Project Manual

Live Oak County

Live Oak County Courthouse

Phase II Restoration & Rehabilitation

March 06, 2026

Live Oak County Commissioners Court

Hon. James Liska
Live Oak County Judge

Hon. Richard Lee	Commissioner Precinct 1
Hon. Randy Kopplin	Commissioner Precinct 2
Hon. Mitchell Williams	Commissioner Precinct 3
Hon. Lucio Morin	Commissioner Precinct 4

Owner:
Live Oak County
301 Houston Street
George West, Texas 78022

Owner's Project Representative:
Judge James Liska
County Judge
P.O. Box 487
Ph. (361) 449-2733 Fax (361) 449-3155

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SECTION 000107
SEALS PAGE

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03/06/2026

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SECTION 002113
INSTRUCTIONS TO BIDDERS

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1.02 RELATED DOCUMENTS

A. Document 004100 - Bid Form.

B. Document 007300 - Supplementary Conditions:

INVITATION

2.01 BID SUBMISSION

A. Bids signed and under seal, executed, and dated will be received at the office of the County Auditor at 301 Houston St, 3rd Floor, George West, Texas 78022-0669 before 5 p.m. local standard time on May 28th, 2026.

1

B. Offers submitted after the above time will be returned to the bidder unopened.

C. Submit required Supplements To Bid Forms within 24 hours after closing time for receiving bids.

2.02 INTENT

A. The intent of this Bid request is to obtain an offer to perform work to complete project named Live Oak County Courthouse Phase II Restoration & Rehabilitation for a Stipulated Sum contract, in accordance with Contract Documents.

2.03 WORK IDENTIFIED IN THE CONTRACT DOCUMENTS

A. Work of this proposed Contract comprises building restoration, including general construction Work.

B. Project Location:
   301 Houston St.
   George West, Texas 78022.

2.04 CONTRACT TIME

A. Identify Contract Time in the Bid Form. The completion date in the Agreement shall be the Contract Time added to the commencement date.

BID DOCUMENTS AND CONTRACT DOCUMENTS

3.01 CONTRACT DOCUMENTS IDENTIFICATION

A. Contract Documents are identified as Owner's Project Number 2308 A1, as prepared by Architect, and with contents as identified in the Project Manual.

3.02 AVAILABILITY

A. Bid documents may be obtained by contacting the Live Oak County Auditor’s Office, (361) 449-2733, P.O. Box 699, George West, Texas 78022-0669 or by email, attention Regina Dove, locap@loctx.org.

3.03 EXAMINATION

A. Upon receipt of Bid Documents verify that documents are complete. Notify Architect should the documents be incomplete.

B. Immediately notify Architect upon finding discrepancies or omissions in the Bid Documents.

3.04 INQUIRIES/ADDENDA

A. Direct questions to Architect , email; nsolis@fisherheck.com.

B. Addenda may be issued during the bidding period. All Addenda become part of Contract Documents. Include resultant costs in the Bid Amount.

C. Verbal answers are not binding on any party.

D. Clarifications requested by bidders must be in writing not less than 7 days before date set for receipt of bids. The reply will be in the form of an Addendum, a copy of which will be forwarded to known recipients.

3.05 PRODUCT/ASSEMBLY/SYSTEM SUBSTITUTIONS

A. General Requirements for Substitution Requests:
   1. Project Manual establishes standards for products, assemblies, and systems.
   2. Submit requests only for elements for which substitution is specifically allowed in the Project Manual.

B. Substitution Request Form:
   1. Submit substitution requests by completing the form in Section 004325; see this section for additional information and instructions. Use only this form; other forms of submission are unacceptable.

C. Review and Acceptance of Request:

1. Architect may approve the proposed substitution and will issue an Addendum to known bidders.
2. For approved substitutions, include representation of changes in the bid, if any, required in the work and changes to Contract Time and Contract Sum to accommodate such substitutions. A later claim by the bidder for an addition to the Contract Time or Contract Sum because of changes in work necessitated by use of substitutions will not be considered.

SITE ASSESSMENT

4.01 SITE EXAMINATION

A. Examine the project site before submitting a bid.

B. The currently occupied premises at the project site are open for examination by bidders only during the following hours:
   1. Monday through Friday: 8AM to 5PM.

4.02 PREBID CONFERENCE

A. A bidders conference has been scheduled for 10 a.m. on the 30th day of April 2026 at the location of the Courthouse.

B. All general contract bidders and suppliers are invited.

C. Representatives of Architect and Live Oak County will be in attendance.

D. Summarized minutes of this meeting will be circulated to attendees. These minutes will not form part of Contract Documents.

E. Information relevant to the Bid Documents will be recorded in an Addendum, issued to Bid Document recipients.

QUALIFICATIONS

5.01 EVIDENCE OF QUALIFICATIONS

A. To demonstrate qualification for performing the Work of this Contract, bidders may be requested to submit written evidence of financial position, license to perform work in the State and historic preservation and restoration experience.

BID SUBMISSION

6.01 SUBMISSION PROCEDURE

A. Bidders shall be solely responsible for the delivery of their bids in the manner and time prescribed.

B. Submit one copy of the executed offer on the Bid Forms provided, signed and sealed with the required security in a closed opaque envelope, clearly identified with bidder's name, project name and Owner's name on the outside.

C. Improperly completed information, irregularities in security deposit, may be cause not to open the Bid Form envelope and declare the bid invalid or informal.

D. An abstract summary of submitted bids will be made available to all bidders following bid opening.

6.02 BID INELIGIBILITY

A. Bids that are unsigned, improperly signed or sealed, conditional, illegible, obscure, contain arithmetical errors, erasures, alterations, or irregularities of any kind, may at the discretion of the Owner, be declared unacceptable.

B. Bid Forms, Appendices, and enclosures that are improperly prepared may, at the discretion of Owner, be declared unacceptable.

C. Failure to provide security deposit, bonding or insurance requirements may, at the discretion of Owner, be waived.

BID ENCLOSURES/REQUIREMENTS

7.01 SECURITY DEPOSIT

A. Bids shall be accompanied by a security deposit as follows:
   1. Bid Bond of a sum no less than 5 percent of the Bid Amount.
   2. Certified check in the amount of no less than 5 percent of the Bid Amount.

B. The security deposit will be returned after delivery to the Owner of the required Performance and Payment Bond(s) by the accepted bidder.

C. Include the cost of bid security in the Bid Amount.

D. If no contract is awarded, all security deposits will be returned.

7.02 CONSENT OF SURETY

A. Submit with the Bid: _____.

7.03 PERFORMANCE ASSURANCE

A. Accepted Bidder: Provide a Performance bond as described in 007300 - Supplementary Conditions.

B. Include the cost of performance assurance bonds in the Bid Amount.

7.04 INSURANCE

A. Provide an executed "Undertaking of Insurance" on the form provided stating their intention to provide insurance to the bidder in accordance with the insurance requirements of Contract Documents.

7.05 BID FORM REQUIREMENTS

A. Complete all requested information in the Bid Form and Appendices.

7.06 FEES FOR CHANGES IN THE WORK

A. Include in the Bid Form, the fees proposed for subcontract work for changes (both additions and deductions) in the Work. Contractor shall apply fees as noted, to the subcontractor's gross (net plus fee) costs on additional work.

7.07 BID FORM SIGNATURE

A. The Bid Form shall be signed by the bidder, as follows:
   1. Sole Proprietorship: Signature of sole proprietor in the presence of a witness who will also sign. Insert the words "Sole Proprietor" under the signature. Affix seal.
   2. Partnership: Signature of all partners in the presence of a witness who will also sign. Insert the word "Partner" under each signature. Affix seal to each signature.
   3. Corporation: Signature of a duly authorized signing officer(s) in their normal signatures. Insert the officer's capacity in which the signing officer acts, under each signature. Affix the corporate seal. If the bid is signed by officials other than the president and secretary of the company, or the president/secretary/treasurer of the company, a copy of the by-law resolution of their board of directors authorizing them to do so, must also be submitted with the Bid Form in the bid envelope.
   4. Joint Venture: Each party of the joint venture shall execute the Bid Form under their respective seals in a manner appropriate to such party as described above, similar to the requirements of a Partnership.

OFFER ACCEPTANCE/REJECTION

8.01 DURATION OF OFFER

A. Bids shall remain open to acceptance and shall be irrevocable for a period of sixty (60) days after the bid closing date.

8.02 ACCEPTANCE OF OFFER

A. Owner reserves the right to accept or reject any or all offers.

B. After acceptance by Owner, Architect on behalf of Owner, will issue to the successful bidder, a written Bid Acceptance.

