manufacturer under the "Startup and Acceptance Testing" contract portion.
- B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.
- C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification.
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

3.7 DEMONSTRATION

- A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in the following:
 - 1. Acquaint personnel in fundamentals of operating the power system in normal and emergency modes.
 - 2. Hand-out and explain the coordination study objectives, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting time-current coordination curves.
 - 3. For Owner's maintenance staff certified as NETA ETT-Certified Technicians Level III or NICET Electrical Power Testing Level III Technicians, teach how to adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION

SECTION 260923 - LIGHTING CONTROL DEVICES**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Electronic time switches.
2. Outdoor photoelectric switches, solid state, flexible mounting.
3. Indoor occupancy and vacancy sensors.
4. Switchbox-mounted occupancy sensors.
5. Lighting contactors.
6. Emergency shunt relay.
7. Conductors and cables.

1.2 ACTION SUBMITTALS**A. Shop Drawings:**

1. Show installation details for the following:
 - a. Occupancy sensors.
 - b. Vacancy sensors.
2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

PART 2 - PRODUCTS**2.1 ELECTRONIC TIME SWITCHES****A. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.**

1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Contact Configuration: SPST.
3. Contact Rating: 20 A ballast load, 120/240 V(ac).
4. Astronomic Time: All channels.
5. Automatic daylight savings time changeover.

2.2 INDOOR OCCUPANCY AND VACANCY SENSORS

A. General Requirements for Sensors:

1. Ceiling-mounted, solid-state indoor occupancy sensors.
2. Dual technology.
3. Hardwired connection to switch.
4. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
5. Operation:
 - a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
6. Mounting:
 - a. Sensor: Suitable for mounting in any position in a standard device box or outlet box.
 - b. Relay: Externally mounted through a 1/2 inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
7. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
8. Bypass Switch: Override the "on" function in case of sensor failure.
9. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

B. Dual-Technology Type: Wall mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6 inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. inch, and detect a person of average size and weight moving not less than 12 inch in either a horizontal or a vertical manner at an approximate speed of 12 inch/s.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96 inch high ceiling.
4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 sq. ft. when mounted 48 inch above finished floor.

2.3 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox using hardwired connection.
 - 1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - 3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
- B. Wall-Switch Sensor as indicated on drawings:
 - 1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft..
 - 2. Sensing Technology: Dual technology - PIR and ultrasonic.
 - 3. Capable of controlling load in three-way application.
 - 4. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
 - 5. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
 - 6. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
 - 7. Color: White.
 - 8. Faceplate: Color matched to switch.

2.4 CONDUCTORS AND CABLES

- A. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

- B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF SENSORS

- 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 systems, and partition assemblies.
- B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's instructions.

3.3 INSTALLATION OF CONTACTORS

- 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.

3.4 INSTALLATION OF WIRING

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's instructions.
- C. Size conductors in accordance with lighting control device manufacturer's instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, device, and outlet boxes; terminal cabinets; and equipment enclosures.

3.5 IDENTIFICATION

- A. Identify components and power and control wiring in accordance with Section 260553 "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
 2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
 3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.7 MAINTENANCE

- A. Software and Firmware Service Agreement:
1. Technical Support: Beginning at Substantial Completion, verify that software and firmware service agreement includes software support for two years.
 2. Upgrade Service: At Substantial Completion, update software and firmware to latest version. Install and program software upgrades that become available within Insert number years from date of Substantial Completion. Verify upgrading software includes operating system and new or revised licenses for using software.
 - a. Upgrade Notice: No fewer than 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.
 3. Upgrade Reports: Prepare written report after each update, documenting upgrades installed.

END OF SECTION 260923

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SECTION 260943.23 - RELAY-BASED LIGHTING CONTROLS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Lighting control relay panels.
2. Conductors and cables.

1.2 DEFINITIONS

- A. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

1.3 ACTION SUBMITTALS**A. Shop Drawings: For each relay panel and related equipment.**

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than Type 1.
3. Detail wiring partition configuration, current, and voltage ratings.
4. Short-circuit current rating of relays.
5. Address Drawing: Reflected ceiling plan and floor plans, showing connected luminaires, address for each luminaire, and luminaire groups. Base plans on construction plans, using the same legend, symbols, and schedules.
6. Point List and Data Bus Load: Summary list of all control devices, sensors, ballasts, and other loads. Include percentage of rated connected load and device addresses.
7. Wire Termination Diagrams and Schedules: Coordinate nomenclature and presentation with Drawings and block diagram. Differentiate between manufacturer-installed and field-installed wiring.
8. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Handle and prepare panels for installation in accordance with NECA 407.

PART 2 - PRODUCTS**2.1 SYSTEM DESCRIPTION**

- A. Sequence of Operations: Input signal from field-mounted manual switches, or digital signal sources, must open or close one or more lighting control relays in the lighting control panels. Any combination of inputs must be programmable to any number of control relays.
- B. Surge Protective Device: Factory installed as an integral part of control components or field-mounted surge suppressors complying with UL 1449, SPD Type 2.
- C. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70 by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
- D. Comply with 47 CFR 15, Subparts A and B, for Class A digital devices.
- E. Comply with UL 916.

2.2 LIGHTING CONTROL RELAY PANELS

- A. Description: Standalone lighting control panel using mechanically latched relays to control lighting and appliances.
- B. Lighting Control Panel:
 - 1. A single enclosure with incoming lighting branch circuits, control circuits, switching relays, and on-board timing and control unit.
 - 2. A vertical barrier separating branch circuits from control wiring.
- C. Control Unit: Contain the power supply and electronic control for operating and monitoring individual relays.
 - 1. Timing Unit:
 - a. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.
 - b. Clock configurable for 12-hour (A.M./P.M.) or 24-hour format.
 - c. Four independent schedules, each having 24 time periods.
 - d. Schedule periods settable to the minute.
 - e. Day-of-week, day-of-month, day-of-year with one-time or repeating capability.
 - f. 10 special date periods.
 - 2. Sequencing Control with Override:

- a. Automatic sequenced on and off switching of selected relays at times set at the timing unit, allowing timed overrides from external switches.
 - b. Sequencing control must operate relays one at a time, completing the operation of all connected relays in not more than 10 seconds.
 - c. Override control must allow any relay connected to it to be switched on or off by a field-deployed manual switch or by an automatic switch, such as an occupancy sensor.
 - d. Override control "blink warning" must warn occupants approximately five minutes before actuating the off sequence.
 3. Nonvolatile memory must retain all setup configurations. After a power failure, the controller must automatically reboot and return to normal system operation, including accurate time of day and date.
- D. Relays:
1. Electrically operated, mechanically held single-pole switch, rated at 20 A at 277 V. Short-circuit current rating must be not less than 5 kA. Control must be three-wire, 24 V(ac).
- E. Power Supply: NFPA 70, Class 2, sized for connected equipment, plus 20 percent spare capacity. Powered from a dedicated branch circuit of the panelboard that supplies power to the line side of the relays, sized to provide control power for the local panel-mounted relays, bus system, control-voltage inputs, field-installed occupancy sensors, and photo sensors.

2.3 CONDUCTORS AND CABLES

- A. Classes 2 and 3 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Twisted-Pair Data Cable: Category 6.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panels in accordance with NECA 407.
- B. Examine panels before installation. Reject panels that are damaged or rusted or have been subjected to water saturation.

- C. Examine elements and surfaces to receive panels for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF WIRING

- A. Wiring Methods:
 - 1. Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters.
 - 2. Install cables in raceways and cable trays except within consoles, cabinets, desks, counters, accessible ceiling spaces, and gypsum board partitions where unenclosed wiring method may be used.
 - 3. Install conductors and cables concealed in accessible ceilings, walls, and floors where possible.
 - 4. Conceal raceway and cables except in unfinished spaces.
 - 5. Provide plenum-rated cable, where installed exposed or in open cable tray, within environmental airspaces, including plenum ceilings.
 - 6. Comply with requirements for raceways and boxes specified in Section 260533 "Raceway and Boxes for Electrical Systems."
- B. 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.

3.3 INSTALLATION OF PANELS

- A. Install panels and accessories in accordance with NECA 407.
- B. Mount top of trim 90 inch above finished floor unless otherwise indicated.
- C. Mount panel cabinet plumb and rigid without distortion of box.
- D. Install filler plates in unused spaces.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."

- C. Create a directory to indicate loads served by each relay; incorporate Owner's final room designations. Obtain approval before installing. Use a PC or typewriter to create directory; handwritten directories are unacceptable.
- D. Lighting Control Panel Nameplates: Label each panel with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 SYSTEM STARTUP

- A. Perform startup service.
 - 1. Complete installation and startup checks in accordance with manufacturer's instructions.
 - 2. Confirm correct communications wiring, initiate communications between panels, and program the lighting control system in accordance with approved configuration schedules, time-of-day schedules, and input override assignments.
 - 3. .

3.6 ADJUSTING

- A. 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.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the control unit and operator interface.

END OF SECTION 260943.23

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SECTION 262213 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

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 distribution, dry-type transformers with a nominal primary and secondary rating of 600 V and less, with capacities up to 1500 kVA.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: On receipt, inspect for and note any shipping damage to packaging and transformer.
 - 1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.
- B. Storage: Store in a warm, dry, and temperature-stable location in original shipping packaging.
- C. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.
- D. Handling: Follow manufacturer's instructions for lifting and transporting transformers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Transformers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

- B. Comply with NFPA 70.
 - 1. 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. Transformers Rated 15 kVA and Larger:
 - 1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
 - 2. Marked as compliant with DOE 2016 efficiency levels by an NRTL.
- D. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NFPA 70.
- B. Provide transformers that are constructed to withstand seismic forces specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- C. Coils: Continuous windings without splices except for taps.
 - 1. Internal Coil Connections: Brazed or pressure type.
 - 2. Terminal Connections: Bolted.
- D. Enclosure: .
 - 1. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
 - 2. Wiring Compartment: Sized for conduit entry and wiring installation.
 - 3. Finish: Comply with NEMA 250.
 - a. Finish Color: Gray weather-resistant enamel.
- E. Enclosure: .
 - 1. Wiring Compartment: Sized for conduit entry and wiring installation.
 - 2. Finish: Comply with NEMA 250.
 - a. Finish Color: Gray weather-resistant enamel.
- F. Taps for Transformers 3 kVA and Smaller: None.
- G. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

- H. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.
- I. Wall Brackets: Manufacturer's standard brackets.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.
 - 1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.
 - 2. Brace wall-mounted transformers as specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.
- C. Construct concrete bases according to Section 033000 "Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Section 260529 "Hangers and Supports for Electrical Systems."

1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- D. Secure transformer to concrete base according to manufacturer's written instructions.
- E. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.
- F. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- 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-486B.
- D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

3.4 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.5 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION

SECTION 262416 - 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. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. MCCB: Molded-case circuit breaker.
- E. SPD: Surge protective device.
- F. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details.
 - 2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
 - 3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
 - 4. Detail bus configuration, current, and voltage ratings.
 - 5. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.6 FIELD CONDITIONS

- A. Environmental Limitations:
 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding minus 22 deg F to plus 104 deg F.
 - b. 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.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.
- D. Enclosures: -mounted, dead-front cabinets.
 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.

2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
3. Finishes:
 - a. Panels and Trim: galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
4. .

E. Incoming Mains:

1. Location: Convertible between top and bottom.
2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

F. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
 - a. Plating shall run entire length of bus.
 - b. Bus shall be fully rated the entire length.
2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. .

G. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. .

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. 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."

B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

2.3 POWER PANELBOARDS

- A. Panelboards: NEMA PB 1, distribution type.
- B. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- C. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic Trip Circuit Breakers:
 - a. RMS sensing.
 - b. Field-replaceable rating plug or electronic trip.
 - c. Digital display of settings, trip targets, and indicated metering displays.
 - d. Multi-button keypad to access programmable functions and monitored data.
 - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
 - f. Integral test jack for connection to portable test set or laptop computer.
 - g. Field-Adjustable Settings:
 - 1) Instantaneous trip.
 - 2) Long- and short-time pickup levels.
 - 3) Long and short time adjustments.
 - 4) Ground-fault pickup level, time delay, and I squared T response.

4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
5. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
6. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Breaker handle indicates tripped status.
 - c. UL listed for reverse connection without restrictive line or load ratings.
 - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - e. Multipole units enclosed in a single housing with a single handle.
 - f. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.

2.6 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder.
 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Comply with NECA 1.
- C. Install panelboards and accessories according to NEMA PB 1.1.
- D. Equipment Mounting:
 - 1. Install panelboards 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. Attach panelboard to the vertical finished or structural surface behind the panelboard.
 - 3. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- F. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- G. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- H. Mount panelboard cabinet plumb and rigid without distortion of box.
- I. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- J. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.
- K. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
 - 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- L. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- M. Install filler plates in unused spaces.

- N. Stub four 1-inch empty conduits from panelboard 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.
- O. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- P. Mount spare fuse cabinet in accessible location.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
 - 1. Measure loads during period of normal facility operations.
 - 2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 - 3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.

4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.5 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION

SECTION 262726 - WIRING 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.

1.2 SUMMARY

- A. Section Includes:

1. GFCI receptacles, 125 V, 20 A.
2. Toggle switches, 120/277 V, 20 A.
3. Occupancy sensors.
4. Wall-box dimmers.
5. Wall plates.
6. Poke-through assemblies.

1.3 DEFINITIONS

- A. AFCI: Arc-fault circuit interrupter.
- B. BAS: Building automation system.
- C. EMI: Electromagnetic interference.
- D. GFCI: Ground-fault circuit interrupter.
- E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- F. RFI: Radio-frequency interference.
- G. SPD: Surge protective device.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

PART 2 - PRODUCTS**2.1 STANDARD-GRADE RECEPTACLES, 125 V, 20 A****A. Duplex Receptacles, 125 V, 20 A :**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
2. Description: Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.

B. Weather-Resistant Duplex Receptacle, 125 V, 20 A :

1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498.
4. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

2.2 GFCI RECEPTACLES, 125 V, 20 A**A. Duplex GFCI Receptacles, 125 V, 20 A :**

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Type: Non-feed through.
4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

2.3 TOGGLE SWITCHES, 120/277 V, 20 A**A. Single-Pole Switches, 120/277 V, 20 A :**

1. Standards: Comply with UL 20 and FS W-S-896.

B. Three-Way Switches, 120/277 V, 20 A :

1. Comply with UL 20 and FS W-S-896.

2.4 OCCUPANCY SENSORS

A. Wall Switch Sensor Light Switch, Dual Technology :

1. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual (ultrasonic and passive infrared) technology.
2. Standards: Comply with UL 20.
3. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
4. Adjustable time delay of 20 minutes.
5. Able to be locked to Automatic-On mode.
6. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.

2.5 DIMMERS

A. Wall-Box Dimmers:

1. Description: Modular, full-wave, solid-state dimmer switch with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
2. Control: Continuously adjustable slider; with single-pole or three-way switching.
3. Standards: Comply with UL 1472.

2.6 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Unfinished Spaces: Galvanized steel.
3. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, extra-duty, rated "while-in-use" weather-resistant, die-cast aluminum with lockable cover.

D. Antimicrobial Cover Plates:

1. Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.
2. Tarnish resistant.

2.7 POKE-THROUGH ASSEMBLIES

- A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
- B. Standards: Comply with scrub water exclusion requirements in UL 514.
- C. Size: Selected to fit nominal 3-inch 4-inch cored holes in floor and matched to floor thickness.
- D. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
 - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtail existing conductors is permitted, provided the outlet box is large enough.
- D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan-speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

- A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use self-adhesive label on face of plate, and durable wire markers or tags inside outlet boxes.

END OF SECTION

SECTION 262813 - FUSES**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. Cartridge fuses rated 600 V ac and less for use in the following:
 - a. Control circuits.
 - b. Motor-control centers.
 - c. Panelboards.
 - d. Switchboards.
 - e. Enclosed controllers.
 - f. Enclosed switches.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles. Include the following for each fuse type indicated:
 - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 3. Current-limitation curves for fuses with current-limiting characteristics.
 - 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in PDF format.
 - 5. Coordination charts and tables and related data.
 - 6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 FIELD CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg For more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
 - 1. Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
 - 2. Type L: 600-V, 601- to 6000-A rating, 200 kAIC.
- B. Comply with NEMA FU 1 for cartridge fuses.
- C. Comply with NFPA 70.
- D. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:

1. Service Entrance: Class T, fast acting.
2. Feeders: Class J, time delay.
3. Motor Branch Circuits: Class RK1, time delay.
4. Large Motor Branch (601-4000 A): Class L, time delay.
5. Other Branch Circuits: Class J, time delay.
6. Control Transformer Circuits: Class CC, time delay, control transformer duty.
7. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Owner.

END OF SECTION 262813

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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 Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Shunt trip switches.
 - 4. Molded-case circuit breakers (MCCBs).

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: For enclosed switches and circuit breakers.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Include wiring diagrams for power, signal, and control wiring.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. 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."

2.2 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

2.3 FUSIBLE SWITCHES

- A. Type HD, Heavy Duty:
 - 1. throw.
 - 2. Three pole.
 - 3. -V ac.
 - 4. 1200 A and smaller.
 - 5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
 - 6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- B. Accessories:
 - 1. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.4 NONFUSIBLE SWITCHES

A. Accessories:

1. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.5 SHUNT TRIP SWITCHES

- A.** General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with Class J fuse block and 200-kA interrupting and short-circuit current rating.
- B.** Type HD, Heavy-Duty, Three Pole, Single-Throw Fusible Switch: -V ac, A; UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, with clips or bolt pads to accommodate specified fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- C.** Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, pilot, indicating and control devices.
- D.** Accessories:
1. Oiltight key switch for key-to-test function.
 2. Oiltight red ON pilot light.
 3. Isolated neutral lug; 100 percent rating.
 4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
 5. Form C alarm contacts that change state when switch is tripped.
 6. Three-pole, double-throw, fire-safety and alarm relay; 24-V dc coil voltage.
 7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.
 8. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.6 MOLDED-CASE CIRCUIT BREAKERS

- A.** Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
- B.** Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

- C. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated. Circuit breaker/circuit breaker combinations for series connected interrupting ratings shall be listed by UL as recognized component combinations. Any series rated combination used shall be marked on the end-use equipment along with the statement "Caution - Series Rated System. _____ Amps Available. Identical Replacement Component Required."
- D. MCCBs shall be equipped with a device for locking in the isolated position.
- E. Lugs shall be suitable for 140 deg F rated wire on 125-A circuit breakers and below.
- F. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 - 3. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

- A. Interruption of Existing Electric Service: 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 no fewer than seven days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Owner's written permission.
 - 4. Comply with NFPA 70E.

3.3 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in fusible devices.
- F. Comply with NFPA 70 and NECA 1.