END OF SECTION 002113

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SECTION 00 3000

CONTRACTOR'S BID DISCLOSURE

CONTRACTOR'S
BIDDER DISCLOSURE STATEMENT

All questions must be answered or your bid will be deemed non-responsive and subject to rejection. The data given must be clear and comprehensive. This statement must be notarized. If necessary, questions may be answered on separate attached sheets. The bidder may submit any additional information he desires.

1. This Bidder Disclosure Statement is submitted to the County of Karnes by:

   _____

   ___a Corporation ___a Partnership ___a Texas Joint Venture or ___an individual

   Address: _____Contractor's No.: _____
   City: _____ State: Zip Code:_____

2. Years in business under present business name:_____.

3. Years of experience in construction work of the type called for in this contract as:
   A General Contractor_____, A Subcontractor_____.

4. What projects has your organization completed? List most recent FIRST.

Contract Amount	Type of Work	Date Completed	Owner's Name & Address Contact Person & Telephone No.

5. What projects does your organization have under way as of this date?

Contract Amount	Type of Work	Date Completed	Owner's Name & Address Contact Person & Telephone No.

6. Have you ever failed to complete any work awarded to you? ___ Yes ___ No. If yes, state where and why. _____

7. Are you at present in any lawsuits involving construction work of any type?

____ Yes ___ No. If Yes, explain:

8. If this contract is awarded to you, your company's office administrative manager for the work will be Mr. (Ms.) _____, and your resident construction superintendent will be Mr. (Ms.) _____.

9. What experience in this type of work does the individual designated as resident superintendent above have? Attach resume.

10. What portion of the work do you intend to subcontract?

11. What equipment do you own that is available for the proposed work?

Description, Size, Quantity Capacity, etc.	Condition	Years in Service	Present Location

12. Have you received firm offers from suppliers or manufacturers for all major items of material and/or equipment within the price totals used in preparing your proposal?
____ Yes ____ No

Credit Available: $_____

Bonding capacity available: $_____

Bank Name: _____
Bank Address: _____
Bank Phone: _____
Contact Name:_____

The undersigned hereby authorizes and requests any person, firm or corporation to furnish any information requested by the Engineer and Owner in verification of the recitals comprising this Pre-Bid Disclosure Statement.

The signatory of this questionnaire guarantees the truth and accuracy of all statements herein made and all answers herein expressed.

Date this _____ day of _____, 20_____.

By: _____

Title: _____

STATE OF _____

COUNTY OF _____

Subscribed and sworn to before me this _____ day of _____, 20___.

Notary Public
My commission expires: _____

END OF SECTION

SECTION 003100
AVAILABLE PROJECT INFORMATION

PART 1 GENERAL

1.01 EXISTING CONDITIONS

A. Certain information relating to existing surface and subsurface conditions and structures is available to bidders but will not be part of Contract Documents, as follows:

B. Site and Utility Survey: Entitled Plat of Survey of Block 18, in the town of George West, Live Oak County, Texas, dated June 7, 2023.

C. Hazardous Material Survey: Entitled Limited Asbestos Inspection and Limited Lead-Based Paint Renovation, Repair, and Painting (RRP) Survey, Live Oak Courthouse, 301 Houston Street, George West, Texas 78022; CEI Project No: 18286, dated July 7, 2023.

1. Original copy is available for inspection at Owner's offices during normal business hours.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 003100

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SECTION 00 4000

PROPOSAL

PLACE: **Live Oak County Courthouse, 301 Houston St., George West, Texas 78022**

DATE: _____

Proposal of _____ (hereafter called Bidder),

a Corporation organized and existing under the laws of the State of _____,

OR a Partnership,

OR an Individual doing business as:
(cross out non-applicable references).

GENTLEMEN:

The Bidder, in compliance with your Invitation for Bids for the construction of "Phase II Restoration & Rehabilitation of the Live Oak County Courthouse, Architect's No. 2308 A1, having examined the plans and specifications with related documents and the site of the proposed work, and being familiar with all of the conditions surrounding the construction of the project including the availability of materials and labor, hereby proposes to furnish all labor, materials, and supplies, and to construct the project in accordance with the contract documents, within the time set forth therein, and at the prices stated below. These prices are to cover all expenses incurred in performing the work required under the contract documents, of which this Proposal is a part.

OFFER

Having examined the Place of The Work and all matters referred to in the Instructions to Bidders and the Contract Documents prepared by Fisher Heck, Inc., Architects for the above-mentioned project, we, the undersigned, hereby offer to enter into a Contract to perform the Work for the Unit Prices listed in this bid form of:

_____
_____ dollars
($_____), in lawful money of the United States of America.

We have included the required security deposit as required by the Instruction to Bidders.

All applicable federal taxes are included and State of Texas taxes are included in the Bid Sum.

All Cash and Contingency Allowances described in Section 01210 are included in the Bid Sum.

BASE BID BREAKDOWN

	Name of Subcontractor/ Supplier	Dollar Amount
Division 1 - General Requirements		
General Conditions.....	_____	$_____
Administration - Scheduling, Submittals, Pay Apps, Etc	_____	$_____

Project Management, Foreman, Supervision	_____	$_____
Temporary Facilities and Controls	_____	$_____
Division 2 - Site Construction	_____	$_____
Division 3 - Concrete	_____	$_____
Division 4 - Masonry	_____	$_____
Division 5 - Metals	_____	$_____
Division 6 - Wood and Plastics	_____	$_____
Division 7 - Thermal and Moisture Protection	_____	$_____
Division 8 - Doors and Windows	_____	$_____
Division 9 - Finishes	_____	$_____
Division 10 - Specialties	_____	$_____
Division 10 - Equipment	_____	$_____
Division 12 - Furnishings	_____	$_____
Division 13 - Special Construction	_____	$_____
Division 14 - Conveying Systems	_____	$_____
Division 21 - Fire Suppression	_____	$_____
Division 22 Plumbing	_____	$_____
Division 23 HVAC	_____	$_____
Division 26 Electrical System	_____	$_____
Division 28 Electronic Safety and Security	_____	$_____
Division 31 Earthwork	_____	$_____
Division 32 Exterior Improvements	_____	$_____
Total for Divisions 1 through 32		$_____
Overhead		$_____
Profit		$_____
TOTAL BASE BID		$_____

SECTION 00 4110

BID BOND

BIDDER (Name and Address):

_____

_____

_____

SURETY (Name/Address/Phone Number of Principal Place of Business):

_____

_____

_____

OWNER (Name and Address):

_____

_____

_____

BID

BID DUE DATE:

PROJECT (Brief Description Including Location):

_____

_____

_____

BOND

BOND NUMBER: _____

DATE (Not later than Bid due date): _____

PENAL SUM: _____ _____

(Words) (Figures)

IN WITNESS WHEREOF, Surety and Bidder, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Bid Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

BIDDER	SURETY
_____ (Seal)	_____ (Seal)
Bidder's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	By: _____
Signature and Title	Signature and Title (Attach Power of Attorney)
Attest: _____	Attest: _____
Signature and Title	Signature and Title

Note: (1) Above addresses are to be used for giving required notice.

(2) Any singular reference to Bidder, Surety, OWNER or other party shall be considered plural where applicable.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to OWNER upon default of Bidder any difference between the total amount of Bidder's Bid and the total amount of the Bid of the next lowest, responsible and responsive Bidder as determined by OWNER for the Work required by the Contract Documents, provided that:
   1.1. If there is no such next lowest, responsible and responsive Bidder, and OWNER does not abandon the Project, then Bidder and Surety shall pay to OWNER the penal sum set forth on the face of this Bond, and
   1.2. In no event shall Bidder's and Surety's obligations hereunder exceed the penal sum set forth on the face of this Bond.

2. Default of Bidder shall occur 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 shall 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 by 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 and 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 shall not in the aggregate exceed 120 days from Bid due date without Surety's written consent.

6. No suit or action shall 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 Bid due date.

7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.

8. Notices required hereunder shall 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 Registered or Certified Mail, return receipt requested, postage pre-paid, and shall 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 or 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 shall 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 shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.