3.4 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

END OF SECTION 262816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

LXT Eastside Development

SECTION 262816

Project #47732472
Permit Set 09/29/23

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SECTION 262913.03 - MANUAL AND MAGNETIC MOTOR CONTROLLERS

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. Enclosed full-voltage magnetic motor controllers.
 - 2. Combination full-voltage magnetic motor controllers.
 - 3. Combination reduced-voltage magnetic motor controllers.
 - 4. Identification.

1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. NC: Normally closed.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SCPD: Short-circuit protective device.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: For each type of magnetic controller.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Indicate dimensions, weights, required clearances, and location and size of each field connection.

3. Wire Termination Diagrams and Schedules: Include diagrams for signal, and control wiring. 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. Differentiate between manufacturer-installed and field-installed wiring.
4. Include features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, cover controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; .

1.6 FIELD CONDITIONS

- A. Ambient Environment Ratings: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 1. Ambient Temperature: Not less than 23 deg F and not exceeding 104 deg F.
 2. Altitude: Not exceeding 6600 feet for electromagnetic and manual devices.
 3. The effect of solar radiation is not significant.

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 use.
- B. UL Compliance: Fabricate and label magnetic motor controllers to comply with UL 508 and UL 60947-4-1.
- C. NEMA Compliance: Fabricate motor controllers to comply with ICS 2.
- D. Seismic Performance: Magnetic controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. The term "withstand" means "the controller will remain in place without separation of any parts when subjected to the seismic forces specified."
 2. Component Importance Factor: 1.0.

2.2 ENCLOSED FULL-VOLTAGE MAGNETIC MOTOR CONTROLLERS

- A. Description: Across-the-line start, electrically held, for nominal system voltage of 600-V ac and less for motors up to 10 hp
- B. 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. Eaton.
 - 2. General Electric Company.
 - 3. Siemens Industry, Inc., Energy Management Division.
 - 4. Square D; by Schneider Electric.
- C. Standard: Comply with NEMA ICS 2, general purpose, Class A.
- D. Configuration: Nonreversing.
- E. Control Power:
 - 1. For on-board control power, obtain from line circuit or from integral CPT. The CPT shall have capacity to operate integral devices and remotely located pilot, indicating, and control devices.
 - a. Spare CPT Capacity as Indicated on Drawings: 100 VA.

2.3 COMBINATION FULL-VOLTAGE MAGNETIC MOTOR CONTROLLER

- A. Description: Factory-assembled, combination full-voltage magnetic motor controller consisting of the controller described in this article, indicated disconnecting means, SCPD and OCPD, in a single enclosure.
- B. Standard: Comply with NEMA ICS 2, general purpose, Class A.
- C. Configuration: Nonreversing.
- D. Control Power:
 - 1. For on-board control power, obtain from line circuit or from integral CPT. The CPT shall have capacity to operate integral devices and remotely located pilot, indicating, and control devices.
 - a. Spare CPT Capacity: 100 VA.
- E. Overload Relays:
 - 1. Solid-State Overload Relay:

- a. Switch or dial selectable for motor-running overload protection.
 - b. Sensors in each phase.
 - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
- F. Class II ground-fault protection shall comply with UL 1053 to interrupt low-level ground faults. The ground-fault detection system shall include circuitry that will prevent the motor controller from tripping when the fault current exceeds the interrupting capacity of the controller. Equip with start and run delays to prevent nuisance trip on starting, and a trip indicator.

2.4 COMBINATION REDUCED-VOLTAGE MOTOR CONTROLLERS

- A. Description: Factory-assembled, combination reduced-voltage magnetic motor controller consisting of the controller described in this article, indicated disconnecting means, and SCPD and OCPD, in a single enclosure.
- B. Configuration:
 - 1. Wye-Delta Controller: Four contactors, with a three-phase starting resistor/reactor bank.
- C. Control Power: -V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
 - 1. Spare CPT Capacity: 100 VA.
- D. Overload Relays:
 - 1. Thermal Overload Relays: Bimetallic type.
 - a. Inverse-time-current characteristic.
 - b. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 - c. Ambient compensated.
 - d. Automatic resetting.
 - 2. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor-running overload protection.
 - b. Sensors in each phase.
 - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.

2.5 MULTISPEED MAGNETIC CONTROLLERS

- A. Standard: Comply with NEMA ICS 2, general purpose, Class A.

1. Configuration: Nonreversing, multispeed.
2. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
 - a. Operating Voltage: Manufacturer's standard, unless indicated.
3. Power Contacts: Totally enclosed, double break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
4. Control Power: 24 -V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
 - a. Spare CPT Capacity: 100 VA.

2.6 IDENTIFICATION

- A. Controller Nameplates: Laminated acrylic or melamine plastic signs, as described in Section 260553 "Identification for Electrical Systems," for each compartment, mounted with corrosion-resistant screws.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and space conditions for compliance with requirements for motor controllers, their relationship with the motors, and other conditions affecting performance of the Work.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Wall-Mounted Controllers: Install magnetic controllers on walls with tops at uniform height indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems" unless otherwise indicated.
- C. Floor-Mounted Controllers: Install controllers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
- D. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- E. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

- F. 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.
- G. Setting of Overload Relays: Select and set overloads on the basis of full-load current rating as shown on motor nameplate. Adjust setting value for special motors as required by NFPA 70 for motors that are high-torque, high-efficiency, and so on.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 SYSTEM FUNCTION TESTS

- A. System function tests shall prove the correct interaction of sensing, processing, and action devices. Perform system function tests after field quality control tests have been completed and all components have passed specified tests.
 - 1. Develop test parameters and perform tests for the purpose of evaluating performance of integral components and their functioning as a complete unit within design requirements and manufacturer's published data.
 - 2. Verify the correct operation of interlock safety devices for fail-safe functions in addition to design function.
 - 3. Verify the correct operation of sensing devices, alarms, and indicating devices.
- B. Motor controller will be considered defective if it does not pass the system function tests and inspections.
- C. Prepare test and inspection reports.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain switchgear.

END OF SECTION

SECTION 264313 - SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Type 2 surge protective devices.
2. Enclosures.

1.2 DEFINITIONS

- A. I_n : Nominal discharge current.
- B. Maximum Continuous Operating Voltage (MCOV): The maximum designated RMS value of the power frequency voltage that may be continuously applied to the mode of protection of an SPD.
- C. Metal-Oxide Varistor (MOV): An electronic component with a significant bidirectional, nonlinear current-voltage characteristic.
- D. Mode(s), Modes of Protection, or Protection Modes: Electrical paths where the SPD offers defense against transient overvoltages. Examples include: line to neutral (L-N), line to ground (L-G), line to line (L-L), and neutral to ground (N-G).
- E. SCCR: Short-circuit current rating.
- F. Type 1 SPDs: Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service disconnect overcurrent device.
- G. Type 2 SPDs: Permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel.
- H. Type 3 SPDs: Point of utilization SPDs.
- I. Type 4 SPDs: Component SPDs, including discrete components, as well as assemblies.
- J. Type 5 SPDs: Discrete component surge suppressors, such as MOVs that may be mounted on a printed wiring board, connected by its leads or provided within an enclosure with mounting means and wiring terminations.
- K. Voltage Protection Rating (VPR): A rating selected from UL 1449 list of preferred values assigned to each mode of protection.

PART 2 - PRODUCTS

2.1 TYPE 2 SURGE PROTECTIVE DEVICES (SPDs)

- A. Source Limitations: Obtain devices from single source from single manufacturer.
- B. General Characteristics:
 - 1. Service Entrance Location: Peak Surge Current Rating: Minimum single pulse surge current withstand rating per phase must not be less than 100 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.
 - 2. Branch Panel Location: Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 100 kA/ Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.
 - 3. Ten distinct protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V 208Y/120 V, three-phase, four-wire circuits must not exceed the following:
 - a. Line to Neutral: 1200 V for 480Y/277 V 700 V for 208Y/120 V.
 - b. Line to Ground: 1200 V for 480Y/277 V 700 V for 208Y/120 V.
 - c. Neutral to Ground: .
 - d. Line to Line: 2000 V for 480Y/277 V 1200 V for 208Y/120 V.
 - 4. Six distinct protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits must not exceed the following:
 - a. Line to Neutral: 700 V.
 - b. Line to Ground: 700 V.
 - c. Neutral to Ground: 700 V.
 - d. Line to Line: 1200 V.
 - 5. SCCR: Equal or exceed 100 kA.
 - 6. I_n Rating: 20 kA.

2.2 ENCLOSURES

- A. Indoor Enclosures: Type 1.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide OCPD and disconnect for installation of SPD in accordance with UL 1449 and manufacturer's instructions.

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- B. Install leads between disconnects and SPDs short, straight, twisted, and in accordance with manufacturer's instructions. Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
 - 1. Do not splice and extend SPD leads unless specifically permitted by manufacturer.
 - 2. Do not exceed manufacturer's recommended lead length.
 - 3. Do not bond neutral and ground.
- C. Use crimped connectors and splices only. Wire nuts are unacceptable.

3.2 STARTUP SERVICE

- A. Complete startup checks in accordance with manufacturer's instructions.
- B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests; reconnect them immediately after the testing is over.
- C. Energize SPDs after power system has been energized, stabilized, and tested.

3.3 DEMONSTRATION

- A. Train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 264313

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SECTION 265119 - LED INTERIOR LIGHTING**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 solid state luminaries that use LED technology.
 - 2. Materials.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Include emergency lighting units, including batteries and chargers.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified in the Light Fixture Schedule on the plans or an approved equal.
- B. Seismic Performance:
 - 1. Luminaires shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
 - 2. Luminaires and lamps shall be labeled vibration and shock resistant.
 - 3. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified."
- C. Ambient Temperature: 41 to 104 deg F.
 - 1. Relative Humidity: Zero to 95 percent.
- D. Altitude: Sea level to 1000 feet.

2.2 LUMINAIRE 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. Luminaries shall be provided with internal drivers unless noted otherwise.
- C. Lamp shall be rated for 50,000 hours minimum and have a CRI of minimum 80.
- D. Fixture Whips: Minimum #14 cu with ground wire in 1/2" C.
- E. 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. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated.
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.

3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

F. Plastic Diffusers, Covers and Globes:

1. Acrylic Lighting Diffusers: 100 percent 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 inch (3.175 mm) minimum unless different thickness is scheduled.
 - b. UV stabilized.
2. Glass: Annealed crystal glass, unless otherwise indicated.

G. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI.

H. Recessed luminaires shall comply with NEMA LE 4.

I. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

J. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

K. California Title 24 compliant.

2.3 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for sheet steel.

C. Stainless Steel:

1. Manufacturer's standard grade.
2. Manufacturer's standard type, ASTM A240/240M.

D. Galvanized Steel: ASTM A653/A653M.

E. Aluminum: ASTM B209.

2.4 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

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 luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
1. Sized and rated for luminaire weight.
 2. Able to maintain luminaire position after cleaning and relamping.

3. Provide support for luminaire without causing deflection of ceiling or wall.
 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- E. Flush-Mounted Luminaires:
1. Secured to outlet box.
 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 3. Trim ring flush with finished surface.
- F. Wall-Mounted Luminaires:
1. Attached to structural members in walls.
 2. Do not attach luminaires directly to gypsum board.
- G. Suspended Luminaires:
1. Ceiling Mount:
 - a. Two 5/32-inch- diameter aircraft cable supports adjustable to 10 feet in length.
 - b. Pendant mount with 5/32-inch- diameter aircraft cable supports adjustable to 10 feet in length.
 - c. Hook mount.
 2. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 3. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 4. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
 5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- H. Ceiling-Grid-Mounted Luminaires:
1. Secure to any required outlet box.
 2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
 3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.
- I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 STARTUP SERVICE

- A. Comply with requirements for startup specified in Section 260943.16 "Addressable-Luminaire Lighting Controls."
- B. Comply with requirements for startup specified in Section 260943.23 "Relay-Based Lighting Controls."

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION

SECTION 265613 - LIGHTING POLES AND STANDARDS**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. Poles and accessories for support of luminaires.

1.3 DEFINITIONS

- A. EPA: Equivalent projected area.
- B. Luminaire: Complete luminaire.
- C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.
- D. Standard: See "Pole."

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Package aluminum poles for shipping according to ASTM B 660.
- B. Store poles on decay-resistant skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Handle wood poles so they will not be damaged. Do not use pointed tools that can indent pole surface more than 1/4 inch deep. Do not apply tools to section of pole to be installed below finished grade.
- D. Retain factory-applied pole wrappings on fiberglass and laminated wood poles until right before pole installation. Handle poles with web fabric straps.
- E. Retain factory-applied pole wrappings on metal poles until right before pole installation. Handle poles with web fabric straps.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design pole foundation and pole power system.
- B. Seismic Performance: Foundation and pole shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 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: 1.0.
 - 3. .
- C. Structural Characteristics: Comply with AASHTO LTS-6-M.
- D. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied according to AASHTO LTS-6-M.
- E. Live Load: Single load of 500 lbf distributed according to AASHTO LTS-6-M.
- F. Ice Load: Load of 3 lbf/sq. ft., applied according to AASHTO LTS-6-M for applicable areas on the Ice Load Map.
- G. Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to AASHTO LTS-6-M.
 - 1. Basic wind speed for calculating wind load for poles exceeding 50 feet in height is 100 mph.
 - a. Wind Importance Factor: 1.0.
 - b. Minimum Design Life: 50 years.
 - c. Velocity Conversion Factor: 1.0.
 - 2. Basic wind speed for calculating wind load for poles 50 feet high or less is 100 mph.
 - a. Wind Importance Factor: 1.0.
 - b. Minimum Design Life: 25 years.
 - c. Velocity Conversion Factor: 1.0.
- H. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.1 to obtain the EPA to be used in pole selection strength analysis.
- I. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

2.2 STEEL POLES

- 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 LitePole.
 2. Bridgewell Resources.
 3. Cooper Lighting, an Eaton business.
 4. E-conolight.
 5. EGS/Appleton Electric.
 6. H.E. Williams.
 7. Hapco.
 8. Hubbell Incorporated.
 9. KIM Lighting.
 10. Lithonia Lighting; Acuity Brands Lighting, Inc.
 11. LSI Industries.
 12. Millerbernd Manufacturing Company.
 13. NAFCO International.
 14. Ruud Lighting Direct.
 15. Union Metal Corporation.
- B. Poles: Comply with ASTM A 500/A 500M, Grade B carbon steel with a minimum yield of 46,000 psig; one-piece construction up to 40 feet in height with access handhole in pole wall.
1. Shape: Round, tapered Round, straight Square, tapered Square, straight.
 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- C. Steel Mast Arms: Single-arm Truss Davit type, continuously welded to pole attachment plate. Material and finish same as plate.
- D. Brackets for Luminaires: Detachable, cantilever, without underbrace.
1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adapter, then bolted together with stainless -steel bolts.
 2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.
- E. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- F. Fasteners: Stainless steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.
1. Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

- G. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size indicated, and accessible through handhole.
- H. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.
- I. Galvanized Finish: After fabrication, hot-dip galvanize according to ASTM A 123/A 123M.
- J. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces according to SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
 - 2. Powder Coat: Comply with AAMA 2604.
 - a. Electrostatic-applied powder coating; single application and cured to a minimum 2.5- to 3.5-mils dry film thickness. Coat interior and exterior of pole for equal corrosion protection.
 - b. Color: . As indicated on plans.

2.3 ALUMINUM POLES

- A. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
 - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 2. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.

2.4 MOUNTING HARDWARE

- A. Anchor Bolts: Manufactured to ASTM F 1554, Grade 55, with a minimum yield strength of 55,000 psi.
 - 1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
- B. Nuts: ASTM A 563, Grade A, Heavy-Hex.
 - 1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
 - 2. Two nuts provided per anchor bolt .

C. Washers: ASTM F 436, Type 1.

1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
2. Two washer(s) provided per anchor bolt.

2.5 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 unacceptable. 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 poles, luminaire-mounting devices, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.
- C. Examine roughing-in for foundation and conduit to verify actual locations of installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 POLE FOUNDATION

- A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123 M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- B. Anchor Bolts: Install plumb using manufacturer-supplied template, uniformly spaced.

3.3 POLE INSTALLATION

- A. Alignment: Align poles as indicated.

- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on drawing.
 - 1. Fire Hydrants and Water Piping: 60 inches.
 - 2. Water, Gas, Electric, Communications, and Sewer Lines: 10 feet.
 - 3. Trees: 15 feet from tree trunk.
 - 4. .
- C. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.
 - 1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
 - 2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
 - 3. Install base covers unless otherwise indicated.
 - 4. Use a short piece of 1/2 -inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- D. Poles and Pole Foundations Set in Concrete-Paved Areas: Install poles with a minimum 6-inch-wide, unpaved gap between the pole or pole foundation and the edge of the adjacent concrete slab. Fill unpaved ring with pea gravel. Insert material to a level 1 inch below top of concrete slab.
- E. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

3.4 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum using insulating fittings or treatment.
- B. Steel Conduits: Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50-percent overlap.

3.5 GROUNDING

- A. Ground Metal Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole unless otherwise indicated.

3.6 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

END OF SECTION 265613

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SECTION 265619 - EXTERIOR LIGHTING**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 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

- A. Shop Drawings: For nonstandard or custom luminaires.
 - 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of luminaire 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.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.5 FIELD CONDITIONS

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

- B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
 - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 FINISHES

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. 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.
- B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 2. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.
 - a. Color: As called for in Light Fixture Schedule.

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 luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Examine walls, roofs, overhang ceilings for suitable conditions where luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Support luminaires without causing deflection of finished surface.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- F. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls or.

- G. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- H. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.
- I. Coordinate layout and installation of luminaires with other construction.
- J. Adjust luminaires that require field adjustment or aiming.
- K. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

- A. Aim as indicated on Drawings.
- B. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.5 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.6 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

3.8 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265619

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SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS 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. Grounding conductors.
 - 2. Grounding connectors.
 - 3. Grounding busbars.
 - 4. Grounding rods.
 - 5. Grounding labeling.

1.3 DEFINITIONS

- A. BCT: Bonding conductor for telecommunications.
- B. TGB: Telecommunications grounding busbar.
- C. TMGB: Telecommunications main grounding busbar.
- D. Service Provider: The operator of a service that provides telecommunications transmission delivered over access provider facilities.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: For communications equipment room signal reference grid. Include plans, elevations, sections, details, and attachments to other work.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Comply with UL 486A-486B.
- B. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
 - 1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
- C. Cable Tray Grounding Jumper:
 - 1. Not smaller than No. 6 AWG and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
 - 2. Not smaller than No. 10 AWG and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with one hole and standard barrel for one crimp. If jumper is a flexible braid, it shall have a one- or two-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.

2.2 GROUNDING BUSBARS

- 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 or comparable product by one of the following:
 - 1. Chatsworth Products, Inc.
 - 2. Harger Lightning & Grounding.
 - 3. Panduit Corp.
- C. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with TIA-607-B.
 - 1. Predrilling shall be with holes for use with lugs specified in this Section.
 - 2. Mounting Hardware: Stand-off brackets that provide a 4-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
 - 3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of BCT connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.
- B. Comply with NECA 1.
- C. Comply with TIA-607-B.

3.3 APPLICATION

- A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
 - 1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
 - 2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2 AWG minimum.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.

4. Connections to Structural Steel: Welded connectors.

D. Conductor Support:

1. Secure grounding and bonding conductors at intervals of not less than 36 inches.

E. Grounding and Bonding Conductors:

1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
2. Install without splices.
3. Support at not more than 36-inch intervals.
4. Install grounding and bonding conductors in 3/4-inch PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
 - a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

3.4 GROUNDING ELECTRODE SYSTEM

- A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than No. 1/0 AWG.

3.5 GROUNDING BUSBARS

- A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches minimum from wall, 12 inches above finished floor unless otherwise indicated.
- B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.6 CONNECTIONS

- A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:

1. Use crimping tool and the die specific to the connector.
 2. Pretwist the conductor.
 3. Apply an antioxidant compound to all bolted and compression connections.
- D. Primary Protector: Bond to the TMGB with insulated bonding conductor.
- E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot of conductor length, up to a maximum size of No. 3/0 AWG unless otherwise indicated.
- F. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.
- G. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.
- H. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA-568-C.1 and TIA-568-C.2 when grounding shielded balanced twisted-pair cables.
- I. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.
- J. Access Floors: Bond all metal parts of access floors to the TGB.
- K. Equipment Room Signal Reference Grid: Provide a low-impedance path between telecommunications cabinets, equipment racks, and the reference grid, using No. 6 AWG bonding conductors.
1. Install the conductors in grid pattern on 4-foot centers, allowing bonding of one pedestal from each access floor tile.
 2. Bond the TGB of the equipment room to the reference grid at two or more locations.
 3. Bond all conduits and piping entering the equipment room to the TGB at the perimeter of the room.
- L. Towers and Antennas:
1. Ground Ring: Buried at least 30 inches below grade and at least 24 inches from the base of the tower or mounting.
 2. Bond each tower base and metallic frame of a dish to the ground ring, buried at least 18 inches below grade.

3. Bond the ground ring and antenna grounds to the equipment room TMGB or TGB, buried at least 30 inches below grade.
4. Bond metallic fences within 6 feet of towers and antennas to the ground ring, buried at least 18 inches below grade.
5. Special Requirements for Roof-Mounted Towers:
 - a. Roof Ring: Meet requirements for the ground ring except the conductors shall comply with requirements in Section 264113 "Lightning Protection for Structures."
 - b. Bond tower base footings steel, the TGB in the equipment room, and antenna support guys to the roof ring.
 - c. Connect roof ring to the perimeter conductors of the lightning protection system.
6. Waveguides and Coaxial Cable:
 - a. Bond cable shields at the point of entry into the building to the TGB and to the cable entrance plate, using No. 2 AWG bonding conductors.
 - b. Bond coaxial cable surge arrester to the ground or roof ring using bonding conductor size recommended by surge-arrester manufacturer.

3.7 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- B. Comply with IEEE C2 grounding requirements.
- C. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches extends above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- D. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect grounding conductors to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

END OF SECTION

SECTION 270529 - HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves.
2. Firestopping relating to communications work.
3. Equipment bases and supports.

B. Related Sections:

1. Section 260529 - Hangers and Supports for Electrical Systems.

1.2 REFERENCES

A. ASTM International:

1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

B. FM Global:

1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

C. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.

D. Underwriters Laboratories Inc.:

1. UL 263 - Fire Tests of Building Construction and Materials.
2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
3. UL 1479 - Fire Tests of Through-Penetration Firestops.
4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
5. UL - Fire Resistance Directory.

E. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

1.3 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SYSTEM DESCRIPTION

- A. Firestopping Materials: Comply with requirements of Section 078400.
- B. Firestopping Materials: UL 1479 to achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1 hour fire rating.
- C. Firestopping Materials: UL 1479, to achieve fire ratings of adjacent construction
- D. Firestop interruptions to fire rated assemblies, materials, and components.

1.5 PERFORMANCE REQUIREMENTS

- A. Firestopping Materials: Comply with requirements of Section 078400.
- B. Firestopping: Conform to applicable code for fire resistance ratings and surface burning characteristics.
- C. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.6 QUALITY ASSURANCE

- A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
 2. Floor Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - a. Floor Penetrations Within Wall Cavities: T-Rating is not required.
- B. Through Penetration Firestopping of Non-Fire Rated Floor Assemblies: Materials to resist free passage of flame and products of combustion.

1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
- D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- E. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 016000 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.
- C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. **Sleeves for** Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.

2.2 FIRESTOPPING

- A. Firestopping Materials: Comply with requirements of Section 078400.
- B. Manufacturers:
 - 1.
 - 2.
 - 3.
 - 4.
 - 5.
- C. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Foam Firestopping Compounds: Single component foam compound.
- D. Color: Black.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.
- C. Verify openings are ready to receive firestopping.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- D. Do not drill or cut structural members.
- E. Obtain permission from Architect/Engineer before drilling or cutting structural members.

3.3 INSTALLATION - HANGERS AND SUPPORTS

A. Anchors and Fasteners:

1. Concrete Structural Elements: Provide , expansion anchors and preset inserts.
2. Steel Structural Elements: Provide beam clamps.
3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
4. Solid Masonry Walls: Provide expansion anchors and preset inserts.
5. Sheet Metal: Provide sheet metal screws.
6. Wood Elements: Provide wood screws.

B. Inserts:

1. Install inserts for placement in concrete forms.
2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

C. Install conduit and raceway support and spacing in accordance with NEC.

D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.

E. Install multiple conduit runs on common hangers.

F. Supports:

1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
2. Install surface mounted cabinets and panelboards with minimum of four anchors.
3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch off wall.
4. Support vertical conduit at every floor.

3.4 INSTALLATION - FIRESTOPPING

A. Firestopping Materials: Comply with requirements of Section 078400.

B. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.

C. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

- D. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating .
- E. Fire Rated Surface:
 - 1. Seal opening at wall, ceiling, and roof as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
 - 2. Where cable tray, conduit, penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported equipment. Refer to Section 033000.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

3.6 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with adjustable interlocking rubber links.
- B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- G. Install stainless steel escutcheons at finished surfaces.

3.7 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for inspecting, testing.
- B. Section 017000 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.8 CLEANING

- A. Section 017000 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean adjacent surfaces of firestopping materials.

3.9 PROTECTION OF FINISHED WORK

- A. Section 017000 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

END OF SECTION 280528.29

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SECTION 270536 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes cable tray.
- B. Related Sections:
 - 1. Section 270526 - Grounding and Bonding for Communications Systems.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 2. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. National Electrical Manufacturers Association:
 - 1. NEMA FG 1 - Nonmetallic Cable Tray Systems.
 - 2. NEMA VE 1 - Metal Cable Tray Systems.
 - 3. NEMA VE 2 - Metal Cable Tray Installation Guidelines.

PART 2 - PRODUCTS

2.1 METAL LADDER-TYPE CABLE TRAY

- A. Manufacturers:
 - 1. Allied Tube & Conduit; a part of Atkore International.
 - 2. B-line, an Eaton business.
 - 3. Calvert Company (The).
 - 4. Chalfant Manufacturing Company.
 - 5. Legrand US.
 - 6. MP Husky USA Cable Tray & Cable Bus.
 - 7. Niedax Inc.
 - 8. Square D; by Schneider Electric.
- B. Product Description: NEMA VE 1, Class 20C ladder type tray.

- C. Material: Steel.
- D. Finish: Galvanized to ASTM A123/A123M; galvanize after fabrication.
- E. Inside Width: As indicated on Drawings.
- F. Inside Depth: As indicated on Drawings.
- G. Straight Section Rung Spacing: 12 inches on center.
- H. Inside Radius of Fittings: As indicated on Drawings.
- I. Furnish manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install metal cable tray in accordance with NEMA VE 2.
- B. Install fiberglass cable tray in accordance with NEMA FG 1.
- C. Install expansion connectors where recommended by manufacturer.
- D. Install firestopping in accordance with Section 078400 to sustain ratings when passing cable tray through fire-rated elements.
- E. Ground and bond metal cable tray in accordance with Section 270526.
 - 1. Provide continuity between tray components.
 - 2. Use anti-oxidant compound to prepare aluminum contact surfaces before assembly.
 - 3. Install 2 AWG bare copper equipment grounding conductor through entire length of tray; bond to each component.
 - 4. Make connections to tray using mechanical, compression or exothermic connectors.

END OF SECTION

SECTION 271343 - COMMUNICATIONS SERVICES CABLING**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes arrangement with Telecommunications Utility Company for telecommunication service; and backboards, termination devices, outlets, and premises wiring.

B. Related Sections:

1. Section 262726 - Wiring Devices: Wall plates.
2. Section 270526 - Grounding and Bonding for Communications Systems.
3. Section 270536 - Cable Trays for Communications Systems.

1.2 REFERENCES

- A. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

- B. National Fire Protection Association:

1. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

- C. Telecommunications Industry Association/Electronic Industries Alliance:

1. TIA/EIA 568 - Commercial Building Telecommunications Cabling Standard.
2. TIA/EIA 569 - Commercial Building Standard for Telecommunications Pathways and Spaces.

- D. Underwriters Laboratories, Inc.:

1. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and their Accessories Installed in Air-Handling Spaces.

1.3 SYSTEM DESCRIPTION

- A. Service entrance from Telecommunications Utility Company.
- B. Service Entrance Pathway: Empty ducts and raceway from point of Telephone Utility connection at manhole to building service terminal backboard.

- C. Backbone Pathway: Conform to TIA/EIA 569 using as indicated on Drawings.
- D. Horizontal Pathway: Conform to TIA/EIA 569, using raceway as indicated on Drawings.
- E. Entrance Wiring: By Telephone Utility Company.
- F. Backbone Wiring: Complete from entrance equipment to each telecommunications closet using [shielded] [optical fiber] backbone cables.
- G. Horizontal Wiring: Complete from telecommunications closet to each outlet using shielded horizontal cables.

1.4 SUBMITTALS

- A. Product Data: Submit catalog data for each termination device, cable, and outlet device.

1.5 QUALITY ASSURANCE

- A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet when tested in accordance with NFPA 262.
- B. Provide combustible electrical equipment exposed within plenums with peak rate of heat release not greater than 100 kW, peak optical density not greater than 0.5, and average optical density not greater than 0.15 when tested in accordance with UL 2043.

1.6 COORDINATION

- A. Coordinate with utility company, relocation of overhead or underground lines interfering with construction. Where power lines are to be relocated, bill utility costs directly to Owner.
- B. Contact utility company regarding charges related to service installation. Include utility charges in this contract.
- C. Utility charges for service installation paid by Owner and are not part of this contract.

PART 2 - PRODUCTS

2.1 TELEPHONE TERMINATION CABINETS

- A. Manufacturers:
 - 1. B-line, an Eaton business.
 - 2. Erickson Electrical Equipment Company.

3. Hoffman; a brand of Pentair Equipment Protection.
4. Hubbell Premise Wiring.

B. Cabinet Fronts: Steel, surface type screw cover front, concealed hinge, double doors, and flush lock .

C. Finish: Gray baked enamel.

2.2 PATCH PANEL

A. Manufacturers:

1. Hyperline Systems Inc.
2. Siemon.

B. Product Description: TIA/EIA 568, rack-mounted assembly of terminals and accessory patch cords, with adequate capacity for active and spare circuits.

2.3 TELEPHONE OUTLET JACKS

A. Manufacturers:

1. Eaton (Arrow Hart).
2. Leviton Manufacturing Co., Inc.
3. Philips Lighting Company.

B. Product Description: Conform to TIA/EIA 568 requirements for cable connectors for specific cable types.

2.4 OPTICAL FIBER BACKBONE CABLE

A. Manufacturers:

1. AMP NETCONNECT; a TE Connectivity Ltd. company.
2. CommScope, Inc.
3. General Cable; General Cable Corporation.
4. Mohawk; a division of Belden Networking, Inc.
5. Superior Essex Inc.

B. Product Description: TIA/EIA 568, 62.5/125 um optical fiber plenum rated cable.

2.5 SHIELDED HORIZONTAL CABLE

A. Manufacturers:

1. Hyperline Systems Inc.

2. Mohawk; a division of Belden Networking, Inc.
 3. Siemon.
- B. Product Description: TIA/EIA 568, 150-ohm shielded, twisted-pair plenum rated cable with 2 pairs, 22 AWG copper conductor.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install pathways in accordance with TIA/EIA 569.
- B. Install wire and cable in accordance with TIA/EIA 568.
- C. Install termination backboards plumb, and attach securely to building wall .
- D. Install pull wire in each empty telephone conduit over 10 feet in length or containing bends.
- E. Ground and bond pathways, cable shields, and equipment in accordance with Section 270526.

3.2 FIELD QUALITY CONTROL

- A. Inspect and test optical fiber cables in accordance with NETA ATS, except Section 4. Perform inspections and tests listed in NETA ATS, Section 7.25.
- B. Inspect and test copper cables and terminations in accordance with TIA/EIA 568.

END OF SECTION

SECTION 284621.11 - ADDRESSABLE FIRE-ALARM 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. Addressable fire-alarm system.
2. Fire-alarm control unit (FACU).
3. Manual fire-alarm boxes.
4. System smoke detectors.
5. Duct smoke detectors.
6. Carbon monoxide detectors.
7. Heat detectors.
8. Fire-alarm notification appliances.
9. Fire-alarm remote annunciators.
10. Fire-alarm addressable interface devices.
11. Digital alarm communicator transmitters (DACTs).

B. Related Requirements:

1. Section 087100 "Door Hardware" for magnetic door holders that release in response to fire-alarm outputs.

1.3 DEFINITIONS

- A. DACT: Digital alarm communicator transmitter.
- B. EMT: Electrical metallic tubing.
- C. FACU: Fire-alarm control unit.
- D. High-Performance Building: A building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.
- E. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the 2007 Energy Independence and Security Act (EISA).

- F. NICET: National Institute for Certification in Engineering Technologies.
- G. PC: Personal computer.
- H. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
 - 1. Control Voltage: Listed and labeled for use in remote-control, signaling, and power-limited circuits supplied by a Class 2 or Class 3 power supply having rated output not greater than 150 V and 5 A, allowing use of alternate wiring methods complying with NFPA 70, Article 725.
 - 2. Low Voltage: Listed and labeled for use in circuits supplied by a Class 1 or other power supply having rated output not greater than 1000 V, requiring use of wiring methods complying with NFPA 70, Article 300, Part I.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: For fire-alarm system.
 - 1. Comply with recommendations and requirements in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 - 2. Include plans, elevations, sections, and details, including details of attachments to other Work.
 - 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
 - 4. Annunciator panel details as required by authorities having jurisdiction.
 - 5. Detail assembly and support requirements.
 - 6. Include voltage drop calculations for notification-appliance circuits.
 - 7. Include battery-size calculations.
 - 8. Include input/output matrix.
 - 9. Include written statement from manufacturer that equipment and components have been tested as a system and comply with requirements in this Section and in NFPA 72.
 - 10. Include performance parameters and installation details for each detector.
 - 11. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 - 12. Provide program report showing that air-sampling detector pipe layout balances pneumatically within airflow range of air-sampling detector.
 - 13. Provide control wiring diagrams for fire-alarm interface to HVAC; coordinate location of duct smoke detectors and access to them.
 - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
 - b. Show field wiring and equipment required for HVAC unit shutdown on alarm.
 - c. Locate detectors in accordance with manufacturer's written instructions.
 - d. Show air-sampling detector pipe routing.

14. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
15. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

B. Delegated Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1. Drawings showing location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of device.
2. Design Calculations: Calculate requirements for selecting spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
2. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
3. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
4. Keys and Tools: One extra set for access to locked or tamperproofed components.
5. Audible and Visual Notification Appliances: One of each type installed.
6. Fuses: Two of each type installed in system. Provide in box or cabinet with compartments marked with fuse types and sizes.

1.6 FIELD CONDITIONS

A. Seismic Conditions: Unless otherwise indicated on Contract Documents, specified Work in this Section must withstand the seismic hazard design loads determined in accordance with ASCE/SEI 7 for installed elevation above or below grade.

1. The term "withstand" means "unit must remain in place without separation of parts from unit when subjected to specified seismic design loads and unit must be fully operational after seismic event."

PART 2 - PRODUCTS**2.1 ADDRESSABLE FIRE-ALARM SYSTEM****A. Description:**

1. Noncoded, UL-certified addressable system, with multiplexed signal transmission and voice-and-strobe notification for evacuation.

B. Performance Criteria:

1. Regulatory Requirements:

- a. Fire-Alarm Components, Devices, and Accessories: Listed and labeled by a NRTL in accordance with NFPA 70 for use with selected fire-alarm system and marked for intended location and application.

2. General Characteristics:

- a. Automatic sensitivity control of certain smoke detectors.
- b. Fire-alarm signal initiation must be by one or more of the following devices and systems:

- 1) Manual stations.
- 2) Heat detectors.
- 3) Flame detectors.
- 4) Smoke detectors.
- 5) Duct smoke detectors.
- 6) Carbon monoxide detectors.
- 7) Automatic sprinkler system water flow.
- 8) .

- c. Fire-alarm signal must initiate the following actions:

- 1) Continuously operate alarm notification appliances, including voice evacuation notices.
- 2) Identify alarm and specific initiating device at FACU and remote annunciators.
- 3) Transmit alarm signal to remote alarm receiving station.
- 4) Unlock electric door locks in designated egress paths.
- 5) Release fire and smoke doors held open by magnetic door holders.
- 6) Activate voice/alarm communication system.
- 7) Switch HVAC equipment controls to fire-alarm mode.
- 8) Close smoke dampers in air ducts of designated air-conditioning duct systems.
- 9) Recall elevators to primary or alternate recall floors.
- 10) Activate elevator power shunt trip.