11. The term "Bid" as used herein includes a Bid, offer or proposal as applicable.

END OF SECTION

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SECTION 006000
GENERAL CONDITIONS OF CONTRACT

GENERAL CONDITIONS OF CONTRACT FOR

LIVE OAK COUNTY COURTHOUSE EXTERIOR RESTORATION

ARTICLE 1 GENERAL PROVISIONS

BASIC DEFINITIONS

CONTRACT DOCUMENTS. THE CONTRACT DOCUMENTS CONSIST OF: THE CONTRACT FOR THE LIVE OAK COUNTY COURTHOUSE EXTERIOR RESTORATION; ANY ADDENDA ISSUED PRIOR TO EXECUTION OF THE CONTRACT; THESE GENERAL CONDITIONS OF THE CONTRACT FOR THE LIVE OAK COUNTY COURTHOUSE EXTERIOR RESTORATION; DRAWINGS INDEX ATTACHED AS EXHIBIT "B" TO THE CONTRACT; THE DRAWINGS AND THE SPECIFICATIONS BEING ON FILE IN OWNER'S FACILITIES AND PARKS DEPARTMENT; NOTICE TO PROCEED; OTHER DOCUMENTS LISTED IN ANY OF THE CONTRACT DOCUMENTS; AND AMENDMENTS ISSUED AFTER EXECUTION OF THE CONTRACT.

AN "AMENDMENT" IS: (A) A WRITTEN AMENDMENT TO THE CONTRACT SIGNED BY BOTH PARTIES; (B) A CHANGE ORDER; (C) A CONSTRUCTION CHANGE DIRECTIVE; OR

(D) A WRITTEN ORDER FOR A MINOR CHANGE IN THE WORK ISSUED BY THE ARCHITECT.

CONTRACT. THE CONTRACT DOCUMENTS FORM THE CONTRACT FOR CONSTRUCTION ("CONTRACT"). THE CONTRACT REPRESENTS THE ENTIRE AND INTEGRATED AGREEMENT BETWEEN THE PARTIES HERETO AND SUPERSEDES PRIOR NEGOTIATIONS, REPRESENTATIONS OR AGREEMENTS, EITHER WRITTEN OR ORAL. THE CONTRACT MAY BE AMENDED OR MODIFIED ONLY BY A AMENDMENT. THE CONTRACT DOCUMENTS SHALL NOT BE CONSTRUED TO CREATE A CONTRACTUAL RELATIONSHIP OF ANY KIND: (A) BETWEEN THE ARCHITECT AND CONTRACTOR; (B) BETWEEN THE OWNER AND A SUBCONTRACTOR OR SUB-SUBCONTRACTOR; (C) BETWEEN THE OWNER AND ARCHITECT; OR (D) BETWEEN ANY PERSONS OR ENTITIES OTHER THAN THE OWNER AND CONTRACTOR. THE ARCHITECT SHALL, HOWEVER, BE ENTITLED TO PERFORMANCE AND ENFORCEMENT OF OBLIGATIONS UNDER THE CONTRACT INTENDED TO FACILITATE PERFORMANCE OF THE ARCHITECT'S DUTIES.

WORK. THE TERM "WORK" MEANS THE CONSTRUCTION AND SERVICES REQUIRED BY THE CONTRACT DOCUMENTS, WHETHER COMPLETED OR PARTIALLY COMPLETED, AND INCLUDES ALL OTHER LABOR, MATERIALS, EQUIPMENT AND SERVICES PROVIDED OR TO BE PROVIDED BY THE CONTRACTOR TO FULFILL THE CONTRACTOR'S OBLIGATIONS. THE WORK MAY CONSTITUTE THE WHOLE OR A PART OF THE PROJECT.

PROJECT. THE "PROJECT" IS THE TOTAL CONSTRUCTION OF WHICH THE WORK PERFORMED UNDER THE CONTRACT DOCUMENTS MAY BE THE WHOLE OR A PART AND WHICH MAY INCLUDE CONSTRUCTION BY THE OWNER OR BY SEPARATE CONTRACTORS.

DRAWINGS. THE "DRAWINGS" ARE THE GRAPHIC AND PICTORIAL PORTIONS OF THE CONTRACT DOCUMENTS SHOWING THE DESIGN, LOCATION AND DIMENSIONS OF THE WORK, GENERALLY INCLUDING PLANS, ELEVATIONS, SECTIONS, DETAILS, SCHEDULES AND DIAGRAMS.

SPECIFICATIONS. THE "SPECIFICATIONS" ARE THAT PORTION OF THE CONTRACT DOCUMENTS CONSISTING OF THE WRITTEN REQUIREMENTS FOR MATERIALS, EQUIPMENT, SYSTEMS, STANDARDS AND WORKMANSHIP FOR THE WORK, AND PERFORMANCE OF RELATED SERVICES.

PROJECT MANUAL. THE "PROJECT MANUAL" IS A VOLUME ASSEMBLED FOR THE WORK WHICH MAY INCLUDE THE BIDDING REQUIREMENTS, SAMPLES, FORMS, CONTRACT DOCUMENTS, AND OTHER MATERIAL.

ADDENDA. "ADDENDA" ARE THE ADDENDA TO THE DRAWINGS OR SPECIFICATIONS FURNISHED BY CONTRACTOR DURING THE BID PROCESS COVERING ADDITIONS, DELETIONS, OR CHANGES TO THE DRAWINGS OR SPECIFICATIONS.

RETAINAGE. ”RETAINAGE” MEANS THAT PART OF THE CONTRACT SUM WITHHELD BY OWNER TO SECURE PERFORMANCE OF THE CONTACT IN ACCORDANCE WITH THE TERMS OF SUBPARAGRAPH 9.11.

DATES

“SCHEDULED SUBSTANTIAL COMPLETION DATE” IS THE DATE SO SPECIFIED IN THE CONTRACT.

“SCHEDULED FINAL COMPLETION DATE” IS THE DATE SO SPECIFIED IN THE CONTRACT.

“SUBSTANTIAL COMPLETION” OCCURS ON THE DATE ALL REQUIREMENTS SPECIFIED FOR SUBSTANTIAL COMPLETION IN PARAGRAPH 9.8 HAVE BEEN COMPLETED AND A CERTIFICATE OF SUBSTANTIAL COMPLETION HAS BEEN ACCEPTED BY OWNER AND CONTRACTOR.

“FINAL COMPLETION” OCCURS ON THE DATE ALL REQUIREMENTS SPECIFIED IN PARAGRAPH 9.10 TO ENTITLE CONTRACTOR TO FINAL PAYMENT HAVE BEEN COMPLETED AND OWNER MAKES FINAL PAYMENT TO CONTRACTOR.

CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

THE INTENT OF THE CONTRACT DOCUMENTS IS TO INCLUDE ALL ITEMS NECESSARY FOR THE PROPER EXECUTION AND COMPLETION OF THE WORK BY THE CONTRACTOR. THE CONTRACT DOCUMENTS ARE COMPLEMENTARY, AND WHAT IS REQUIRED BY ONE SHALL BE AS BINDING AS IF REQUIRED BY ALL; PERFORMANCE BY THE CONTRACTOR SHALL BE REQUIRED ONLY TO THE EXTENT CONSISTENT WITH THE CONTRACT DOCUMENTS AND REASONABLY INFERABLE FROM THEM AS BEING NECESSARY TO PRODUCE THE INDICATED RESULTS.

ORGANIZATION OF THE SPECIFICATIONS INTO DIVISIONS, SECTIONS AND ARTICLES, AND ARRANGEMENT OF DRAWINGS SHALL NOT CONTROL THE CONTRACTOR IN DIVIDING THE WORK AMONG SUBCONTRACTORS OR IN ESTABLISHING THE EXTENT OF WORK TO BE PERFORMED BY ANY TRADE.

UNLESS OTHERWISE STATED IN THE CONTRACT DOCUMENTS, WORDS WHICH HAVE WELL-KNOWN TECHNICAL OR CONSTRUCTION INDUSTRY MEANINGS ARE USED IN THE CONTRACT DOCUMENTS IN ACCORDANCE WITH SUCH RECOGNIZED MEANINGS.

IN THE EVENT OF CONFLICTS, EXPLANATORY NOTES IN THE DRAWINGS TAKE PRECEDENCE OVER GRAPHIC INDICATIONS, LARGE SCALE DRAWINGS AND DETAILS TAKE PRECEDENCE OVER SMALLER SCALE DRAWINGS, AND FIGURED DIMENSIONS TAKE PRECEDENCE OVER SCALED DIMENSIONS. WHERE FIGURED DIMENSIONS ARE NOT INDICATED, SCALED DIMENSIONS MAY BE USED UPON APPROVAL BY THE ARCHITECT. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS, BOTH FIGURED AND SCALED, BY MEASUREMENTS OF CONDITIONS AND OF WORK IN PLACE.

CAPITALIZATION TERMS CAPITALIZED IN THESE GENERAL CONDITIONS INCLUDE THOSE WHICH ARE (1) SPECIFICALLY DEFINED; OR (2) THE TITLES OF NUMBERED ARTICLES AND IDENTIFIED REFERENCES TO PARAGRAPHS, SUBPARAGRAPHS AND CLAUSES IN THE DOCUMENT.