- 11) Activate emergency shutoffs for gas and fuel supplies.
 - 12) Record events in system memory.
 - 13) Record events by system printer.
- d. Supervisory signal initiation must be by one or more of the following devices and actions:
- 1) Valve supervisory switch.
 - 2) High- or low-air-pressure switch of dry-pipe or preaction sprinkler system.
 - 3) Alert and Action signals of air-sampling detector system.
 - 4) Elevator shunt-trip supervision.
 - 5) Independent fire-detection and -suppression systems.
 - 6) Zones or individual devices have been disabled.
 - 7) FACU has lost communication with network.
- e. System trouble signal initiation must be by one or more of the following devices and actions:
- 1) Open circuits, shorts, and grounds in designated circuits.
 - 2) Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 - 3) Loss of communication with addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
 - 4) Loss of primary power at FACU.
 - 5) Ground or single break in internal circuits of FACU.
 - 6) Abnormal ac voltage at FACU.
 - 7) Break in standby battery circuitry.
 - 8) Failure of battery charging.
 - 9) Abnormal position of switch at FACU or annunciator.
 - 10) Voice signal amplifier failure.
 - 11) Hose cabinet door open.
- f. System Supervisory Signal Actions:
- 1) Initiate notification appliances.
 - 2) Identify specific device initiating event at FACU and remote annunciators.
 - 3) Record event on system printer.
 - 4) After time delay of 200 seconds, transmit trouble or supervisory signal to remote alarm receiving station.
 - 5) Transmit system status to building management system.
 - 6) Display system status on graphic annunciator.
- g. Network Communications:
- 1) Provide network communications for fire-alarm system in accordance with fire-alarm manufacturer's written instructions.
 - 2) Provide network communications pathway per manufacturer's written instructions and requirements in NFPA 72 and NFPA 70.

- 3) Provide integration gateway using BACnet for connection to building automation system.
- h. System Printer:
 - 1) Printer must be listed and labeled as integral part of fire-alarm system.
- i. Device Guards:
 - 1) Description: Welded wire mesh of size and shape for manual station, smoke detector, gong, or other device requiring protection.
 - a) Factory fabricated and furnished by device manufacturer.
 - b) Finish: Paint of color to match protected device.
- j. Document Storage Box:
 - 1) Description: Enclosure to accommodate standard 8-1/2-by-11 inch manuals and loose document records. Legend sheet will be permanently attached to door for system required documentation, key contacts, and system information. Provide two key ring holders with location to mount standard business cards for key contact personnel.
 - 2) Material and Finish: 18-gauge cold-rolled steel; four mounting holes.
 - 3) Color: Red powder-coat epoxy finish.
 - 4) Labeling: Permanently screened with 1 inch high lettering "SYSTEM RECORD DOCUMENTS" with white indelible ink.
 - 5) Security: Locked with 3/4 inch barrel lock. Provide solid 12 inch stainless steel piano hinge.

2.2 FIRE-ALARM CONTROL UNIT (FACU)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Honeywell International (Fire-Lite Alarms).
 - 2. Honeywell International (Honeywell Gamewell-FCI).
 - 3. Honeywell International (Notifier).
 - 4. Honeywell International (Silent Knight).
 - 5. United Technologies Corporation (UTC Climate, Controls & Security - Edwards).
- B. Description: Field-programmable, microprocessor-based, modular, power-limited design with electronic modules.
- C. Performance Criteria:
 - 1. Regulatory Requirements: Comply with NFPA 72 and UL 864.
 - 2. General Characteristics:

- a. System software and programs must be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining information through failure of primary and secondary power supplies.
- b. Include real-time clock for time annotation of events on event recorder and printer.
- c. Provide communication between FACU and remote circuit interface panels, annunciators, and displays.
- d. FACU must be listed for connection to central-station signaling system service.
- e. Provide nonvolatile memory for system database, logic, and operating system and event history. System must require no manual input to initialize in the event of complete power down condition. FACU must provide minimum 500-event history log.
- f. Addressable Initiation Device Circuits: FACU must indicate which communication zones have been silenced and must provide selective silencing of alarm notification appliance by building communication zone.
- g. Fire-Alarm Annunciator: Arranged for interface between human operator at FACU and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and programming and control menu.
 - 1) Annunciator and Display: LCD, 80 characters, minimum.
 - 2) Keypad: Arranged to permit entry and execution of programming, display, and control commands.
- h. Alphanumeric Display and System Controls: Arranged for interface between human operator at FACU and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and programming and control menu.
 - 1) Annunciator and Display: LCD, two three Insert number line(s) of 40 80 Insert number characters, minimum.
 - 2) Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into system for control of smoke-detector sensitivity and other parameters.
- i. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
 - 1) Pathway Class Designations: NFPA 72, Class B.
 - 2) Pathway Survivability: Level 0 .
 - 3) Install no more than 50 addressable devices on each signaling-line circuit.
 - 4) Install fault circuit isolators to comply with circuit performance requirements of NFPA 72 or with manufacturer's written instructions, whichever is more conservative.
- j. Serial Interfaces:
 - 1) One dedicated RS 485 port for remote station operation using point ID DACT.

- 2) One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
 - 3) One USB port for PC configuration.
 - 4) One RS 232 port for air-aspirating smoke detector connection.
 - 5) One RS 232 port for voice evacuation interface.
- k. Smoke-Alarm Verification:
- 1) Initiate audible and visible indication of "alarm-verification" signal at FACU.
 - 2) Activate approved "alarm-verification" sequence at FACU and detector.
 - 3) Record events by system printer.
 - 4) Sound general alarm if alarm is verified.
 - 5) Cancel FACU indication and system reset if alarm is not verified.
- l. Notification-Appliance Circuit:
- 1) Audible appliances must sound in three-pulse temporal pattern, as defined in NFPA 72.
 - 2) Where notification appliances provide signals to sleeping areas, alarm signal must be 520 Hz square wave with intensity 15 dB above average ambient sound level or 5 dB above maximum sound level, or at least 75 dB(A-weighted), whichever is greater, measured at pillow.
 - 3) Visual alarm appliances must flash in synchronization where multiple appliances are in same field of view, as defined in NFPA 72.
- m. Elevator Recall: Initiate by one of the following alarm-initiating devices:
- 1) Elevator lobby detectors except lobby detector on designated floor.
 - 2) Smoke detectors in elevator machine room.
- n. Elevator controller must be programmed to move cars to alternate recall floor if lobby detectors located on designated recall floors are activated.
- o. Water-flow alarm connected to sprinkler in elevator shaft and elevator machine room must shut down elevators associated with location without time delay.
- 1) Water-flow switch associated with sprinkler in elevator pit may have delay to allow elevators to move to designated floor.
- p. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls must be connected to fire-alarm system.
- q. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to remote alarm station.
- r. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as special module that is part of FACU.

- s. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of central-control microphone. Amplifiers must comply with UL 1711.
 - 1) Allow application of, and evacuation signal to, indicated number of zones and simultaneously allow voice paging to other zones selectively or in combination.
 - 2) Programmable tone and message sequence selection.
 - 3) Standard digitally recorded messages for "Evacuation" and "All Clear."
 - 4) 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 FACU.
- t. Status Annunciator: Indicate status of various voice/alarm speaker zones and status of firefighters' two-way telephone communication zones.
- u. Preamplifiers, amplifiers, and tone generators must automatically transfer to backup units, on primary equipment failure.
- v. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from other printed indications. Also, print system reset event, including same information for device, location, date, and time. Commands initiate printing of list of existing alarm, supervisory, and trouble conditions in system and historical log of events.
- w. Primary Power: 24 V(dc) obtained from 120 V(ac) service and power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, and supervisory and DACT and must be powered by 24 V(dc) source.
- x. Alarm current draw of entire fire-alarm system must not exceed 80 percent of power-supply module rating.
- y. Secondary Power: 24 V(dc) supply system with batteries, automatic battery charger, and automatic transfer switch.
- z. Batteries: Sealed, valve-regulated, recombinant lead acid.

D. Accessories:

- 1. Instructions: Computer printout or typewritten instruction card mounted behind plastic or glass cover in stainless steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe functional operation of system under normal, alarm, and trouble conditions.
- 2. Preaction System Functionality:
 - a. Initiate Presignal Alarm: This function must cause audible and visual alarm and indication to be provided at FACU. Activation of initiation device connected as part of preaction system must be annunciated at FACU only, without activation of general evacuation alarm.

2.3 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes must be finished in red with molded, raised-letter operating instructions in contrasting color; must show visible indication of operation; and must be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
1. Double-action mechanism requiring two actions to initiate alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to FACU.
 2. Station Reset: Key- or wrench-operated switch.
 3. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at top to permit lifting for access to initiate alarm. Lifting cover actuates integral battery-powered audible horn intended to discourage false-alarm operation.
 4. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at top to permit lifting for access to initiate alarm.
 5. Able to perform at up to 90 percent relative humidity at 90 deg F.

2.4 SYSTEM SMOKE DETECTORS

- A. Photoelectric Smoke Detectors:
1. Performance Criteria:
 - a. Regulatory Requirements:
 - 1) NFPA 72.
 - 2) UL 268.
 - b. General Characteristics:
 - 1) Detectors must be four -wire type.
 - 2) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
 - 3) Base Mounting: Detector and associated electronic components must be mounted in twist-lock module that connects to fixed base. Provide terminals in fixed base for connection to building wiring.
 - 4) Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 - 5) Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
 - 6) Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
 - 7) Operator at FACU, having designated access level, must be able to manually access the following for each detector:
 - a) Primary status.

- b) Device type.
 - c) Present average value.
 - d) Present sensitivity selected.
 - e) Sensor range (normal, dirty, etc.).
- 8) Detector must have functional humidity range within 10 to 90 percent relative humidity.
 - 9) Color: White.
 - 10) Remote Control: Unless otherwise indicated, detectors must be digital-addressable type, individually monitored at FACU for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by FACU.
 - 11) Rate-of-rise temperature characteristic of combination smoke- and heat-detection units must be selectable at FACU for 15 or 20 deg F per minute.
 - 12) Fixed-temperature sensing characteristic of combination smoke- and heat-detection units must be independent of rate-of-rise sensing and must be settable at FACU to operate at 135 or 155 deg F.
 - 13) Multiple levels of detection sensitivity for each sensor.
 - 14) Sensitivity levels based on time of day.

B. Ionization Smoke Detectors:

1. Performance Criteria:

a. Regulatory Requirements:

- 1) NFPA 72.
- 2) UL 268.

b. General Characteristics:

- 1) Detectors must be four -wire type.
- 2) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
- 3) Base Mounting: Detector and associated electronic components must be mounted in twist-lock module that connects to fixed base. Provide terminals in fixed base for connection to building wiring.
- 4) Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
- 5) Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
- 6) Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
- 7) Operator at FACU, having designated access level, must be able to manually access the following for each detector:
 - a) Primary status.
 - b) Device type.

- c) Present average value.
 - d) Present sensitivity selected.
 - e) Sensor range (normal, dirty, etc.).
- 8) Detector must have functional humidity range within 10 to 90 percent relative humidity.
- 9) Color: White.
- 10) Remote Control: Unless otherwise indicated, detectors must be digital-addressable type, individually monitored at FACU for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by FACU.
- 11) Rate-of-rise temperature characteristic of combination smoke- and heat-detection units must be selectable at FACU for 15 or 20 deg F per minute.
- 12) Fixed-temperature sensing characteristic of combination smoke- and heat-detection units must be independent of rate-of-rise sensing and must be settable at FACU to operate at 135 or 155 deg F.
- 13) Multiple levels of detection sensitivity for each sensor.
- 14) Sensitivity levels based on time of day.

2.5 DUCT SMOKE DETECTORS

A. Description: Photoelectric-type, duct-mounted smoke detector.

B. Performance Criteria:

1. Regulatory Requirements:

- a. NFPA 72.
- b. UL 268A.

2. General Characteristics:

- a. Detectors must be four -wire type.
- b. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
- c. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
- d. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
- e. Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
- f. Operator at FACU, having designated access level, must be able to manually access the following for each detector:
 - 1) Primary status.
 - 2) Device type.
 - 3) Present average value.

- 4) Present sensitivity selected.
- 5) Sensor range (normal, dirty, etc.).
- g. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with supplied detector for smoke detection in HVAC system ducts.
- h. Each sensor must have multiple levels of detection sensitivity.
- i. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
- j. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.6 CARBON MONOXIDE DETECTORS

A. Description: Carbon monoxide detector listed for connection to fire-alarm system.

B. Performance Criteria:

1. Regulatory Requirements:

- a. NFPA 72
- b. NFPA 720.
- c. UL 2075.

2. General Characteristics:

- a. Mounting: Adapter plate for outlet box mounting.
- b. Testable by introducing test carbon monoxide into sensing cell.
- c. Detector must provide alarm contacts and trouble contacts.
- d. Detector must send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
- e. Locate, mount, and wire in accordance with manufacturer's written instructions.
- f. Provide means for addressable connection to fire-alarm system.
- g. Test button simulates alarm condition.

2.7 HEAT DETECTORS

A. Combination-Type Heat Detectors:

1. Performance Criteria:

a. Regulatory Requirements:

- 1) NFPA 72.
- 2) UL 521.

b. General Characteristics:

- 1) Temperature sensors must test for and communicate sensitivity range of device.
- 2) Actuated by fixed temperature of 135 deg F or rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
- 3) Mounting: Twist-lock base interchangeable with smoke-detector bases.
- 4) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
- 5) Detector must have functional humidity range of 10 to 90 percent relative humidity.
 - a) Color: White.

B. Fixed-Temperature-Type Heat Detectors:

1. Performance Criteria:

a. Regulatory Requirements:

- 1) NFPA 72.
- 2) UL 521.

b. General Characteristics:

- 1) Actuated by temperature that exceeds fixed temperature of 190 deg F.
- 2) Mounting: Twist-lock base interchangeable with smoke-detector bases.
- 3) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
- 4) Detector must have functional humidity range of 10 to 90 percent.
- 5) Color: White.

2.8 FIRE-ALARM NOTIFICATION APPLIANCES

A. Fire-Alarm Voice/Tone Notification Appliances:

1. Description: Notification appliances capable of outputting voice evacuation messages.
2. Performance Criteria:

a. Regulatory Requirements:

- 1) NFPA 72.
- 2) UL 1480.

b. General Characteristics:

- 1) Speakers for Voice Notification: Locate speakers for voice notification to provide intelligibility requirements of "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
- 2) High-Range Units: Rated 2 to 15 W.

- 3) Low-Range Units: Rated 1 to 2 W.
- 4) Mounting: surface mounted and bidirectional.
- 5) Matching Transformers: Tap range matched to acoustical environment of speaker location.
- 6) Combination Devices: Factory-integrated audible and visible devices in single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

B. Fire-Alarm Visible Notification Appliances:

1. Performance Criteria:

a. Regulatory Requirements:

- 1) NFPA 72.
- 2) UL 1971.

b. General Characteristics:

- 1) Rated Light Output:
 - a) 15/30/75/110 cd, selectable in field.
- 2) Clear or nominal white polycarbonate lens mounted on aluminum faceplate.
- 3) Mounting: Wall mounted unless otherwise indicated.
- 4) For units with guards to prevent physical damage, light output ratings must be determined with guards in place.
- 5) Flashing must be in temporal pattern, synchronized with other units.
- 6) Strobe Leads: Factory connected to screw terminals.
- 7) Mounting Faceplate: Factory finished, red white.

2.9 FIRE-ALARM REMOTE ANNUNCIATORS

A. Performance Criteria:

1. Regulatory Requirements:

- a. NFPA 72.

2. General Characteristics:

- a. Annunciator functions must match those of FACU for alarm, supervisory, and trouble indications. Manual switching functions must match those of FACU, including acknowledging, silencing, resetting, and testing.
 - 1) Mounting: Surface cabinet, NEMA 250, Type 1.

- b. Display Type and Functional Performance: Alphanumeric display and LED indicating lights must match those of FACU. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.10 FIRE-ALARM ADDRESSABLE INTERFACE DEVICES

A. Performance Criteria:

1. Regulatory Requirements:

- a. NFPA 72.

2. General Characteristics:

- a. Include address-setting means on module.
- b. Store internal identifying code for control panel use to identify module type.
- c. Listed for controlling HVAC fan motor controllers.
- d. Monitor Module: Microelectronic module providing system address for alarm-initiating devices for wired applications with normally open contacts.
- e. Integral Relay: Capable of providing direct signal to elevator controller to initiate elevator recall and to circuit-breaker shunt trip for power shutdown.
 - 1) Allow control panel to switch relay contacts on command.
 - 2) Have minimum of two normally open and two normally closed contacts available for field wiring.
- f. Control Module:
 - 1) Operate notification devices.
 - 2) Operate solenoids for use in sprinkler service.
 - 3) .

2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTERS (DACTs)

A. Performance Criteria:

1. Regulatory Requirements:

- a. NFPA 72.

2. General Characteristics:

- a. DACT must be acceptable to remote central station and must be listed for fire-alarm use.

- b. Functional Performance: Unit must receive alarm, supervisory, or trouble signal from FACU and automatically capture one telephone line(s) and dial preset number for remote central station. When contact is made with central station(s), signals must be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter must initiate local trouble signal and transmit signal indicating loss of telephone line to remote alarm receiving station over remaining line. Transmitter must automatically report telephone service restoration to central station. If service is lost on both telephone lines, transmitter must initiate local trouble signal.
- c. Local functions and display at DACT must include the following:
 - 1) Verification that both telephone lines are available.
 - 2) Programming device.
 - 3) LED display.
 - 4) Manual test report function and manual transmission clear indication.
 - 5) Communications failure with central station or FACU.
- d. Digital data transmission must include the following:
 - 1) Address of alarm-initiating device.
 - 2) Address of supervisory signal.
 - 3) Address of trouble-initiating device.
 - 4) Loss of ac supply.
 - 5) Loss of power.
 - 6) Low battery.
 - 7) Abnormal test signal.
 - 8) Communication bus failure.
 - 9) .
- e. Secondary Power: Integral rechargeable battery and automatic charger.
- f. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
 - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Preinstallation Testing: Perform verification of functionality of installed components of existing system prior to starting work. Document equipment or components not functioning as designed.
- B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service in accordance with requirements indicated:
 - 1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of fire-alarm service.
 - 2. Do not proceed with interruption of fire-alarm service without Construction Manager's written permission.
- C. Protection of In-Place Conditions: Protect devices during construction unless devices are placed in service to protect facility during construction.

3.3 INSTALLATION OF EQUIPMENT

- A. Comply with NECA 305, NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
 - 1. Devices placed in service before other trades have completed cleanup must be replaced.
 - 2. Devices installed, but not yet placed, in service must be protected from construction dust, debris, dirt, moisture, and damage in accordance with manufacturer's written storage instructions.
- B. Equipment Floor Mounting: Install FACU on concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
 - 1. Install seismic bracing. Comply with requirements in Section 270548.16 "Seismic Controls for Communications Systems."
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18 inch centers around full perimeter of concrete base.
 - 3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use 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.
- C. Equipment Floor and Wall Mounting: Install FACU on finished floor.
 - 1. Comply with requirements for seismic-restraint devices specified in Section 270548.16 "Seismic Controls for Communications Systems."

- D. Install wall-mounted equipment, with tops of cabinets not more than 78 inch above finished floor.
 - 1. Comply with requirements for seismic-restraint devices specified in Section 270548.16 "Seismic Controls for Communications Systems."
- E. Manual Fire-Alarm Boxes:
 - 1. Install manual fire-alarm box in normal path of egress within 60 inch of exit doorway.
 - 2. Mount manual fire-alarm box on background of contrasting color.
 - 3. Operable part of manual fire-alarm box must be between 42 and 48 inch above floor level. Devices must be mounted at same height unless otherwise indicated.
- F. Smoke- and Heat-Detector Spacing:
 - 1. Comply with "Smoke-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
 - 2. Comply with "Heat-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
 - 3. Smooth ceiling spacing must not exceed 30 ft..
 - 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas must be determined in accordance with Annex A in NFPA 72.
 - 5. HVAC: Locate detectors not closer than 36 inch from air-supply diffuser or return-air opening.
 - 6. Lighting Fixtures: Locate detectors not closer than 12 inch from lighting fixture and not directly above pendant mounted or indirect lighting.
- G. Install cover on each smoke detector that is not placed in service during construction. Cover must remain in place except during system testing. Remove cover prior to system turnover.
- H. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend full width of duct. Tubes more than 36 inch long must be supported at both ends.
 - 1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
- I. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.
- J. Remote Status and Alarm Indicators: Install in visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.
- K. Audible Alarm-Indicating Devices: Install not less than 6 inch below ceiling. Install bells and horns on flush-mounted back boxes with device-operating mechanism concealed behind grille. Install devices at same height unless otherwise indicated.
- L. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inch below ceiling. Install devices at same height unless otherwise indicated.

- M. Device Location-Indicating Lights: Locate in public space near device they monitor.
- N. Antenna for Radio Alarm Transmitter: Mount to building structure where indicated. Use mounting arrangement and substrate connection that resists wind load of 100 mph with gust factor of 1.3 without damage.

3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplate must be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
 - 2. Nameplate must be laminated acrylic or melamine plastic signs with black background and engraved white letters at least 1/2 inch high.

3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."
- C. Install nameplate for each control connection, indicating field control panel designation and I/O control designation feeding connection.

3.6 PATHWAYS

- A. Pathways must be installed in EMT.
- B. All EMT must be painted red enamel.

3.7 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
- B. Make addressable connections with supervised interface device to the following devices and systems. Install interface device less than 36 inch from device controlled. Make addressable confirmation connection when such feedback is available at device or system being controlled.
 - 1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
 - 2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
 - 3. Smoke dampers in air ducts of designated HVAC duct systems.
 - 4. Magnetically held-open doors.
 - 5. Electronically locked doors and access gates.
 - 6. Alarm-initiating connection to elevator recall system and components.
 - 7. Supervisory connections at valve supervisory switches.
 - 8. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
 - 9. Supervisory connections at elevator shunt-trip breaker.
 - 10. Data communication circuits for connection to building management system.
 - 11. Supervisory connections at fire-extinguisher locations.

3.8 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."
- B. Install framed instructions in location visible from FACU.

3.9 GROUNDING

- A. Ground FACU and associated circuits in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Ground shielded cables at control panel location only. Insulate shield at device location.

3.10 FIELD QUALITY CONTROL

- A. Field tests must be witnessed by authorities having jurisdiction.
- B. Administrant for Tests and Inspections:

1. Owner will engage qualified testing agency to administer and perform tests and inspections.
 2. Engage qualified testing agency to administer and perform tests and inspections.
 3. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
 4. Administer and perform tests and inspections.
- C. Tests and Inspections:
1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection must be based on completed record Drawings and system documentation that is required by "Completion Documents, Preparation" table in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 - b. Comply with "Visual Inspection Frequencies" table in "Inspection" section of "Inspection, Testing and Maintenance" chapter in NFPA 72; retain "Initial/Reacceptance" column and list only installed components.
 2. System Testing: Comply with "Test Methods" table in "Testing" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
 3. Test audible appliances for public operating mode in accordance with manufacturer's written instructions. Perform test using portable sound-level meter complying with Type 2 requirements in ASA S1.4 Part 1/IEC 61672-1.
 4. Test audible appliances for private operating mode in accordance with manufacturer's written instructions.
 5. Test visible appliances for public operating mode in accordance with manufacturer's written instructions.
 6. Factory-authorized service representative must prepare "Fire Alarm System Record of Completion" in "Documentation" section of "Fundamentals" chapter in NFPA 72 and "Inspection and Testing Form" in "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
- D. Reacceptance Testing: Perform reacceptance testing to verify proper operation of added or replaced devices and appliances.
- E. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- H. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.11 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

3.12 MAINTENANCE

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service must include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies must be manufacturer's authorized replacement parts and supplies.
 - 1. Include visual inspections in accordance with "Visual Inspection Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 2. Perform tests in "Test Methods" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 3. Perform tests per "Testing Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.13 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning at Substantial Completion, service agreement must include software support for two years.
- C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software must include operating system and new or revised licenses for using software.
 - 1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

END OF SECTION 284621.11

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City of Lee's Summit, Missouri
Lee's Summit Municipal Airport

Storm Water Pollution Prevention Plan for
Storm Water Discharge Associated with

LXT EASTSIDE DEVELOPMENT

Originally Prepared: November 01, 2023

Prepared by
Crawford, Murphy & Tilly, Inc.
1627 Main St. Suite 600
Kansas City, MO 64108

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1. Site Description

The facility to be affected by construction activities is the Lee's Summit Municipal Airport located at 2751 NE Douglas; Lee's Summit, Missouri 64064. This is in Section 20, Township 48 north, Range 31 west, Jackson County, Missouri. The project site drains to an existing low area to the north which then is received by an unnamed tributary to Lakewood Lakes. Figure 1-1 shows the airport's location on a combined USGS map.

Construction activities at the site will include the construction of a new hangar building, site grading, drainage improvements, paving, utilities, pavement marking, and other associated improvements east of the airport along NE Hagan Rd.

UNITED STATES
MISSOURI-JACKSON CO. DEPARTMENT OF THE INTERIOR
7.5 MINUTE SERIES (TOPOGRAPHIC) GEOLOGICAL SURVEY
1:250,000

LEES SUMMIT, MO
39044647-001
1990

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AND DIVISION OF GEOLOGY AND LAND SURVEY
MISSOURI DEPARTMENT OF NATURAL RESOURCES, BOLLA, MISSOURI 63401
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CONTOUR INTERVAL 10 FEET
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2. Drainage Areas

Any areas where changes to a defined drainage area are to occur, shall not be disturbed until all materials and equipment necessary to protect and complete the drainage change are on site. Changes to defined drainage areas shall be completed as quickly as possible once the work has been initiated. Any areas impacted by the land disturbance of a drainage course change are to be protected from erosion as soon as possible. This shall include installation of BMPs prior to the start of disturbance activity at the downstream end and within 14 days of completion of disturbance activities within the disturbance area.

3. Description of Best Management Practices

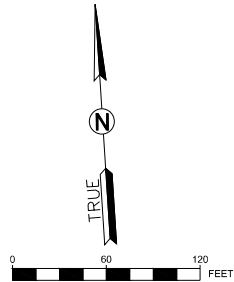
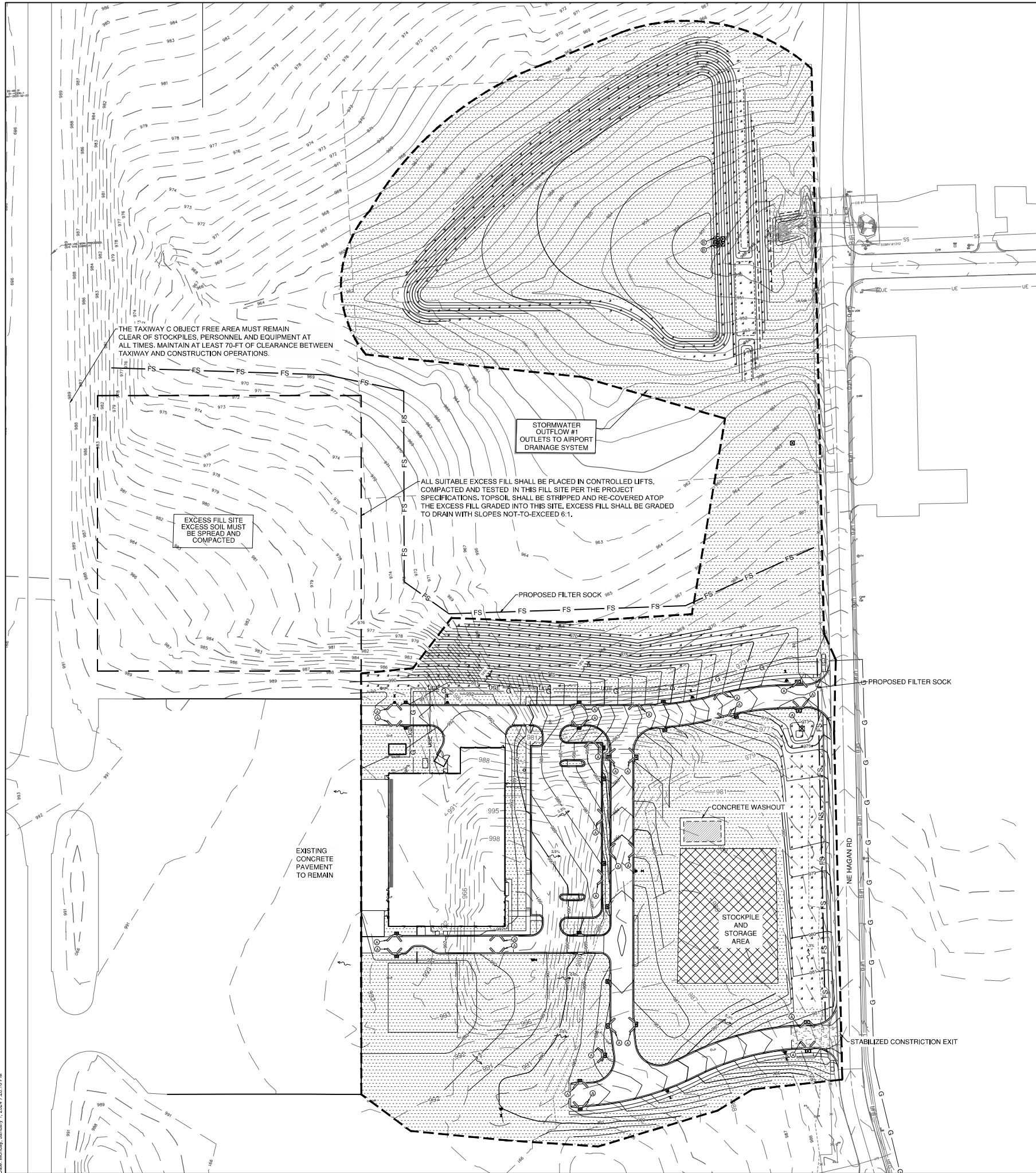
The following Best Management Practices (BMPs) shall be used as methods to control the storm water runoff during the construction of this project. Specifications Item P-156 – Erosion and Sediment Control, Item T-901 – Seeding, and Item T-908 – Mulching provide additional information and are included in Appendix A. Figure 3-1 thru 3-2 shows the locations of the BMPs and Figure 3-3 shows the installation details.

- A. Stabilized Construction Entrance
- B. Silt Sock
- C. Silt Dike Ditch Check
- D. Concrete Washout Pit
- E. Temporary Seeding and Mulching
- F. Erosion Control Blanket
- G. Rip Rap
- H. Inlet Protection
- I. Permanent Seeding and Mulching

Figure 3-1

Figure 3-2

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Date: Wednesday, January 3, 2024 11:28:16 AM



LEGEND

- AREA TO RECEIVE SEEDING / FERTILIZING PER SPECIFICATIONS AND NORTH AMERICAN GREEN ErosNet SC150 EROSION CONTROL BLANKET SEE EROSION CONTROL DETAILS
- AREA TO BE SEED
- RIP-RAP AT END SECTION SEE EROSION CONTROL DETAILS
- STABILIZED CONSTRUCTION ENTRANCE (COORDINATE LOCATION WITH OWNER) SEE EROSION CONTROL DETAILS
- STOCKPILE AND STORAGE AREA
- LIMITS OF DISTURBANCE
- 1400 EXISTING CONTOUR
- 1400 PROPOSED CONTOURS
- FS PROPOSED FILTER SOCK
- FLOW ARROW
- INLET PROTECTION
- BASIN OUTFALL PROTECTION
- TEMPORARY CONCRETE WASHOUT AS REQUIRED FOR PCC CONSTRUCTION

SEQUENCE OF CONSTRUCTION:

- CONTRACTOR MUST INSTALL PERIMETER FILTER SOCK CONTROLS PRIOR TO GRADING OPERATIONS.
- WHEN NEW INLETS ARE INSTALLED, CONTRACTOR TO PUT IN PLACE INLET PROTECTION ON NEW INLETS AS SOON AS POSSIBLE AS INDICATED ON THE PLANS.
- AFTER GRADING OF DITCHES, DITCH CHECKS TO BE PUT IN PLACE AS SOON AS POSSIBLE.
- ALL INLET PROTECTION, SILT SOCKS, AND DITCH CHECKS TO REMAIN IN PLACE AND BE MAINTAINED THROUGHOUT CONSTRUCTION AS REQUIRED UNTIL FULL VEGETATION IS ESTABLISHED, CONTRACTOR TO USE SEEDING AND EROSION CONTROL BLANKETS ACCORDING TO REQUIREMENTS OF THIS SHEET AND LANDSCAPE PLANS.