INTERPRETATION IN THE INTEREST OF BREVITY THE CONTRACT DOCUMENTS FREQUENTLY OMIT MODIFYING WORDS SUCH AS “ALL” AND “ANY” AND ARTICLES SUCH AS “THE” AND “AN,” BUT THE FACT THAT A MODIFIER OR AN ARTICLE IS ABSENT FROM ONE STATEMENT AND APPEARS IN ANOTHER IS NOT INTENDED TO AFFECT THE INTERPRETATION OF EITHER STATEMENT.

EXECUTION OF CONTRACT DOCUMENTS

THE CONTRACT DOCUMENTS SHALL BE SIGNED BY THE OWNER AND CONTRACTOR. IF EITHER THE OWNER OR CONTRACTOR OR BOTH DO NOT SIGN ALL THE CONTRACT DOCUMENTS, THE ARCHITECT SHALL IDENTIFY SUCH UNSIGNED DOCUMENTS UPON REQUEST.

EXECUTION OF THE CONTRACT BY THE CONTRACTOR IS A REPRESENTATION THAT THE CONTRACTOR HAS VISITED THE SITE, BECOME GENERALLY FAMILIAR WITH LOCAL CONDITIONS UNDER WHICH THE WORK IS TO BE PERFORMED, AND CORRELATED PERSONAL OBSERVATIONS WITH REQUIREMENTS OF THE CONTRACT DOCUMENTS.

BEFORE PERFORMING ANY PORTION OF THE WORK, THE CONTRACTOR SHALL FULLY INVESTIGATE ALL PHYSICAL ASPECTS OF THE PROJECT SITE AND VERIFY ALL DIMENSIONS, MEASUREMENTS, PROPERTY LINES, UTILITY LOCATIONS, GRADES AND ELEVATIONS, EXISTING IMPROVEMENTS, SURFACE AND SUBSURFACE SOIL CONDITIONS, DRAINAGE OF BOTH SURFACE AND SUBSURFACE, SOIL PLASTICITY, AND GENERAL SUITABILITY OF CONDITIONS AT THE PROJECT SITE.

OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS AND OTHER INSTRUMENTS ALL PLANS, DRAWINGS, SPECIFICATIONS AND

COPIES THEREOF FURNISHED BY THE ARCHITECT ARE AND SHALL REMAIN THE PROPERTY OF THE OWNER. THEY SHALL NOT BE USED BY ANY PERSON ON ANY OTHER PROJECT WITHOUT THE PRIOR WRITTEN CONSENT OF THE OWNER.

ARTICLE 2 OWNER

GENERAL

THE OWNER IS THE PERSON OR ENTITY IDENTIFIED AS SUCH IN THE CONTRACT AND IS REFERRED TO THROUGHOUT THE CONTRACT DOCUMENTS AS IF SINGULAR IN NUMBER. OWNER'S REPRESENTATIVE DESIGNATED IN THE CONTRACT (OR AS CHANGED BY WRITTEN NOTICE TO CONTRACTOR) SHALL HAVE EXPRESS AUTHORITY TO BIND THE OWNER WITH RESPECT TO ALL MATTERS REQUIRING THE OWNER'S APPROVAL OR AUTHORIZATION. THE ARCHITECT DOES NOT HAVE SUCH AUTHORITY. THE TERM "OWNER" FOR PURPOSES OF COMMUNICATION AND INTERACTION MEANS THE OWNER OR THE OWNER'S AUTHORIZED REPRESENTATIVE.

THE OWNER SHALL FURNISH TO THE CONTRACTOR, WITHIN FIFTEEN (15) DAYS AFTER RECEIPT OF A WRITTEN REQUEST, INFORMATION NECESSARY AND RELEVANT FOR THE CONTRACTOR TO EVALUATE, GIVE NOTICE OF OR ENFORCE MECHANIC'S LIEN RIGHTS. SUCH INFORMATION SHALL INCLUDE A CORRECT STATEMENT OF THE RECORD LEGAL TITLE TO THE PROPERTY ON WHICH THE PROJECT IS LOCATED, USUALLY REFERRED TO AS THE SITE, AND THE OWNER'S INTEREST THEREIN.

INFORMATION AND SERVICES REQUIRED OF THE OWNER

AFTER INDEPENDENT INVESTIGATION, CONTRACTOR IS SATISFIED THAT OWNER HAS THE FINANCIAL ABILITY TO FULFILL OWNER'S OBLIGATIONS UNDER THE CONTRACT DOCUMENTS.

EXCEPT FOR PERMITS AND FEES, INCLUDING THOSE REQUIRED UNDER SUBPARAGRAPH 3.7.1, WHICH ARE THE RESPONSIBILITY OF THE CONTRACTOR UNDER THE CONTRACT DOCUMENTS, THE OWNER SHALL SECURE AND PAY FOR NECESSARY APPROVALS, EASEMENTS, ASSESSMENTS AND CHARGES REQUIRED FOR CONSTRUCTION, USE OR OCCUPANCY OF PERMANENT STRUCTURES OR FOR PERMANENT CHANGES IN EXISTING FACILITIES.

THE OWNER SHALL FURNISH SURVEYS DESCRIBING PHYSICAL CHARACTERISTICS, LEGAL LIMITATIONS AND UTILITY LOCATIONS FOR THE SITE OF THE PROJECT, AND A LEGAL DESCRIPTION OF THE SITE. THE CONTRACTOR SHALL BE ENTITLED TO RELY ON THE ACCURACY OF SUCH INFORMATION FURNISHED BY THE OWNER BUT SHALL EXERCISE PROPER PRECAUTIONS RELATING TO THE SAFE PERFORMANCE OF THE WORK.

INFORMATION OR SERVICES REQUIRED OF THE OWNER BY THE CONTRACT DOCUMENTS SHALL BE FURNISHED BY THE OWNER WITH REASONABLE PROMPTNESS. ANY OTHER INFORMATION OR SERVICES RELEVANT TO THE CONTRACTOR'S PERFORMANCE OF THE WORK UNDER THE OWNER'S CONTROL SHALL BE FURNISHED BY THE OWNER AFTER RECEIPT FROM THE CONTRACTOR OF A WRITTEN REQUEST FOR SUCH INFORMATION OR SERVICES.

UNLESS OTHERWISE PROVIDED IN THE CONTRACT DOCUMENTS, THE CONTRACTOR WILL BE FURNISHED, FREE OF CHARGE, SUCH COPIES OF DRAWINGS AND PROJECT MANUALS AS ARE REASONABLY NECESSARY FOR EXECUTION OF THE WORK.

OWNER'S RIGHT TO STOP WORK IF THE CONTRACTOR FAILS TO CORRECT WORK WHICH IS NOT IN ACCORDANCE WITH THE REQUIREMENTS OF THE CONTRACT DOCUMENTS AS REQUIRED BY PARAGRAPH 12.2 OR FAILS TO CARRY OUT WORK IN ACCORDANCE WITH THE CONTRACT DOCUMENTS, THE OWNER MAY ISSUE A WRITTEN ORDER TO THE CONTRACTOR TO STOP THE WORK, OR ANY PORTION THEREOF, UNTIL THE CAUSE FOR SUCH ORDER HAS BEEN ELIMINATED; HOWEVER, THE RIGHT OF THE OWNER TO STOP THE WORK SHALL NOT GIVE RISE TO A DUTY ON THE PART OF THE OWNER TO EXERCISE THIS RIGHT FOR THE BENEFIT OF THE CONTRACTOR OR ANY OTHER PERSON OR ENTITY, EXCEPT TO THE EXTENT REQUIRED BY SUBPARAGRAPH 6.1.3. THIS RIGHT SHALL BE IN ADDITION TO, NOT IN RESTRICTION OF, OWNER'S RIGHTS UNDER PARAGRAPH 12.2.

OWNER'S RIGHT TO CARRY OUT THE WORK IF THE CONTRACTOR DEFAULTS OR NEGLECTS TO CARRY OUT THE WORK IN ACCORDANCE WITH THE CONTRACT DOCUMENTS AND FAILS, WITHIN A PERIOD OF FORTY-EIGHT (48) HOURS AFTER RECEIPT OF NOTICE FROM THE OWNER, TO COMMENCE AND CONTINUE CORRECTION OF SUCH DEFAULT OR NEGLECT WITH DILIGENCE AND PROMPTNESS, THE OWNER MAY, WITHOUT PREJUDICE TO OTHER REMEDIES THE OWNER MAY HAVE, CORRECT SUCH DEFICIENCIES. IN SUCH CASE, AN APPROPRIATE CHANGE ORDER SHALL BE ISSUED (WHICH MAY BE SIGNED ONLY BY OWNER) DEDUCTING FROM PAYMENTS THEN OR THEREAFTER DUE THE CONTRACTOR THE REASONABLE COST OF CORRECTING SUCH DEFICIENCIES, INCLUDING OWNER'S EXPENSES AND COMPENSATION FOR THE ARCHITECT'S ADDITIONAL SERVICES MADE NECESSARY BY SUCH DEFAULT, NEGLECT OR FAILURE. IF PAYMENTS THEN OR THEREAFTER DUE THE CONTRACTOR ARE NOT SUFFICIENT TO COVER SUCH AMOUNTS, THE CONTRACTOR SHALL PAY THE DIFFERENCE TO THE OWNER.