KEYNOTE

- (A) INLET PROTECTION
- (B) BASIN OUTFALL PROTECTION

ACREAGE SUMMARY

DISTURBED AREA = 13.71 AC
IMPERVIOUS AREA = 5.17 AC
PERVIOUS AREA = 8.54 AC



1627 MAIN STREET, SUITE 600
KANSAS CITY, MO 64108



1627 MAIN STREET, #100
KANSAS CITY, MO 64108



1301 BURLINGTON STREET
NORTH KANSAS CITY, MO 64116

LEE'S SUMMIT MUNICIPAL AIRPORT
LEE'S SUMMIT, MISSOURI

EASTSIDE DEVELOPMENT
CITY PROJECT NO. - 47732472



LEE'S SUMMIT MUNICIPAL AIRPORT
LEE'S SUMMIT, MO

MARK DATE DESCRIPTION

PROJECT NO: 47732472
CAD DWG FILE: EROSION CONTROL PLAN-PHASE 2
DESIGNED BY: WLC
DRAWN BY: WLC
CHECKED BY: JRC
APPROVED BY: TGH
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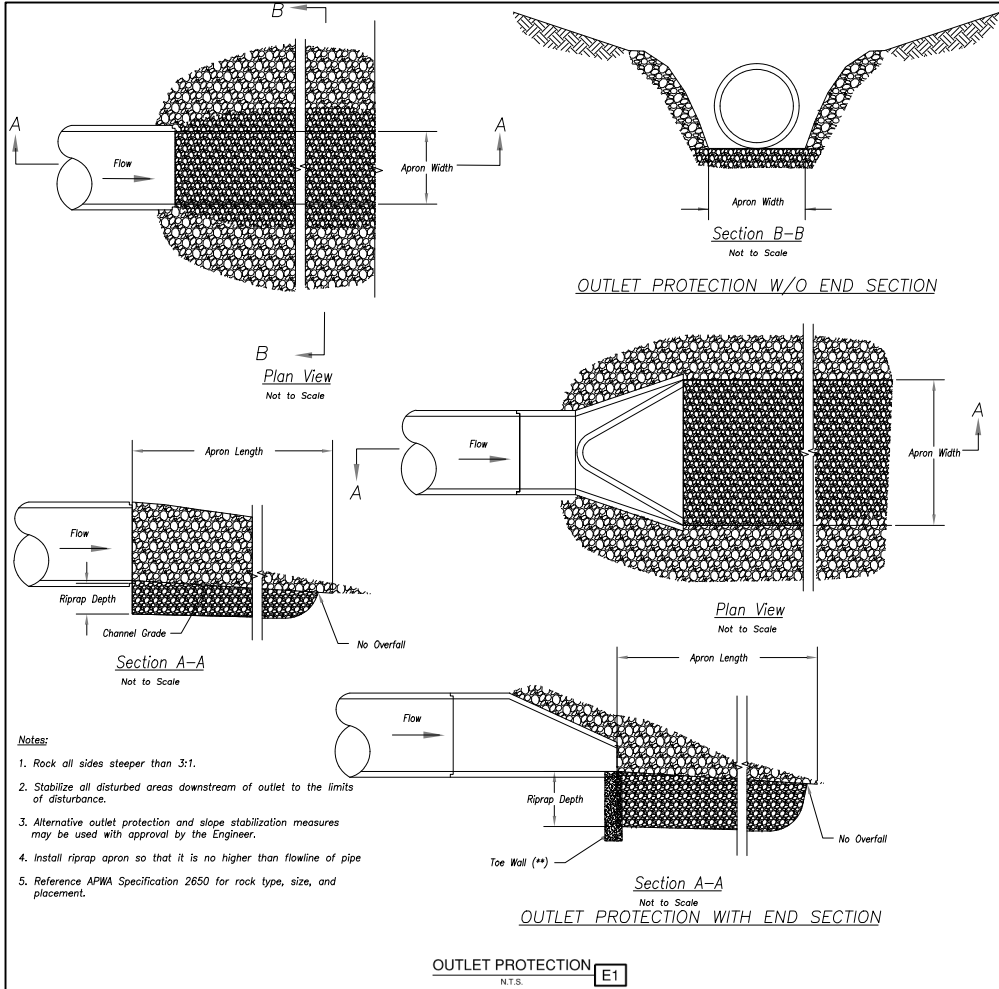
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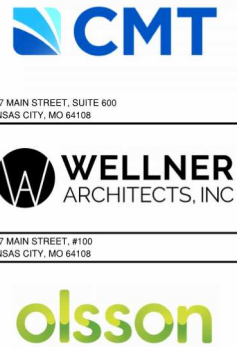
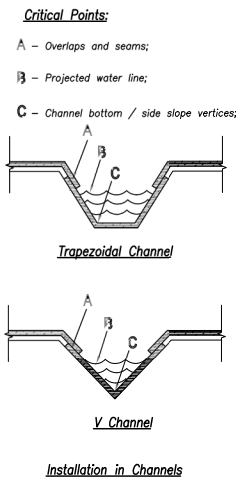
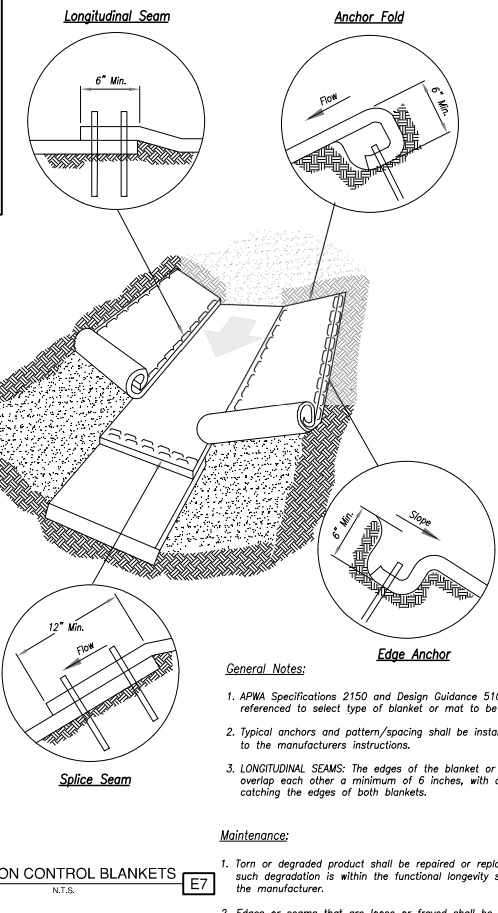
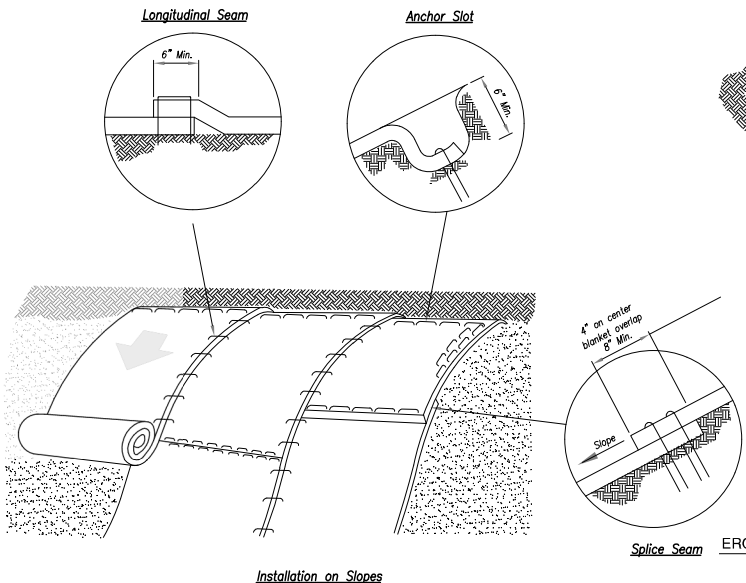
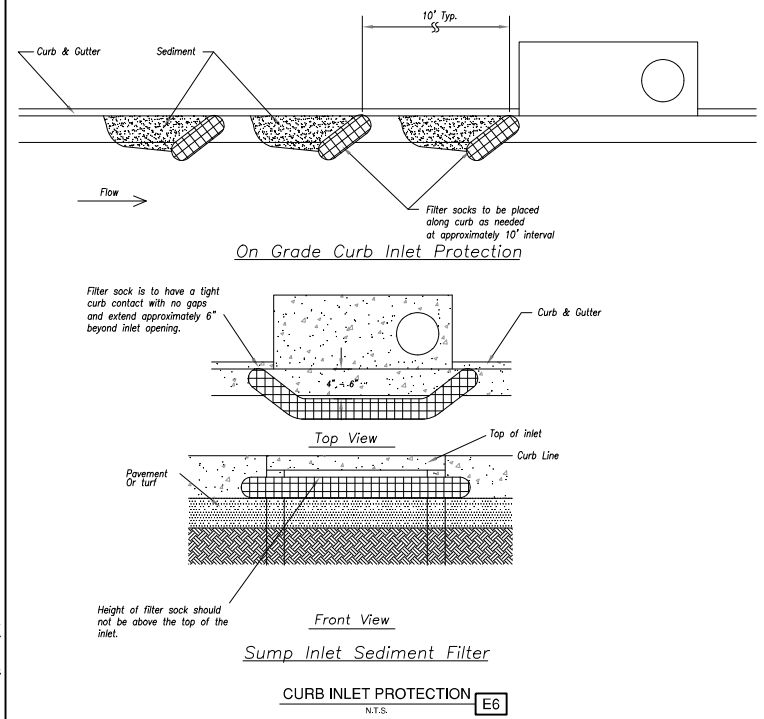
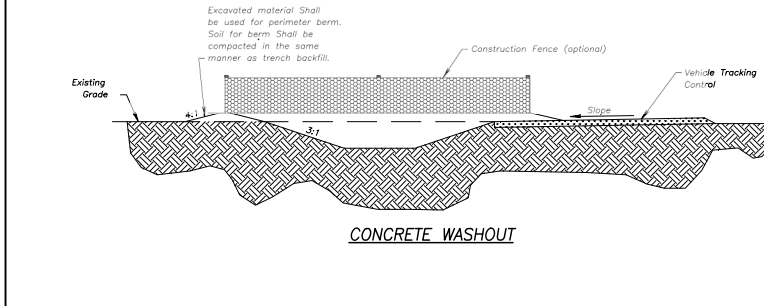
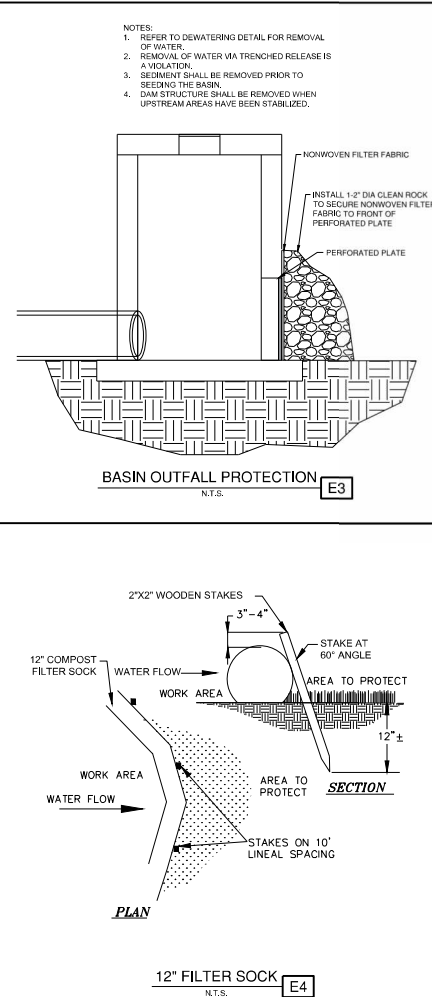
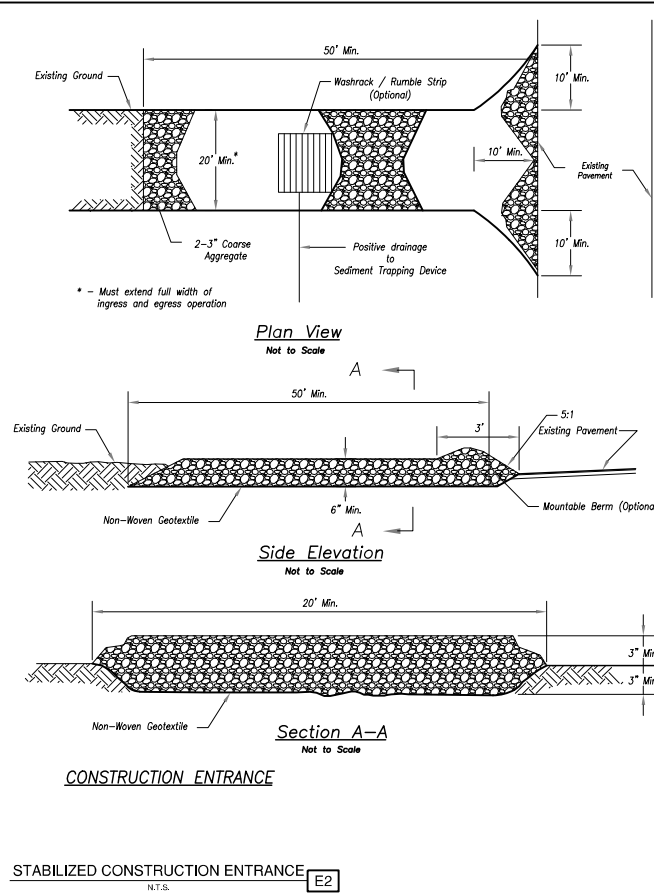
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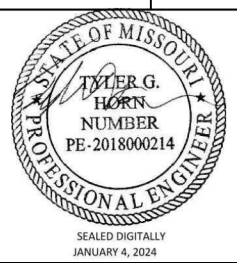
Figure 3-3



- Maintenance for Construction Entrance:**
1. Reshape entrance as needed to maintain function and integrity of installation. Top dress with clean aggregate as needed.
- Notes for Construction Entrance:**
1. Avoid locating on steep slopes, at curves on public roads, or downhill of disturbed area.
 2. Remove all vegetation and other unsuitable material from the foundation area, grade, and crown for positive drainage.
 3. If slope towards the public road exceeds 2%, construct a 6- to 8-inch high ridge with 3H:1V side slopes across the foundation approximately 15 feet from the edge of the public road to divert runoff from it.
 4. Install pipe under the entrance if needed to maintain drainage ditches along public roads.
 5. Place stone to dimensions and grade as shown on plans. Leave surface sloped for drainage.
 6. Divert all surface runoff and drainage from the entrance to a sediment control device.
 7. If conditions warrant, place geotextile fabric on the graded foundation to improve stability.



LEE'S SUMMIT MUNICIPAL AIRPORT
LEE'S SUMMIT, MISSOURI
EASTSIDE DEVELOPMENT
CITY PROJECT NO. - 47732472



LEE'S SUMMIT MUNICIPAL AIRPORT LEE'S SUMMIT, MO		
MARK	DATE	DESCRIPTION
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SHEET TITLE		
EROSION CONTROL DETAILS		
C125		
SHEET 036 OF 131		

4. Disturbed Areas

The contractor shall apply temporary seeding and mulching in any disturbed area where grading activities will remain idle for more than 14 days but will require additional grading. For areas where final grading has been achieved, permanent seeding and mulching shall be applied within 14 days of the completion of the grading operations.

5. Installation

All BMPs shall be installed in accordance with the specifications in Appendix A and the details shown on Figure 3-3.

6. Temporary and Permanent Non-Structural BMPs

The non-structural BMPs to be used on this project are temporary and permanent seeding and mulching. They shall be installed within 14 days of the completion or stoppage of grading activities. A temporary stabilized construction entrance shall be installed as specified to reduce material from public roadways. However, the contractor shall still monitor the entrance and exit points of the public roads, keep the area as clean as practical and route the construction traffic in a way that will reduce trackout. A water truck will be available to clean the pavement.

7. Temporary and Permanent Structural BMPs

The structural BMPs to be used on this project are silt filter socks, silt ditch checks, sedimentation basin, rip rap, inlet protect and erosion control blanket. The silt filter sock shall be installed at the locations specified by the engineer within 48 hours of completing clearing and grubbing operations in that area. Where practical, silt sock will be installed prior to initial disturbance of the ground.

Structural BMPs shall be maintained in proper working condition until final acceptance of the project for permanent BMPs and establishment of turf for temporary BMPs.

8. Routine Monitoring and Reporting of Site Conditions

The contractor shall be responsible for performing routine inspections of the project site in order to evaluate, document, and report the effectiveness of the erosion control measures that are in place at the project site. The purpose of these inspections is to monitor the site in order to facilitate implementation of appropriate modifications and maintenance activities in order to minimize and/or eliminate loss of sediment from the site.

The contractor shall make routine inspections at least once every seven (7) calendar days. If a rainfall causes storm water runoff to occur on site, the BMPs must be inspected within a reasonable time period (not to exceed 48 hours).

The contractor shall provide the Engineer a record of each site inspection using the form provided in this SWPPP. The contractor shall indicate on the form the name of the individual performing the inspection and the date that the inspection occurred. The individual performing the inspection shall sign the form. The contractor shall provide four copies of each report to the Engineer within 3 days of the inspection.

The contractor shall notify the Engineer immediately of any indications of loss of sediment from the project site.

9. Additional Site Management BMPs

The contractor shall exercise best management practices throughout the life of the project to control water pollution. Pollutants such as chemicals, fuels, lubricants, bitumen, raw sewage or other harmful material shall not be discharged from the project. Temporary pollution control measures shall be coordinated with permanent erosion control features specified in the contract to ensure economical, effective and continuous erosion control.

Temporary control may include work outside the construction limits such as borrow pit operations, equipment and material storage sites, waste areas, and temporary plant sites.

Trash containers and portable toilets shall be provided by the contractor for his/her employees. The trash containers and portable toilets shall be maintained by the contractor as needed in accordance with all local, state, and federal laws.

10. Permanent Storm Water Management

The contractor shall maintain all permanent seeding and mulching areas until final acceptance of the project. Upon final acceptance of the project, the City of Lee's Summit will inspect the area once a month and will take action as needed.

Stormwater Construction Site Inspection Report

General Information			
Project Name	LXT Eastside Development		
Permit No.		Location	Lee's Summit Municipal Airport
Date of Inspection		Start/End Time	
Inspector's Name(s)			
Inspector's Title(s)			
Inspector's Contact Information			
Inspector's Qualifications			
Describe present phase of construction			
Type of Inspection: <input type="checkbox"/> Regular <input type="checkbox"/> Pre-storm event <input type="checkbox"/> During storm event <input type="checkbox"/> Post-storm event			
Weather Information			
Has there been a storm event since the last inspection? <input type="checkbox"/> Yes <input type="checkbox"/> No If yes, provide: Storm Start Date & Time: Storm Duration (hrs): Approximate Amount of Precipitation (in):			
Weather at time of this inspection? <input type="checkbox"/> Clear <input type="checkbox"/> Cloudy <input type="checkbox"/> Rain <input type="checkbox"/> Sleet <input type="checkbox"/> Fog <input type="checkbox"/> Snowing <input type="checkbox"/> High Winds <input type="checkbox"/> Other: Temperature:			
Have any discharges occurred since the last inspection? <input type="checkbox"/> Yes <input type="checkbox"/> No If yes, describe:			
Are there any discharges at the time of inspection? <input type="checkbox"/> Yes <input type="checkbox"/> No If yes, describe:			

Site-specific BMPs

- Number the structural and non-structural BMPs identified in your SWPPP on your site map and list them below (add as many BMPs as necessary). Carry a copy of the numbered site map with you during your inspections. This list will ensure that you are inspecting all required BMPs at your site.
- Describe corrective actions initiated, date completed, and note the person that completed the work in the Corrective Action Log.

	BMP	BMP Installed?	BMP Maintenance Required?	Corrective Action Needed and Notes
1		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
2		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
3		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
4		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
5		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
6		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
7		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
8		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
9		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	

	BMP	BMP Installed?	BMP Maintenance Required?	Corrective Action Needed and Notes
10		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
11		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
12		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
13		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
14		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
15		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
16		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
17		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
18		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
19		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
20		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	

Overall Site Issues

Below are some general site issues that should be assessed during inspections. Customize this list as needed for conditions at your site.

	BMP/activity	Implemented?	Maintenance Required?	Corrective Action Needed and Notes
1	Are all slopes and disturbed areas not actively being worked properly stabilized?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	<input type="checkbox"/> Yes <input type="checkbox"/> No	
2	Are natural resource areas (e.g., streams, wetlands, mature trees, etc.) protected with barriers or similar BMPs?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	<input type="checkbox"/> Yes <input type="checkbox"/> No	
3	Are perimeter controls and sediment barriers adequately installed (keyed into substrate) and maintained?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	<input type="checkbox"/> Yes <input type="checkbox"/> No	
4	Are discharge points and receiving waters free of any sediment deposits?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	<input type="checkbox"/> Yes <input type="checkbox"/> No	
5	Are storm drain inlets properly protected?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	<input type="checkbox"/> Yes <input type="checkbox"/> No	
6	Is the construction exit preventing sediment from being tracked into the street?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	<input type="checkbox"/> Yes <input type="checkbox"/> No	
7	Is trash/litter from work areas collected and placed in covered dumpsters?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	<input type="checkbox"/> Yes <input type="checkbox"/> No	

	BMP/activity	Implemented?	Maintenance Required?	Corrective Action Needed and Notes
8	Are washout facilities (e.g., paint, stucco, concrete) available, clearly marked, and maintained?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	<input type="checkbox"/> Yes <input type="checkbox"/> No	
9	Are vehicle and equipment fueling, cleaning, and maintenance areas free of spills, leaks, or any other deleterious material?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	<input type="checkbox"/> Yes <input type="checkbox"/> No	
10	Are materials that are potential stormwater contaminants stored inside or under cover?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	<input type="checkbox"/> Yes <input type="checkbox"/> No	
11	Are non-stormwater discharges (e.g., wash water, dewatering) properly controlled?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	<input type="checkbox"/> Yes <input type="checkbox"/> No	
12	(Other)	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	<input type="checkbox"/> Yes <input type="checkbox"/> No	

Non-Compliance

Describe any incidents of non-compliance not described above:

CERTIFICATION STATEMENT

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Print name and title: _____

Signature: _____ **Date:** _____

Appendix A: Specifications

ITEM P-156 TEMPORARY AIR AND WATER POLLUTION, SOIL EROSION, AND SILTATION CONTROL

DESCRIPTION

156-1.1 This item shall consist of temporary and permanent control measures as shown on the plans or as ordered by the Engineer during the life of a contract to control water pollution, soil erosion, and siltation through the use of silt fences, berms, dikes, dams, sediment basins, fiber mats, gravel, mulches, grasses, slope drains, and other erosion control devices or methods.

The temporary erosion control measures contained herein shall be coordinated with the permanent erosion control measures specified as part of this contract to the extent practical to assure economical, effective, and continuous erosion control throughout the construction period. As a minimum the contractor shall erect and maintain silt fence along existing ditches and around drainage structures in the grading areas or in the vicinity of grading areas that receive runoff from graded areas. The contractor shall exercise best management practices throughout the life of the project to control water pollution. Pollutants such as chemicals, fuels, lubricants, bitumen, raw sewage or other harmful material shall not be discharged from the project.

Temporary control may include work outside the construction limits such as borrow pit operations, equipment and material storage sites, waste areas, and temporary plant sites.

Temporary control measures shall be designed, installed and maintained to minimize the creation of wildlife attractants that have the potential to attract hazardous wildlife on or near public-use airports.

Inlet Protection shall consist of constructing inlet protection basins in accordance with the details in the plans for the purpose of preventing infiltration of silt into the inlets.