ARTICLE 3 CONTRACTOR

GENERAL

THE CONTRACTOR IS THE PERSON OR ENTITY IDENTIFIED AS SUCH IN THE CONTRACT AND IS REFERRED TO THROUGHOUT THE CONTRACT DOCUMENTS AS IF SINGULAR IN NUMBER. THE TERM "CONTRACTOR" FOR PURPOSES OF COMMUNICATION AND INTERACTION MEANS THE CONTRACTOR OR THE CONTRACTOR'S AUTHORIZED REPRESENTATIVE AS SPECIFIED IN THE CONTRACT OR CHANGED ACCORDING TO ITS TERMS.

ARTICLE 5 SUBCONTRACTORS

DEFINITIONS

A SUBCONTRACTOR IS A PERSON OR ENTITY WHO HAS A DIRECT CONTRACT WITH THE CONTRACTOR TO PERFORM A PORTION OF THE WORK AT THE SITE OR OTHERWISE FURNISHES LABOR OR MATERIALS. THE TERM "SUBCONTRACTOR" IS REFERRED TO THROUGHOUT THE CONTRACT DOCUMENTS AS IF SINGULAR IN NUMBER AND MEANS A SUBCONTRACTOR OR AN AUTHORIZED REPRESENTATIVE OF THE SUBCONTRACTOR. THE TERM "SUBCONTRACTOR" DOES NOT INCLUDE A SEPARATE CONTRACTOR OR SUBCONTRACTORS OF A SEPARATE CONTRACTOR.

A SUB-SUBCONTRACTOR IS A PERSON OR ENTITY WHO HAS A DIRECT OR INDIRECT CONTRACT WITH A SUBCONTRACTOR TO PERFORM A PORTION OF THE WORK AT THE SITE OR OTHERWISE FURNISHES LABOR OR MATERIALS. THE TERM "SUB-SUBCONTRACTOR" IS REFERRED TO THROUGHOUT THE CONTRACT DOCUMENTS AS IF SINGULAR IN NUMBER AND MEANS A SUB-SUBCONTRACTOR OR AN AUTHORIZED REPRESENTATIVE OF THE SUB-SUBCONTRACTOR.

ARTICLE 6

CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

OWNER'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS

THE OWNER RESERVES THE RIGHT TO PERFORM CONSTRUCTION OR OPERATIONS RELATED TO THE PROJECT WITH THE OWNER'S OWN FORCES AND/OR TO AWARD SEPARATE CONTRACTS IN CONNECTION WITH OTHER PORTIONS OF THE PROJECT OR OTHER CONSTRUCTION OR OPERATIONS ON THE SITE.

WHEN SEPARATE CONTRACTS ARE AWARDED FOR DIFFERENT PORTIONS OF THE PROJECT OR OTHER CONSTRUCTION OR OPERATIONS ON THE SITE, THE TERM "CONTRACTOR" IN THE APPLICABLE "CONTRACT DOCUMENTS" IN EACH CASE SHALL MEAN THE CONTRACTOR WHO EXECUTES EACH SEPARATE OWNER-CONTRACTOR AGREEMENT.

IF OWNER EXERCISES OWNER'S RIGHT TO PERFORM CONSTRUCTION OR OPERATIONS UNDER SUBPARAGRAPH 6.1.1, OWNER SHALL PROVIDE FOR COORDINATION OF THE ACTIVITIES OF THE OWNER'S OWN FORCES AND OF EACH SEPARATE CONTRACTOR WITH THE WORK OF THE CONTRACTOR. CONTRACTOR AGREES TO COOPERATE WITH OWNER'S OWN FORCES AND/OR EACH SEPARATE CONTRACTOR. THE CONTRACTOR SHALL PARTICIPATE WITH OTHER SEPARATE CONTRACTORS AND THE OWNER IN REVIEWING THE CONSTRUCTION SCHEDULES OF ALL PARTIES. THE CONTRACTOR SHALL MAKE ANY REVISIONS TO THE CONSTRUCTION SCHEDULE DEEMED NECESSARY BY OWNER AND CONTRACTOR, AFTER A JOINT REVIEW OF ALL PARTIES' CONSTRUCTION SCHEDULES AND MUTUAL AGREEMENT THEREON. UNTIL MUTUAL AGREEMENT ON A REVISED CONSTRUCTION SCHEDULE IS REACHED, THE CONSTRUCTION SCHEDULES OF EACH PARTY SHALL CONSTITUTE THE SCHEDULES TO BE USED BY THE CONTRACTOR, SEPARATE CONTRACTORS AND THE OWNER UNTIL SUBSEQUENTLY REVISED.

ARTICLE 7 CHANGES IN THE WORK

GENERAL

CHANGES IN THE WORK MAY BE ACCOMPLISHED AFTER EXECUTION OF THE CONTRACT, AND WITHOUT INVALIDATING THE CONTRACT, ONLY BY CHANGE ORDER, CONSTRUCTION CHANGE DIRECTIVE, OR ORDER FOR A MINOR CHANGE IN THE WORK, SUBJECT TO THE LIMITATIONS STATED IN THIS ARTICLE 7 AND ELSEWHERE IN THE CONTRACT DOCUMENTS.

ARTICLE 8 TIME

DEFINITIONS

UNLESS OTHERWISE PROVIDED, CONTRACT TIME BEGINS ON THE DATE OF COMMENCEMENT SPECIFIED IN THE CONTRACT AND IS THE PERIOD OF TIME, INCLUDING AUTHORIZED ADJUSTMENTS, ALLOTTED IN THE CONTRACT DOCUMENTS FOR SUBSTANTIAL COMPLETION OF THE WORK.

THE DATE OF COMMENCEMENT OF THE WORK IS THE DATE ESTABLISHED IN THE CONTRACT AS THE DATE STIPULATED IN THE NOTICE TO PROCEED.

THE DATE OF ACTUAL SUBSTANTIAL COMPLETION IS THE DATE CERTIFIED BY THE ARCHITECT AND APPROVED IN WRITING BY OWNER IN ACCORDANCE WITH PARAGRAPH 9.8.

THE TERM "DAY" AS USED IN THE CONTRACT DOCUMENTS SHALL MEAN CALENDAR DAY UNLESS OTHERWISE SPECIFICALLY DEFINED.

ARTICLE 9 PAYMENTS AND COMPLETION

CONTRACT SUM THE CONTRACT SUM IS STATED IN THE CONTRACT AND, INCLUDING PROPERLY AUTHORIZED ADJUSTMENTS, IS THE TOTAL AMOUNT PAYABLE BY THE OWNER TO THE CONTRACTOR FOR PERFORMANCE OF THE WORK UNDER THE CONTRACT DOCUMENTS.

ARTICLE 10

PROTECTION OF PERSONS AND PROPERTY

SAFETY PRECAUTIONS AND PROGRAMS NOTWITHSTANDING ANYTHING IN THE CONTRACT DOCUMENTS TO THE CONTRARY, THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR INITIATING, MAINTAINING AND SUPERVISING ALL SAFETY PRECAUTIONS AND PROGRAMS AS MAY BE PRUDENT UNDER THE CIRCUMSTANCES TO INSURE THE SAFE COMPLETION OF THE PROJECT. SUCH SAFETY PRECAUTIONS AND PROGRAMS SHALL INCLUDE, BUT NOT BE LIMITED TO ALCOHOL AND SUBSTANCE ABUSE PREVENTION AND TESTING FOR PERSONS PERFORMING THE WORK ON THE PROJECT SITE.