The Contractor shall follow the requirements of the Storm Water Pollution Prevention Plan (SWPPP) and shall perform erosion control inspections as outlined in the SWPPP until final acceptance of the project. Erosion control inspection shall not be measured for payment but shall be considered incidental to the contract. The SWPPP is included in the appendix and is considered part of the contract. Any requirements of the SWPPP that do not have a specified pay item are considered incidental to the contract and shall be performed by the Contractor at no additional cost to the Contract. The Contractor shall update the SWPPP during construction as needed to comply with Missouri Department of Natural Resources (MoDNR) requirements.

The Contractor shall be responsible for meeting the requirements of the City's Missouri State Operating Permit, Permit No. MOR 100089 from the time of the issuance of the Notice to Proceed (NTP) until final project acceptance. Any fines issued by MoDNR for noncompliance of the permit related to the Construction of this project between the NTP and final project acceptance shall be paid by the Contractor

MATERIALS

PROOF OF BUY AMERICAN NOTICE: All tier contractors and subcontractors shall provide proof of Buy American compliance for all manufactured products in accordance with statues established under Title 49 U.S.C. Section 50101. The AIP Buy American preference does not recognize US trade agreements such as NAFTA. If, upon submittal sufficient information to confirm compliance is not included, the submittal will be returned with no action.

156-2.1 Grass. Grass that will not compete with the grasses sown later for permanent cover per Item T-901 shall be a quick-growing species (such as ryegrass or Italian ryegrass) suitable to the area providing a temporary cover. Selected grass species shall not create a wildlife attractant.

156-2.2 Mulches. Mulches shall be reasonably clean and free of noxious weeds and deleterious materials per Item T-908. Mulches shall not create a wildlife attractant.

156-2.3 Fertilizer. Fertilizer shall be a standard commercial grade and shall conform to all Federal and state regulations and to the standards of the Association of Official Agricultural Chemists.

156-2.4 Slope drains. NOT USED.

156-2.5 Silt fence. The silt fence shall consist of polymeric filaments which are formed into a stable network such that filaments retain their relative positions. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life. Silt fence shall meet the requirements of ASTM D6461.

156-2.6 Other. All other materials shall meet commercial grade standards and shall be approved by the Engineer before being incorporated into the project.

CONSTRUCTION REQUIREMENTS

156-3.1 General. In the event of conflict between these requirements and pollution control laws, rules, or regulations of other Federal, state, or local agencies, the more restrictive laws, rules, or regulations shall apply.

The Engineer shall be responsible for assuring compliance to the extent that construction practices, construction operations, and construction work are involved.

156-3.2 Schedule. Prior to the start of construction, the Contractor shall submit schedules for accomplishment of temporary and permanent erosion control work for clearing and grubbing; grading; construction; paving; and structures at watercourses. The Contractor shall also submit a proposed method of erosion and dust control on haul roads and borrow pits and a plan for disposal of waste materials. Work shall not be started until the erosion control schedules and methods of operation for the applicable construction have been accepted by the Engineer.

During construction operations, dust shall be controlled to the satisfaction of the Engineer.

156-3.3 Construction details. The Contractor will be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the accepted schedule. Except where future construction operations will damage slopes, the Contractor shall perform the permanent seeding and mulching and other specified slope protection work in stages, as soon as substantial areas of exposed slopes can be made available, but no later than 14 days after the completion of final grading activities unless temporary seeding is applied.. Temporary erosion and pollution control measures will be used to correct conditions that develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.

Where erosion may be a problem, clearing and grubbing operations should be scheduled and performed so that grading operations and permanent erosion control features can follow immediately if project conditions permit; otherwise, temporary erosion control measures may be required.

The Engineer shall limit the area of clearing and grubbing, excavation, borrow, and embankment operations in progress, commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding, and other such permanent control measures current with the accepted

schedule. If seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible and justified as directed by the Engineer.

The Contractor shall provide immediate permanent or temporary pollution control measures to minimize contamination of adjacent streams or other watercourses, lakes, ponds, or other areas of water impoundment as directed by the Engineer. If temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled or directed by the Engineer, the work shall be performed by the Contractor and the cost shall be incidental to this item.

The Engineer may increase or decrease the area of erodible earth material that can be exposed at any time based on an analysis of project conditions.

The erosion control features installed by the Contractor shall be acceptably maintained by the Contractor during the construction period.

Whenever construction equipment must cross watercourses at frequent intervals, temporary structures should be provided.

Pollutants such as fuels, lubricants, bitumen, raw sewage, wash water from concrete mixing operations, and other harmful materials shall not be discharged into any waterways, impoundments or into natural or manmade channels.

156-3.4 Installation, maintenance and removal of silt fences. Silt fences shall extend a minimum of 16 inches (41 cm) and a maximum of 34 inches (86 cm) above the ground surface. Posts shall be set no more than 10 feet (3 m) on center. Filter fabric shall be cut from a continuous roll to the length required minimizing joints where possible. When joints are necessary, the fabric shall be spliced at a support post with a minimum 12-inch (300-mm) overlap and securely sealed. A trench shall be excavated approximately 4 inches (100 mm) deep by 4 inches (100 mm) wide on the upslope side of the silt fence. The trench shall be backfilled and the soil compacted over the silt fence fabric. The Contractor shall remove and dispose of silt that accumulates during construction and prior to establishment of permanent erosion control. The fence shall be maintained in good working condition until permanent erosion control is established. Silt fence shall be removed upon approval of the Engineer.

156-3.5 Erosion Control Maintenance. The temporary erosion control systems installed by the Contractor shall be properly repaired and maintained as directed by the Engineer to control siltation at all times during the life of the contract. If the Contractor fails to maintain the temporary erosion control systems as required to limit the erosion from the site, payment for the noted pay items in this section can be withheld or fines assessed

156-3.6 Removal Of Erosion Control. The Contractor shall remove and dispose of any of the sediment control items installed at the direction of the Engineer. The cost of this removal shall be incidental to this item.

156-3.7 Inlet Protection. The contractor shall construct inlet protection reservoirs around inlets on the project in accordance with the details shown in the plans. The contractor shall inspect, clean and properly maintain the excavated inlet protection basin after every storm until the contributing drainage basin has been permanently stabilized. The Contractor shall remove sediment when the volume of the basin has been reduced by one-half. The excavated material shall be spread evenly over the surrounding ground or placed in an area which still needs stabilized. Once the drainage basin has been stabilized, the basin shall be backfilled in accordance with Item P-152 and stabilized.

156-3.8 STABILIZED CONSTRUCTION ENTRANCE. A temporary, stabilized construction entrance shall be constructed at all entrance/exit to the project site for heavy construction traffic to/from public roads. The entrance shall serve as a durable entrance, as well as a dirt and sediment trap for

vehicles leaving the project site. The entrance shall consist of 12" of an ASTM C33, Size 2 or 3 crushed coarse aggregate on a geotextile separation fabric. The entrance shall be of a width adequate to accommodate full ingress and egress operations.

ASTM Size No.	Amounts finer than each laboratory sieve, mass percent passing						
	3 in.	2-1/2 in.	2 in.	1-1/2 in.	1 in.	3/4 in.	1/2 in.
2	100	90 to 100	35 to 70	0 to 15	--	0 to 5	--
3	--	100	90 to 100	35 to 70	0 to 15	--	0 to 5

The stabilized construction entrance shall be removed at project completion, and the disturbed area returned to its original condition or better.

The construction and removal of the stabilized construction entrance including all labor, materials, equipment, tools, and other effort necessary to meet the requirements of this section shall be considered incidental to the cost of the project and no separate measurement or payment will be made for this work.

156-3.6 PERMITS. The project is being constructed under a U.S. Army Corps of Engineers, Kansas City District, 404 Permit and Missouri Department of Natural Resources 401 Water Quality Certification. The contractor shall adhere to requirements regarding erosion and sediment control specified in the permit. A copy of the permit is available upon request.

TEMPORARY EROSION CONTROL **(SILT FENCE/STRAW BALES/ SILT DIKE DITCH CHECK)**

156-4.1 DESCRIPTION. This work shall consist of furnishing, installing, maintaining and removing erosion controls for temporary ditch checks and at other temporary locations shown on the plans for controlling pollution and erosion, and removing sediment deposits at these locations and disposing of the sediment deposits at a location approved by the engineer. The quantities of temporary erosion control shown on the plans may be increased or decreased at the direction of the engineer. At the engineer's discretion, the location may be field modified to fit field conditions. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work.

156-4.2 MATERIAL. Geotextile Fabric shall meet the physical and chemical requirements of AASHTO M 288.

Posts for silt fence may be wood, steel or synthetic. Posts shall be sufficient length, not less than 4 feet, to ensure adequate embedment while fully supporting the silt fence and shall have sufficient strength to resist damage during installation and to support applied loads while in service.

All geotextile silt fence shall be **supported either externally by wire or other approved mesh** to a height of at least 24 inches or by a suitable designed-in support system capable of keeping the material erect. Either method shall be strong enough to withstand applied loads. The support system shall be installed at all silt fence locations and shall be securely attached to the geotextile fabric.

Prefabricated fence systems may be used provided they meet all of the above requirements.

Straw bales shall meet the requirements of MO-908.

Posts for straw bales shall be wood. Posts shall be 2 inch by 2 inch and sufficient length, not less than 3 feet, to ensure adequate embedment.

Silt dike ditch checks shall be triangular in shape with a minimum height of 10 inches and shall consist of urethane foam and geotextile fabric with a protective apron.

156-4.3 CONSTRUCTION REQUIREMENTS. The contractor shall install the temporary erosion control as shown on the plans or at other locations as directed by the engineer. Silt fence construction shall be adequate to handle the stress from hydraulic and sediment loading. Fabric at the bottom of the silt fence shall be buried a minimum 6 inches so that no flow can pass under the barrier. The trench shall be backfilled and the soil compacted over the fabric. The fabric shall be spliced together only at a support post with a minimum 6-inch overlap. Any installation method acceptable to the engineer will be allowed as long as the effectiveness and intent of the silt fence is achieved.

Post spacing shall not exceed 5 feet. Posts shall be driven a sufficient depth into the ground or placed on closer spacing as necessary to ensure adequate resistance to applied loads.

The silt fence shall be fastened securely to the upslope side of the post. When wire support is used, the wire shall extend into the trench a minimum of 2 inches.

Straw bale construction shall be adequate to handle the stress from hydraulic and sediment loading. Geotextile fabric shall be fastened securely to the bale on the side of flow and on top and then embedded a minimum of 6 inches so that no flow can pass under the barrier.

Post spacing shall not exceed 2 feet. Posts shall be driven a sufficient depth into the ground or placed on closer spacing as necessary to ensure adequate resistance to applied loads.

The contractor shall maintain the integrity of the erosion control as long as they are necessary to contain sediment runoff. **The contractor shall inspect all erosion control** within 48 hours of a rain event exceeding 0.5 inches and at least daily during prolonged rainfall. Any deficiencies shall be immediately corrected by the contractor. In addition, the contractor shall make a **daily review** of the location of erosion control in areas where construction activities have changed the natural contour and drainage runoff to ensure the erosion control is properly located for effectiveness. Where deficiencies exist, additional erosion control shall be installed as approved or directed by the engineer.

The contractor shall remove and dispose of sediment deposits when the deposit approaches one-half the height of the original height or sooner when directed by the engineer. Periodic sediment removal shall include removal and disposal of sediment in a location where it will not erode into construction areas or watercourses.

The erosion control shall remain in place until the engineer directs it to be removed. Upon removal, the contractor shall remove and dispose of any excess silt accumulations, grade and dress the area to the satisfaction of the engineer, and establish vegetation on all bare areas in accordance with the contract requirements. The erosion control material shall remain the property of the contractor and may be used at other locations, provided the material continues to meet the requirements of this specification, is sound and not weakened by exposure to the elements.

Upon completion of the work and removal of the silt fence and silt dike ditch checks the contractor shall replace the area disturbed by the removal of the silt fence and silt dike ditch checks with sod in accordance with the details in the plans, matching the lines grades and elevations of the surrounding turf creating a smooth transition between the disturbed area and the surrounding turf. Installation of the sod shall be considered incidental to the silt fence and silt dike ditch check pay items.

156-4.4 METHOD OF MEASUREMENT. Measurement of temporary silt fence erosion control will be made to the nearest linear foot. The temporary erosion control will be measured in place from end to end of each separate installation completed and approved in place. The measurement of silt dike ditch check will be made per each installation location regardless of the total length needed at each location.

The removal of accumulated sediment shall not be measured for payment but shall be considered incidental to the silt fence and silt dike pay items.

156-4.5 BASIS OF PAYMENT. The accepted quantities of temporary site fence erosion control completed, accepted and in-place will be paid for at the contract unit price per linear foot. The accepted quantities of silt dike ditch check completed, accepted and in-place will be paid for at the contract unit price per each. Both items shall be full compensation for all labor, equipment and material to complete the described work. This includes maintaining and repairing the original structure and the removal and disposal of the erosion control after completion of the work. The contractor will be compensated if the engineer determines unusual conditions warrant a repair or replacement of the erosion control.

The removal of accumulated quantity of sediment is considered incidental to the silt fence and silt dike ditch check line items and will not be paid for.

There will be no payment for the construction of the temporary stabilized construction entrance, nor its removal, fine grading, seeding, and mulching upon project completion. It shall be considered incidental to the project.

Payment will be made under:

<u>Item P-156-.5.1</u>	<u>Silt Fence--per linear foot</u>
<u>Item P-156-5.2</u>	<u>Silt Dike Ditch Check--per linear foot</u>

TEMPORARY SEEDING AND MULCHING

156-5.1 DESCRIPTION. This work shall consist of fertilizing, furnishing and sowing of seed, mulching or other acceptable cover authorized by the engineer. This work shall produce a quick ground cover to reduce erosion in disturbed areas expected to be redisturbed at a later date. Finish grading of areas will not be required. Hydraulic seeding and fertilizing in accordance with P-901 will be allowed.

156-5.2 CONSTRUCTION REQUIREMENTS. Seeding and mulching shall be a continuous operation on all cut and fill slopes, excess material sites and borrow pits during the construction process. All disturbed areas shall be seeded and mulched as necessary to eliminate erosion. The contractor shall provide permanent seeding and mulching as shown on the plans following temporary seeding.

Temporary seeding mixtures of oats, cereal rye or wheat shall be applied at a rate of 100 pounds per acre. Temporary seeding mixtures of oats shall be applied only during the months of December through May.

Temporary mulch placed over temporary seed mixtures shall be applied in accordance with P-908.

Fertilizer shall be applied at a rate of 40 pounds nitrogen per acre. Lime will not be required for temporary seeding.

156-5.3 METHOD OF MEASUREMENT. Temporary Seeding and mulching will not be measured for payment but will be considered incidental to the grading and erosion control.

TEMPORARY ROLLED EROSION CONTROL PRODUCTS (RECP)

156-6.1 DESCRIPTION. This work shall consist of furnishing and installation of RECP acceptable and authorized by the engineer. Net-less or single-net blankets, as specified on the detail plan sheets, shall maintain a functional longevity between 3 and 12 months. The RECP must be composed of curled wood fibers with 80 percent of the fibers six-inch or greater in length, and of consistent thickness and fiber distribution throughout the entire area of the blanket. Single-net products shall be covered with photodegradable or biodegradable netting. Single-net products must provide protection from shear stress up to 1.75 lb/ft²; net-less products must provide protection from shear stress up to 1.0 lb/ft².

RECP shall be used as erosion control blanket on the embankment slopes as shown on the plans and in the areas shown for Wood Fiber Erosion Control Blanket on the stream stabilization plan sheets.

156-6.2 CONSTRUCTION REQUIREMENTS. Installation of RECP shall follow manufacturer's instructions. Within the areas shown on the plan sheets to be covered in RECP, the RECP shall not be installed prior to final grading and permanent seeding, and shall be installed within seven days of the permanent seeding, as approved by the engineer.

156-6.3 METHOD OF MEASUREMENT. Measurement of all RECP will be made to the nearest square yard.

156-6.4 BASIS OF PAYMENT. The accepted quantities of all RECP will be paid for at the contract unit price per square yard.

Payment will be made under:

P-156-5.3 Erosion Control Blanket—per square yard

RIPRAP

156-7.1 DESCRIPTION. This item shall include the construction of permanent erosion control features through the use of a rock bed (riprap) placed on bedding material on geotextile fabric.

156-7.2 MATERIAL. The material for riprap shall consist of a predominantly one-sized, durable stone, shot rock, or broken concrete. Acceptance by the engineer may be made by visual inspection. The size of the riprap shall meet the requirements of the 2004 Missouri Standard Specification for Highway Construction (MSSHC), Section 609.60 – Rock Ditch Liner for Type 3 Rock Ditch Liner.

The riprap shall be placed on a bedding material that shall conform to the requirements of MSSHC, Section 609.60.2.5. Bedding shall consist of crushed stone or gravel with a gradation consisting of 100 percent passing the 3-inch sieve, 30 to 70 percent passing the 1-1/2-inch sieve and 0 to 15 percent passing the No. 4 sieve.

The geotextile fabric to be placed below the bedding material shall conform to the requirement of the MSSHC, Section 1011.3.3, Permanent Erosion Control Geotextile. The fabric shall meet the requirements of AASHTO Class 1 or Class 2 geotextiles, have a minimum permittivity of 1.0 sec⁻¹ and shall be suitable for use as permanent erosion control

156-7.3 CONSTRUCTION REQUIREMENTS. A trench at the toe of the pipe outlet shall be excavated to the dimensions shown on the plans or as indicated by the resident engineer in the field. The slopes shall conform to the proper cross section and be compacted to a uniform density as required for

adjacent material. The rock or broken concrete to be placed on the slope, to the specified thickness, elevation, and extent, and manipulated so that most of the flat sides are in contact, thereby eliminating large voids. The finished surface of the blanket shall present an appearance free from segregation and with a proportionate quantity of the larger pieces showing.

156-7.4 METHOD OF MEASUREMENT. Measurement of permanent rip rap erosion control shall be made by the square yard of rock bed (riprap), including the bedding material and geotextile fabric, in place installed and maintained by the Contractor and accepted by the Engineer.

156-7.5 BASIS OF PAYMENT. The accepted quantities of riprap will be paid for at the contract unit price per square yard and will be full compensation for all labor, equipment and material to complete the described work.

Payment will be made under:

Item P-156-5.4 Rip Rap--per square yard

INLET PROTECTION

156-8.1 DESCRIPTION. This work shall consist of constructing inlet protection basins in accordance with the details in the plans for the purpose of preventing infiltration of silt into the inlets.

156-8.2 CONSTRUCTION REQUIREMENTS. The contractor shall construct inlet protection reservoirs around inlets on the project in accordance with the details shown in the plans. The contractor shall inspect, clean and properly maintain the excavated inlet protection basin after every storm until the contributing drainage basin has been permanently stabilized. The Contractor shall remove sediment when the volume of the basin has been reduced by one-half. The excavated material shall be spread evenly over the surrounding ground or placed in an area which still needs stabilized. Once the drainage basin has been stabilized, the basin shall be backfilled in accordance with Item MO-152 and stabilized.

Posts for straw bales shall be wood. Posts shall be 2 inch by 2 inch and sufficient length, not less than 3 feet, to ensure adequate embedment.

156-8.3 METHOD OF MEASUREMENT. The quantity of inlet protection to be paid for shall be the number of inlet protection systems installed.

156-8.4 BASIS OF PAYMENT. The accepted quantity of inlet protection will be paid for at the contract unit price per each. This price shall be full compensation for all materials, equipment, labor and incidentals necessary to complete and maintain this work to the satisfaction of the Engineer.

Payment will be made under:

Item P 156-5.5 Inlet Protection--per each

END OF ITEM P-156

ITEM T-901 SEEDING**DESCRIPTION**

901-1.1 This item shall consist of soil preparation, seeding, application of lime and commercial fertilizer on the areas shown on the plans or as directed by the Engineer in accordance with these specifications.

MATERIALS

901-2.1 Seed. The species and application rates of grass, legume, and cover-crop seed furnished shall be those stipulated herein. Seed shall conform to the requirements of Federal Specification JJJ-S-181, Federal Specification, Seeds, Agricultural.

Seed shall be furnished separately or in mixtures in standard containers labeled in conformance with the Agricultural Marketing Service (AMS) Seed Act and applicable state seed laws with the seed name, lot number, net weight, percentages of purity and of germination and hard seed, and percentage of maximum weed seed content clearly marked for each kind of seed. The Contractor shall furnish the Engineer duplicate signed copies of a statement by the vendor certifying that each lot of seed has been tested by a recognized laboratory for seed testing within six (6) months of date of delivery. This statement shall include: name and address of laboratory, date of test, lot number for each kind of seed, and the results of tests as to name, percentages of purity and of germination, and percentage of weed content for each kind of seed furnished, and, in case of a mixture, the proportions of each kind of seed. Wet, moldy, or otherwise damaged seed will be rejected.

Seeds shall be applied as follows:

Seed Mixture – Type A (Upland Turf Mix)*

Seed Species		Rate of Application lb./acre
<i>Scientific Name</i>	Common Name	
<i>Festuca arundinacea</i>	Tall Fescue	200
<i>Trifolium repens</i>	White Clover	2
Total		202

***no cover crop necessary unless seeded as a dormant crop (post August 1)**

Seed Mixture – Cover Crops, Type A*

Seed Species		Rate of Application lb./acre
Scientific Name	Common Name	
August 1-September 15		
Avena sativa	Oats	50
September 16-October 10		
Triticum aestivum	Winter Wheat	50

***Only necessary if dormant seeding; seeding prior to March 1 or past October 10 not permissible**

***Seeding prior to March 1 or past October 10 not permissible**

The following percentages for purity and germination or pure live seed will be the minimum requirements in the acceptance of seed, unless otherwise permitted by the engineer. For species not shown on the table, PLS listed for each vendor must be supplied to the engineer to determine if adjustments to the seeding rates is required.

SEED REQUIREMENTS				
Non-native Grasses	Scientific Name	Purity	Germination¹	Pure Live Seed
Tall Fescue	Festuca arundinacea	97	85	
Cereal or Cover Crop	Scientific Name	Purity	Germination	Pure Live Seed
Oat Grain	Avena sativa	98	85	
Wheat Grain	Triticum aestivum	97	85	
Legumes	Scientific Name	Purity	Germination	Pure Live Seed
White Clover	Trifolium repens	98	85	
Native Grasses	Scientific Name	Purity	Variety(s)	Pure Live Seed
Blue Grama	Bouteloua gracilis			40
Buffalograss	Buchloe dactyloides		Mo. Ecotype Sharp's Improved Texoka	65
Little Bluestem	Schizachyrium scoparium		Mo. Ecotype Aldous Cimmaron	40
Wildrye, Canada	Elymus canadensis			60
Rough Dropseed	Sporobolus compositus ²		Mo. Ecotype	40

¹ Will not apply if unhulled or unscarified seed is specified.

² *S. asper* synonym

If the specified quantity is in pounds of seed, no reduction will be permitted in the specified quantity of seed if the purity or germination, or both, are higher than the minimum required by the specifications. If the specified quantity is in pounds of pure live seed, the pure live seed quantity shall be determined from the actual percentage shown by the supplier for native grasses or by multiplying the actual percentages of purity times the actual percentage of germination including hard seed for other seed.

All leguminous seed shall be inoculated or treated with the proper quantity of cultures approved for the particular legume to be sown. Leguminous seed include alsike clover, Korean lespedeza, red clover, white clover, hairy vetch, partridge pea and slender bush clover. The inoculant for treating leguminous seed shall be a nitrogen-fixing bacteria culture. The inoculant containers shall be plainly marked with the expiration date for use. The manufacturer's recommendations for inoculating seed shall be followed.

901-2.2 Lime. Lime shall be ground limestone containing not less than 85% of total carbonates, and shall be ground to such fineness that 90% will pass through a No. 20 mesh sieve and 50% will pass through a No. 100 mesh sieve. Coarser material will be acceptable, providing the rates of application are increased to provide not less than the minimum quantities and depth specified in the special provisions on the basis of the two sieve requirements above. Dolomitic lime or a high magnesium lime shall contain at least 10% of magnesium oxide. Lime shall be applied at the rate of **1,000 lbs per acre**. All liming materials shall conform to the requirements of ASTM C602.

The Contractor may test the in-place topsoil in order to reduce the required rate of application of lime to provide at least the quantity of effective neutralizing material (E.N.M.) in pounds per acre subsequent to grading activities, prior to seeding application. Surface soil pH will be supplied to the engineer by the contractor and the Engineer shall determine if a reducing in lime is acceptable.

901-2.3 Fertilizer. Fertilizer shall be a standard commercial product which, when applied at the proper rate, will supply the quantity of total nitrogen (N), available phosphoric acid (P_2O_5) and soluble potash (K_2O) as specified below. Material may be accepted on the basis of bag label analysis or supplier's certification, and shall be in accordance with all applicable Missouri fertilizer laws.

Fertilizer	lbs/acre
Nitrogen (N)	40
Phosphoric Acid (P_2O_5)	10
Potash (K_2O)	20

901-2.4 Soil for repairs. The soil for fill and topsoiling of areas to be repaired shall be at least of equal quality to that which exists in areas adjacent to the area to be repaired. The soil shall be relatively free from large stones, roots, stumps, or other materials that will interfere with subsequent sowing of seed, compacting, and establishing turf, and shall be approved by the Engineer before being placed.

CONSTRUCTION METHODS

901-3.1 Advance preparation and cleanup. After grading of areas has been completed and before applying fertilizer and ground limestone, areas to be seeded shall be raked or otherwise cleared of stones larger than 2 inches (50 mm) in any diameter, sticks, stumps, and other debris that might interfere with sowing of seed, growth of grasses, or subsequent maintenance of grass-covered areas. If any damage by erosion or other causes has occurred after the completion of grading and before beginning the application of fertilizer and ground limestone, the Contractor shall repair such damage include filling gullies, smoothing irregularities, and repairing other incidental damage.

An area to be seeded shall be considered a satisfactory seedbed without additional treatment if it has recently been thoroughly loosened and worked to a depth of not less than 5 inches (125 mm) as a result of grading operations and, if immediately prior to seeding, the top 3 inches (75 mm) of soil is loose, friable, reasonably free from large clods, rocks, large roots, or other undesirable matter, and if shaped to the required grade.

When the area to be seeded is sparsely sodded, weedy, barren and unworked, or packed and hard, any grass and weeds shall first be cut or otherwise satisfactorily disposed of, and the soil then scarified or otherwise loosened to a depth not less than 5 inches (125 mm). Clods shall be broken and the top 3 inches (75 mm) of soil shall be worked into a satisfactory seedbed by discing, or by use of cultipackers, rollers, drags, harrows, or other appropriate means.

901-3.2 Dry application method.

a. Liming. Lime shall be applied separately and prior to the application of any fertilizer or seed and only on seedbeds that have previously been prepared as described above. The lime shall then be worked into the top 3 inches (75 mm) of soil after which the seedbed shall again be properly graded and dressed to a smooth finish.

b. Fertilizing. Following advance preparations and cleanup fertilizer shall be uniformly spread at the rate that will provide not less than the minimum quantity stated in paragraph 901-2.3.

c. Seeding. Grass seed shall be sown at the rate specified in paragraph 901-2.1 immediately after fertilizing. The fertilizer and seed shall be raked within the depth range stated in the special provisions. Seeds of legumes, either alone or in mixtures, shall be inoculated before mixing or sowing, in accordance with the instructions of the manufacturer of the inoculant. When seeding is required at other than the seasons shown on the plans or in the special provisions, a cover crop shall be sown by the same methods required for grass and legume seeding.

d. Rolling. After the seed has been properly covered, the seedbed shall be immediately compacted by means of an approved lawn roller, weighing 40 to 65 pounds per foot (60 to 97 kg per meter) of width for clay soil (or any soil having a tendency to pack), and weighing 150 to 200 pounds per foot (223 to 298 kg per meter) of width for sandy or light soils.

901-3.3 Wet application method.

a. General. The Contractor may elect to apply seed and fertilizer (and lime, if required) by spraying them on the previously prepared seedbed in the form of an aqueous mixture and by using the methods and equipment described herein. The rates of application shall be as specified in the special provisions.

b. Spraying equipment. The spraying equipment shall have a container or water tank equipped with a liquid level gauge calibrated to read in increments not larger than 50 gallons (190 liters) over the entire range of the tank capacity, mounted so as to be visible to the nozzle operator. The container or tank shall also be equipped with a mechanical power-driven agitator capable of keeping all the solids in the mixture in complete suspension at all times until used.

The unit shall also be equipped with a pressure pump capable of delivering 100 gallons (380 liters) per minute at a pressure of 100 lb / sq inches (690 kPa). The pump shall be mounted in a line that will recirculate the mixture through the tank whenever it is not being sprayed from the nozzle. All pump passages and pipe lines shall be capable of providing clearance for 5/8 inch (16 mm) solids. The power unit for the pump and agitator shall have controls mounted so as to be accessible to the nozzle operator. There shall be an indicating pressure gauge connected and mounted immediately at the back of the nozzle.

The nozzle pipe shall be mounted on an elevated supporting stand in such a manner that it can be rotated through 360 degrees horizontally and inclined vertically from at least 20 degrees below to at least 60 degrees above the horizontal. There shall be a quick-acting, three-way control valve connecting the recirculating line to the nozzle pipe and mounted so that the nozzle operator can control and regulate the amount of flow of mixture delivered to the nozzle. At least three different types of nozzles shall be supplied so that mixtures may be properly sprayed over distance varying from 20 to 100 feet (6 to 30 m). One shall be a close-range ribbon nozzle, one a medium-range ribbon nozzle, and one a long-range jet

nozzle. For case of removal and cleaning, all nozzles shall be connected to the nozzle pipe by means of quick-release couplings.

In order to reach areas inaccessible to the regular equipment, an extension hose at least 50 feet (15 m) in length shall be provided to which the nozzles may be connected.

c. Mixtures. Lime, if required, shall be applied separately, in the quantity specified, prior to the fertilizing and seeding operations. Not more than 220 pounds (100 kg) of lime shall be added to and mixed with each 100 gallons (380 liters) of water. Seed and fertilizer shall be mixed together in the relative proportions specified, but not more than a total of 220 pounds (100 kg) of these combined solids shall be added to and mixed with each 100 gallons (380 liters) of water.

All water used shall be obtained from fresh water sources and shall be free from injurious chemicals and other toxic substances harmful to plant life. Brackish water shall not be used at any time. The Contractor shall identify to the Engineer all sources of water at least two (2) weeks prior to use. The Engineer may take samples of the water at the source or from the tank at any time and have a laboratory test the samples for chemical and saline content. The Contractor shall not use any water from any source that is disapproved by the Engineer following such tests.

All mixtures shall be constantly agitated from the time they are mixed until they are finally applied to the seedbed. All such mixtures shall be used within two (2) hours from the time they were mixed or they shall be wasted and disposed of at approved locations.

d. Spraying. Lime, if required, shall be sprayed only upon previously prepared seedbeds. After the applied lime mixture has dried, the lime shall be worked into the top 3 inches (75 mm), after which the seedbed shall again be properly graded and dressed to a smooth finish.

Mixtures of seed and fertilizer shall only be sprayed upon previously prepared seedbeds on which the lime, if required, shall already have been worked in. The mixtures shall be applied by means of a high-pressure spray that shall always be directed upward into the air so that the mixtures will fall to the ground like rain in a uniform spray. Nozzles or sprays shall never be directed toward the ground in such a manner as might produce erosion or runoff.

Particular care shall be exercised to ensure that the application is made uniformly and at the prescribed rate and to guard against misses and overlapped areas. Proper predetermined quantities of the mixture in accordance with specifications shall be used to cover specified sections of known area.

Checks on the rate and uniformity of application may be made by observing the degree of wetting of the ground or by distributing test sheets of paper or pans over the area at intervals and observing the quantity of material deposited thereon.

On surfaces that are to be mulched as indicated by the plans or designated by the Engineer, seed and fertilizer applied by the spray method need not be raked into the soil or rolled. However, on surfaces on which mulch is not to be used, the raking and rolling operations will be required after the soil has dried.

901-3.4 Maintenance of seeded areas. The Contractor shall protect seeded areas against traffic or other use by warning signs or barricades, as approved by the Engineer. Surfaces gullied or otherwise damaged following seeding shall be repaired by regrading and reseeding as directed. The Contractor shall mow, water as directed, and otherwise maintain seeded areas in a satisfactory condition until final inspection and acceptance of the work.

When either the dry or wet application method outlined above is used for work done out of season, it will be required that the Contractor establish a good stand of grass of uniform color and density to the satisfaction of the Engineer. A grass stand shall be considered adequate when bare spots are one square foot (0.01 sq m) or less, randomly dispersed, and do not exceed 3% of the area seeded.

METHOD OF MEASUREMENT

901-4.1 The quantity of seeding to be paid for shall be the number of units **to the nearest 1/10 acre** measured on the ground surface, completed and accepted.

BASIS OF PAYMENT

901-5.1 Payment shall be made at the contract unit price per **acre** or fraction thereof, which price and payment shall be full compensation for furnishing and placing all material and for all labor, equipment, tools, and incidentals necessary to complete the work prescribed in this item.

Payment will be made under:

Item 901-5.1 Seeding - per acre

MATERIAL REQUIREMENTS

ASTM C602	Standard Specification for Agricultural Liming Materials
ASTM D977	Standard Specification for Emulsified Asphalt
FED SPEC	JJJ-S-181, Federal Specification, Seeds, Agricultural

END OF ITEM T-901

ITEM T-908 MULCHING

DESCRIPTION

908-1.1 This work shall consist of furnishing, hauling, placing, and securing hydraulically applied mulch on surfaces indicated on the plans or as designated by the engineer. Disturbed areas outside of authorized construction limits shall be mulched at the contractor's expense. This work may be combined with the seeding described in Item MO-901 in areas other than are not to receive erosion control blanket.

MATERIALS

908-2.0 BUY AMERICAN. All materials used for this work shall meet the requirements of Buy American in accordance with Title 49 U.S.C. Section 50101. A certification statement or waiver request shall be submitted by the supplier for each proposed material. All waiver requests shall be submitted prior to issuance of the Notice to Proceed.

908-2.1 HYDRALICALLY APPLIED MULCH MATERIALS. No vegetative mulch will be allowed on this project. In lieu of the vegetative mulch, a hydraulically applied mulch material shall be applied. The mulch material shall be North American Green HydraCM or approved equal and shall be green in color.

The contractor shall furnish a manufacturer's certification in triplicate certifying that the overspray mulch materials comply with these specifications. The engineer may sample and test these materials prior to approval and use. Acceptance will be based upon a satisfactory certification and results of any test deemed necessary by the engineer.

CONSTRUCTION METHODS

908-3.1 MULCHING. Before spreading mulch, all stones larger than 2 inches in any diameter, sticks, stumps, and other debris shall be removed from the area to be mulched. All mulch shall be distributed evenly over the area to be mulched within 24 hours following the seeding operation.

Special care shall be taken to prevent any of the slurry from being sprayed onto any hardscape areas including concrete walks, pavements, fences, buildings, runway and taxiway edge lights, etc. Any slurry sprayed onto surfaces other than those to be seeded shall be washed immediately before the slurry dries.

The hydraulically applied mulch shall be mixed and applied according to the manufacturers recommendations. The Contractor shall provide the Engineer a copy of the manufacturer's installation procedures a minimum of seven (7) calendar days prior to the start of the work.

The mulch material shall be mixed with water in a manner to provide a homogenous slurry as recommended by the manufacturer. Equipment for mixing and applying the slurry shall be capable of applying it uniformly over the seeded ground surface. The slurry mixture shall be agitated during application to keep the ingredients thoroughly mixed.

The mulch material shall be applied at a rate of 2,500 pounds per acre. All empty packaging shall be kept onsite until the Engineer authorizes the removal of the packaging. The empty packaging will be used by the Engineer for yield check calculations for the application rate.

Mulch shall provide uniform coverage and thickness such that rill erosion is prevented from sheet flow during precipitation events. Bare soil should not be exposed. Mulch layer shall be applied to engineer's satisfaction. Mulching shall not occur prior to seeding.

908-3.2 CARE AND REPAIR.

Following the overspray operation, precautions shall be taken to prohibit foot or vehicular traffic over the mulched area. The contractor shall be required to repair or replace any mulching that is defective or becomes damaged until the project is finally accepted. When, in the judgment of the engineer, such defects or damages are the result of poor workmanship or failure to meet the requirements of the specifications, the cost of the necessary repairs or replacement shall be borne by the contractor.

However, once the contractor has completed the mulching of any area in accordance with the provisions of the specifications and to the satisfaction of the engineer, no additional work at his/her expense will be required, but subsequent repairs and replacements deemed necessary by the engineer shall be made by the contractor and will be paid for as additional or extra work in accordance with Section 40-04 of the General Provisions.

METHOD OF MEASUREMENT

908-4.1 Measurement of mulch will be made to the nearest 1/10 acre of the area mulched. Temporary mulching as required under MO-156 and the SWPPP will not be measured for payment and shall be considered incidental to the contract. Mulching required for pond removal shall not be measured for payment and shall be considered incidental to the pond removal.

BASIS OF PAYMENT

908-5.1 Payment shall be made at the contract unit price per acre or fraction thereof, for the accepted quantity of mulching. The price shall be full compensation for furnishing and placing all material and for all labor, equipment, tools, and incidentals necessary to complete the work prescribed in this item.

Payment will be made under:

Item T-908-5.1 Mulching--per acre

END ITEM T-908