ARTICLE 11

INSURANCE, INDEMNIFICATION, AND BONDS

INSURANCE PROVIDED BY CONTRACTOR

CONTRACTOR SHALL, AT ITS SOLE EXPENSE, MAINTAIN IN EFFECT AT ALL TIMES DURING THE FULL TERM OF ITS WORK UNDER THE CONTRACT DOCUMENTS (INCLUDING, WITHOUT LIMITATION, ANY POST ACCEPTANCE WARRANTY WORK OF CONTRACTOR OR ANY SUBCONTRACTOR) AND AS OTHERWISE REQUIRED UNDER THE CONTRACT DOCUMENTS, INSURANCE COVERAGE WITH LIMITS NOT LESS THAN THOSE SET FORTH IN THE CONTRACT DOCUMENTS. INSURANCE COVERAGE SHALL BE PROCURED FROM INSURERS LICENSED TO DO BUSINESS IN THE STATE OF TEXAS, ACCEPTABLE TO OWNER AND UNDER FORMS OF POLICIES SATISFACTORY TO OWNER. NONE OF THE REQUIREMENTS CONTAINED IN THIS ARTICLE 11 AS TO TYPES, LIMITS OR OWNER'S APPROVAL OF INSURANCE COVERAGE TO BE MAINTAINED BY CONTRACTOR IS INTENDED TO AND SHALL NOT IN ANY MANNER LIMIT, QUALIFY OR QUANTIFY THE LIABILITIES AND OBLIGATIONS ASSUMED BY CONTRACTOR UNDER THE CONTRACT DOCUMENTS OR OTHERWISE PROVIDED BY LAW. IN THE EVENT OF ANY FAILURE BY CONTRACTOR TO COMPLY WITH THE PROVISIONS OF THIS PARAGRAPH 11.1, OWNER MAY, WITHOUT IN ANY WAY COMPROMISING OR WAIVING ANY RIGHT OR REMEDY AT LAW OR IN EQUITY, ON NOTICE TO CONTRACTOR, PURCHASE SUCH INSURANCE, AT CONTRACTOR'S EXPENSE (WHICH MAY BE DEDUCTED FROM ANY PAYMENT DUE BY OWNER TO CONTRACTOR UNDER THE CONTRACT DOCUMENTS), PROVIDED THAT OWNER SHALL HAVE NO OBLIGATION TO OBTAIN AND MAINTAIN SUCH INSURANCE AMOUNTS AND COVERAGES.

SCHEDULE OF CONTRACTOR'S INSURANCE COVERAGES

MINIMUM AMOUNTS AND LIMITS

WORKER'S COMPENSATION

STATUTORY LIMITS

$1,000,000

THE COVERAGE SET FORTH IN THIS SUBPARAGRAPH 11.1.2.1 SHALL INCLUDE ALL OPERATIONS OF THE CONTRACTOR AND ALL SUBCONTRACTORS. THIS COVERAGE SHALL INCLUDE A WAIVER OF SUBROGATION IN FAVOR OF THE OWNER.

COMMERCIAL GENERAL LIABILITY

$1,000,000 EACH OCCURRENCE, OR EQUIVALENT,

SUBJECT TO A $1,000,000 AGGREGATE APPLICABLE TO THE PROJECT

THIS POLICY SHALL BE ON A FORM ACCEPTABLE TO OWNER, ENDORSED TO INCLUDE THE OWNER AS ADDITIONAL INSURED, CONTAIN CROSS-LIABILITY AND SEVERABILITY OF INTEREST ENDORSEMENTS, STATE THAT THIS INSURANCE IS PRIMARY AND NON-CONTRIBUTORY INSURANCE AS REGARDS ANY OTHER INSURANCE CARRIED BY THE OWNER, AND SHALL INCLUDE THE FOLLOWING COVERAGES:

PREMISES/OPERATIONS;

INDEPENDENT CONTRACTORS;

COMPLETED OPERATIONS FOR A PERIOD OF TWO YEARS FOLLOWING THE ACCEPTANCE OF CONTRACTOR'S WORK;

BROAD FORM CONTRACTUAL LIABILITY

BROAD FORM PROPERTY DAMAGE;

HAZARDS.

THE COVERAGE REQUIRED IN THIS SUBPARAGRAPH 11.1.2.2 SHALL COVER CONTRACTOR AND ANY APPLICABLE SUBCONTRACTOR.

UMBRELLA EXCESS LIABILITY INSURANCE

$3,000,000 PER OCCURRENCE

$3,000,000 AGGREGATE

THIS POLICY SHALL BE ON A FORM ACCEPTABLE TO OWNER, WRITTEN ON AN UMBRELLA EXCESS BASIS ABOVE COVERAGES AS DESCRIBED IN 11.1.2.1 AND 11.1.2.2 ABOVE AND 11.1.2.5 BELOW, ENDORSED TO INCLUDE OWNER AS AN ADDITIONAL INSURED (OWNER SHALL BE NAMED AS ADDITIONAL INSURED ON THE POLICIES REQUIRED IN 11.1.2.2 AND 11.1.2.3), CONTAIN CROSS-LIABILITY AND SEVERABILITY OF INTEREST ENDORSEMENTS, AND STATE THAT THIS INSURANCE IS PRIMARY AND NON-CONTRIBUTORY INSURANCE AS REGARDS ANY OTHER INSURANCE CARRIED BY OWNER. IN ADDITION, THE POLICY SHALL BE ENDORSED TO PROVIDE DEFENSE COVERAGE OBLIGATIONS. THE COVERAGE REQUIRED IN THIS SUBPARAGRAPH 11.1.2.3 SHALL COVER CONTRACTOR AND SUBCONTRACTORS.

BUILDER'S RISK INSURANCE. CONTRACTOR SHALL CARRY, AT ITS SOLE EXPENSE, COMPLETED VALUE FORM BUILDER'S RISK PROPERTY INSURANCE (SUBJECT TO A DEDUCTIBLE PER LOSS NOT TO EXCEED TWENTY FIVE THOUSAND DOLLARS ($25,000.00)) UPON THE ENTIRE WORK, INCLUDING WITHOUT LIMITATION, COVERAGE FOR ALL OWNER SUPPLIED MATERIALS, FOR ONE HUNDRED PERCENT (100%) OF THE FULL REPLACEMENT COST VALUE OF SUCH OWNER SUPPLIED MATERIALS (100% INCLUDES ADDITIONAL COSTS OF ARCHITECTURAL AND ENGINEERING SERVICES IN THE EVENT OF A LOSS). THIS POLICY SHALL INCLUDE THE INTERESTS OF THE OWNER, CONTRACTOR, AND SUBCONTRACTORS IN THE WORK AS NAMED INSURED'S, AS THEIR INTERESTS MAY APPEAR, AND SHALL BE ON AN "ALL RISK" BASIS FOR PHYSICAL LOSS OR DAMAGE RESULTING FROM, WITHOUT LIMITATION, FIRE, FLOOD, EARTHQUAKE, SUBSIDENCE, HAIL, THEFT, VANDALISM AND MALICIOUS MISCHIEF. THIS POLICY SHALL ALSO INCLUDE COVERAGE FOR PORTIONS OF THE WORK WHILE IT IS STORED OFF THE SITE OR IS IN TRANSIT. THIS POLICY SHALL FURTHER PROVIDE, BY ENDORSEMENT OR OTHERWISE, THAT CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR THE PAYMENT OF ALL PREMIUMS UNDER THE POLICY, AND THAT OWNER SHALL HAVE NO OBLIGATION FOR THE PREMIUM PAYMENT, NOTWITHSTANDING THAT OWNER IS A NAMED INSURED UNDER THE POLICY. ANY INSURED LOSS OR CLAIM OF LOSS SHALL BE ADJUSTED BY THE OWNER, AND ANY SETTLEMENT PAYMENTS SHALL BE MADE PAYABLE TO THE OWNER. UPON THE OCCURRENCE OF AN INSURED LOSS OR CLAIM OF LOSS, MONIES RECEIVED WILL BE HELD BY OWNER, WHO SHALL MAKE DISTRIBUTION IN ACCORDANCE WITH AN AGREEMENT TO BE REACHED IN SUCH EVENT BETWEEN OWNER AND CONTRACTOR. IF THE PARTIES ARE UNABLE TO AGREE BETWEEN THEMSELVES ON THE SETTLEMENT OF THE LOSS, SUCH DISPUTE SHALL BE SUBMITTED FIRST TO MEDIATION AS DESCRIBED IN PARAGRAPH 4.5, BUT THE WORK OF THE PROJECT SHALL, NEVERTHELESS PROGRESS DURING ANY SUCH PERIOD OF DISPUTE WITHOUT PREJUDICE TO THE RIGHTS OF ANY PARTY TO THE DISPUTE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY LOSS, THE VALUE OF WHICH IS WITHIN THE DEDUCTIBLE OF THE POLICY.

COMPREHENSIVE AUTOMOBILE LIABILITY

COMBINED SINGLE LIMIT OF $1,000,000 PER OCCURRENCE

THIS POLICY SHALL BE ON A FORM ACCEPTABLE TO OWNER, WRITTEN TO COVER ALL OWNED, HIRED AND NON-OWNED AUTOMOBILES. THE POLICY SHALL BE ENDORSED TO INCLUDE THE OWNER AS ADDITIONAL INSURED, CONTAIN CROSS-LIABILITY AND SEVERABILITY OF INTEREST ENDORSEMENTS, AND STATE THAT THIS INSURANCE IS PRIMARY AND NON-CONTRIBUTORY INSURANCE AS REGARDS ANY OTHER INSURANCE CARRIED BY THE OWNER.

CONTRACTOR'S EQUIPMENT ANY SUCH INSURANCE POLICY COVERING THE EQUIPMENT OF CONTRACTOR OR ITS SUBCONTRACTORS AGAINST LOSS BY PHYSICAL DAMAGE SHALL INCLUDE AN ENDORSEMENT WAIVING THE INSURER'S RIGHT OF SUBROGATION AGAINST THE OWNER. THE INSURANCE COVERING EQUIPMENT SHALL BE THE SOLE AND COMPLETE MEANS OF RECOVERY FOR ANY LOSS OF SUCH EQUIPMENT BY CONTRACTOR OR ITS SUBCONTRACTORS. SHOULD CONTRACTOR OR ITS SUBCONTRACTORS CHOOSE TO SELF INSURE THE RISK, IT IS EXPRESSLY AGREED THAT THE CONTRACTOR AND ITS SUBCONTRACTORS HEREBY WAIVE ANY CLAIM FOR DAMAGE OR LOSS TO SAID EQUIPMENT, IN FAVOR OF THE OWNER.

EVIDENCE OF INSURANCE EVIDENCE OF THE INSURANCE COVERAGE REQUIRED TO BE MAINTAINED BY THE CONTRACTOR UNDER THIS PARAGRAPH 11.1, REPRESENTED BY CERTIFICATES OF INSURANCE AND ENDORSEMENTS ISSUED BY THE INSURANCE CARRIER, MUST BE FURNISHED TO THE OWNER AT THE ADDRESS BELOW, PRIOR TO EXECUTION OF THE CONTRACT BY OWNER. CERTIFICATES OF INSURANCE SHALL SPECIFY THE INSURED STATUS MENTIONED ABOVE IN THIS PARAGRAPH 11.1, AS WELL AS THE WAIVERS OF SUBROGATION. THE CERTIFICATES OF INSURANCE SHALL STATE THAT OWNER WILL BE NOTIFIED IN WRITING THIRTY (30) DAYS PRIOR TO A CANCELLATION, MATERIAL CHANGE, OR NON-RENEWAL OF INSURANCE. CONTRACTOR SHALL PROVIDE TO OWNER A CERTIFIED COPY OF ANY AND ALL APPLICABLE INSURANCE POLICIES, UPON REQUEST OF OWNER. TIMELY RENEWAL CERTIFICATES WILL BE PROVIDED TO OWNER AS THE COVERAGE OF EACH POLICY RENEWS.

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SUBCONTRACTORS' INSURANCE SIMILAR TO THAT REQUIRED OF CONTRACTOR, INCLUDING AN ENDORSEMENT BY THE INSURANCE COMPANY OF OWNER AS AN ADDITIONAL INSURED, WITH LIMITS OF LIABILITY AS DETERMINED BY OWNER, SHALL BE PROVIDED BY OR ON BEHALF OF ALL SUBCONTRACTORS TO COVER OPERATIONS PERFORMED BY SUCH SUBCONTRACTORS UNDER THE CONTRACT DOCUMENTS. CONTRACTOR SHALL BE HELD RESPONSIBLE FOR ANY MODIFICATION IN THE INSURANCE REQUIREMENTS OF PARAGRAPH 11.1, AS THEY APPLY TO SUBCONTRACTORS. CONTRACTOR SHALL MAINTAIN CERTIFICATES OF INSURANCE FROM ALL SUBCONTRACTORS, ENUMERATING, AMONG OTHER THINGS, THE WAIVERS IN FAVOR OF, AND INSURED STATUS OF, THE OWNER, AS REQUIRED HEREIN, AND SHALL MAKE SUCH CERTIFICATES AVAILABLE TO OWNER IN ACCORDANCE WITH THE TIME FRAME DESCRIBED IN PARAGRAPH 11.1.4. THE TERM "SUBCONTRACTOR(S)" FOR THE PURPOSES OF THIS ARTICLE 11 SHALL INCLUDE SUBCONTRACTORS OF ANY TIER.

RELEASE AND WAIVER CONTRACTOR HEREBY RELEASES, AND SHALL CAUSE ITS SUBCONTRACTORS TO RELEASE, OWNER FROM ANY AND ALL CLAIMS OR CAUSES OF ACTION, WHATSOEVER, WHICH CONTRACTOR AND/OR ITS SUBCONTRACTORS MIGHT OTHERWISE POSSESS RESULTING IN OR FROM OR IN ANY WAY CONNECTED WITH ANY LOSS COVERED OR WHICH SHOULD HAVE BEEN COVERED BY INSURANCE (INCLUDING THE DEDUCTIBLE PORTION THEREOF), MAINTAINED AND/OR REQUIRED TO BE MAINTAINED BY CONTRACTOR AND/OR ITS SUBCONTRACTORS PURSUANT TO THE CONTRACT DOCUMENTS.

CLAIMS MADE POLICIES WITH RESPECT TO ANY OF THE INSURANCE POLICIES PROVIDED BY CONTRACTOR PURSUANT TO THE CONTRACT DOCUMENTS WHICH ARE "CLAIMS MADE" POLICIES, IN THE EVENT AT ANY TIME ANY SUCH POLICIES ARE CANCELED OR NOT RENEWED, CONTRACTOR SHALL PROVIDE TO OWNER A SUBSTITUTE INSURANCE POLICY(IES) WITH TERMS AND CONDITIONS AND IN AMOUNTS WHICH COMPLY WITH THE TERMS OF THE CONTRACT DOCUMENTS AND WHICH PROVIDES FOR RETROACTIVE COVERAGE TO THE DATE OF CANCELLATION OR NON-RENEWAL TO FILL ANY GAPS IN COVERAGE WHICH MAY EXIST DUE TO THE CANCELLATION OR NON-RENEWAL OF THE PRIOR "CLAIMS MADE" POLICIES. WITH RESPECT TO ALL "CLAIMS MADE" POLICIES WHICH ARE RENEWED, CONTRACTOR SHALL PROVIDE COVERAGE RETROACTIVE TO THE DATE OF COMMENCEMENT OF THE WORK IN SAID RENEWED POLICY. ALL SUBSTITUTE OR RENEWED "CLAIMS MADE" POLICIES SHALL BE MAINTAINED IN FULL FORCE AND EFFECT FOR THE LONGER OF (A) TWO (2) YEARS FROM THE DATE OF FINAL COMPLETION OF THE WORK; OR (B) AS OTHERWISE REQUIRED BY THE CONTRACT DOCUMENTS. A CERTIFICATE EVIDENCING CONTINUATION OF SUCH POLICIES SHALL BE SUBMITTED WITH THE FINAL APPLICATION FOR PAYMENT, AS REQUIRED BY SUBPARAGRAPH 9.10.2. NOTHING HEREIN SHALL AFFECT THE CONTINUING EFFECT OF THE INDEMNITY CLAUSES IN THE CONTRACT DOCUMENTS.

OWNER MAY ELECT AT ANY TIME DURING THE TERM OF THE CONTRACT TO REQUIRE CONTRACTOR TO PROCURE AND MAINTAIN OTHER OR ADDITIONAL INSURANCE. NOTICE OF SUCH ELECTION SHALL BE GIVEN AT LEAST SIXTY (60) DAYS PRIOR TO THE EFFECTIVE DATE OF THE REQUIRED MODIFICATIONS. ANY ADDITIONAL REASONABLE COSTS INCURRED BY CONTRACTOR IN SECURING SUCH INSURANCE SHALL BE BY CHANGE ORDER IN ACCORDANCE WITH SUBPARAGRAPH 7.2 ABOVE.

INDEMNIFICATION TO THE FULLEST EXTENT PERMITTED BY LAW, CONTRACTOR SHALL, AND DOES, AGREE TO INDEMNIFY, PROTECT, DEFEND, AND HOLD HARMLESS THE OWNER, ITS OFFICIALS, EMPLOYEES, AND AGENTS THEREOF (COLLECTIVELY THE "INDEMNITEES") FROM AND AGAINST ALL CLAIMS, DAMAGES, LOSSES, LIENS, CAUSES OF ACTION, SUITS, JUDGMENTS, AND EXPENSES, INCLUDING ATTORNEY FEES, OF ANY NATURE, KIND OR DESCRIPTION OF ANY PERSON OR ENTITY, DIRECTLY OR INDIRECTLY ARISING OUT OF, CAUSED BY, OR RESULTING FROM (IN WHOLE OR IN PART): (A) THE WORK PERFORMED HEREUNDER, OR ANY PART THEREOF; (B) WORK NOT IN ACCORDANCE WITH THE REQUIREMENTS OF THE CONTRACT; (C) THE CONTRACT; OR (D) ANY ACT OR OMISSION OF CONTRACTOR, ANY SUBCONTRACTOR, ANYONE DIRECTLY OR INDIRECTLY EMPLOYED BY THEM, OR ANYONE THAT THEY CONTROL OR EXERCISE CONTROL OVER (COLLECTIVELY, "THE LIABILITIES"). CONTRACTOR SHALL PROMPTLY ADVISE OWNER, IN WRITING, OF ANY ACTION, ADMINISTRATIVE OR LEGAL PROCEEDING OR INVESTIGATION TO WHICH THIS INDEMNIFICATION MAY APPLY, AND CONTRACTOR, AT CONTRACTOR'S EXPENSE, SHALL ASSUME, ON BEHALF OF OWNER (AND OTHER INDEMNITEES) AND SHALL CONDUCT, WITH DUE DILIGENCE AND IN GOOD FAITH, THE DEFENSE THEREOF WITH COUNSEL SATISFACTORY TO OWNER; PROVIDED, HOWEVER, THAT OWNER SHALL HAVE THE RIGHT, AT ITS OPTION, TO BE REPRESENTED BY ADVISORY COUNSEL OF ITS OWN SELECTION AND AT ITS OWN EXPENSE. IN THE EVENT OF FAILURE BY THE CONTRACTOR TO FULLY PERFORM, IN ACCORDANCE WITH THIS INDEMNIFICATION PARAGRAPH, OWNER, AT ITS OPTION, AND WITHOUT RELIEVING CONTRACTOR OF ITS OBLIGATIONS HEREUNDER, MAY SO PERFORM, BUT ALL COSTS AND EXPENSES SO INCURRED BY OWNER IN THAT EVENT SHALL BE REIMBURSED BY CONTRACTOR TO OWNER, TOGETHER WITH INTEREST ON THE SAME FROM THE DATE ANY SUCH EXPENSE WAS PAID BY OWNER UNTIL REIMBURSED BY CONTRACTOR, AT THE HIGHEST LAWFUL RATE OF INTEREST. FURTHER, SHOULD OWNER ELECT TO PERFORM, ALL COSTS AND EXPENSES INCURRED BY OWNER SHALL, AT THE OPTION OF OWNER, BE DEDUCTED FROM ANY PAYMENT DUE BY OWNER TO CONTRACTOR, PURSUANT TO THE CONTRACT. THIS INDEMNIFICATION

SHALL NOT BE LIMITED TO DAMAGES, COMPENSATION, OR BENEFITS PAYABLE UNDER INSURANCE POLICIES, WORKERS' COMPENSATION ACTS, DISABILITY BENEFIT ACTS, OR OTHER EMPLOYEES' BENEFIT ACTS.

IT IS UNDERSTOOD AND AGREED THAT PARAGRAPH 11.2 ABOVE IS SUBJECT TO, AND EXPRESSLY LIMITED BY, THE TERMS AND CONDITIONS OF TEX. CIV. PRACT. & REM. CODE ANN. "130.001-130.005 (VERNON SUPP. 1989), AS AMENDED OR REVISED AND AS IN EFFECT AT THE TIME OF THE EXECUTION OF THE CONTRACT. CONTRACTOR SHALL NOT BE OBLIGATED UNDER PARAGRAPH 11.2 TO INDEMNIFY OR HOLD HARMLESS ARCHITECT OR ANY AGENT, SERVANT, OR EMPLOYEE OF ARCHITECT FROM LIABILITY OR DAMAGE THAT:

IS CAUSED BY OR RESULTS FROM:

DEFECTS IN PLANS, DESIGNS, OR SPECIFICATIONS PREPARED, APPROVED, OR USED BY THE ARCHITECT; OR

NEGLIGENCE OF THE ARCHITECT IN THE RENDITION OR CONDUCT OF PROFESSIONAL DUTIES CALLED FOR OR ARISING OUT OF THE CONTRACT DOCUMENTS AND THE PLANS, DESIGNS, OR SPECIFICATIONS THAT ARE A PART OF THE CONTRACT DOCUMENTS; AND

ARISES FROM:

PERSONAL INJURY OR DEATH;

PROPERTY INJURY; OR

ANY OTHER EXPENSE THAT ARISES FROM PERSONAL INJURY, DEATH, OR PROPERTY INJURY.

IT IS AGREED WITH RESPECT TO ANY LEGAL LIMITATIONS NOW OR HEREAFTER IN EFFECT AND AFFECTING THE VALIDITY OR ENFORCEABILITY OF THE INDEMNIFICATION OBLIGATION UNDER THIS PARAGRAPH 11.2, SUCH LEGAL LIMITATIONS ARE MADE A PART OF THE INDEMNIFICATION OBLIGATION AND SHALL OPERATE TO AMEND THE INDEMNIFICATION OBLIGATION TO THE MINIMUM EXTENT NECESSARY TO BRING THE PROVISION INTO CONFORMITY WITH THE REQUIREMENTS OF SUCH LIMITATIONS, AND AS SO MODIFIED, THE INDEMNIFICATION OBLIGATION SHALL CONTINUE IN FULL FORCE AND EFFECT. CONTRACTOR'S OBLIGATIONS UNDER PARAGRAPH 11.2 AND ALL OTHER INDEMNITIES BY CONTRACTOR IN THE CONTRACT DOCUMENTS SHALL SURVIVE THE COMPLETION OF THE WORK AND THE TERMINATION OF THE CONTRACT.

PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND

CONTRACTOR SHALL OBTAIN A PERFORMANCE BOND AND A PAYMENT BOND IN THE AMOUNT OF ONE HUNDRED PERCENT (100%) OF THE CONTRACT SUM, THE COST OF WHICH BONDS, SHOULD BE INCLUDED IN THE CONTRACT SUM, ADDITIONAL WORK SHALL BE ADDED BY A CHANGE ORDER IN ACCORDANCE WITH SUBPARAGRAPH 7.2.1. CONTRACTOR SHALL DELIVER THE EXECUTED ORIGINALS AND TWO EXECUTED COPIES OF EACH OF THE REQUIRED BONDS TO OWNER, NOT LATER THAN THE DATE OF EXECUTION OF THE AGREEMENT, AND SHALL DELIVER THE EXECUTED ORIGINALS AND TWO EXECUTED COPIES OF EACH OF THE REQUIRED SUBCONTRACTOR BONDS TO OWNER, NOT LATER THAN THE DATE OF EXECUTION OF THE SUBCONTRACTOR AGREEMENT WITH CONTRACTOR.

THE BONDS SHALL, IN ALL RESPECTS, CONFORM TO THE REQUIREMENTS OF THE LAWS OF THE STATE OF TEXAS.

ARTICLE 12

UNCOVERING AND CORRECTION OF WORK

UNCOVERING OF WORK.

IF A PORTION OF THE WORK IS COVERED, CONTRARY TO THE ARCHITECT'S REQUEST OR TO REQUIREMENTS SPECIFICALLY EXPRESSED IN THE CONTRACT DOCUMENTS, SUCH PORTION OF THE WORK MUST, IF REQUIRED IN WRITING BY THE ARCHITECT, BE UNCOVERED OR MADE VISIBLE FOR THE ARCHITECT'S EXAMINATION AND MUST BE REPLACED, AT THE CONTRACTOR'S EXPENSE, WITHOUT CHANGE IN THE CONTRACT TIME.

IF A PORTION OF THE WORK HAS BEEN COVERED WHICH THE ARCHITECT HAS NOT SPECIFICALLY REQUESTED TO EXAMINE PRIOR TO ITS BEING COVERED OR OBSTRUCTED, THE ARCHITECT MAY REQUEST TO SEE SUCH WORK AND SUCH WORK SHALL BE UNCOVERED BY THE CONTRACTOR. IF THE PORTION OF WORK IS IN ACCORDANCE WITH THE CONTRACT DOCUMENTS, COSTS OF UNCOVERING AND REPLACEMENT SHALL, BY APPROPRIATE CHANGE ORDER, BE AT THE OWNER'S EXPENSE. IF THE PORTION OF WORK IS NOT IN ACCORDANCE WITH THE CONTRACT DOCUMENTS, COSTS OF UNCOVERING AND REPLACEMENT SHALL BE AT THE CONTRACTOR'S EXPENSE, UNLESS THE CONDITION WAS CAUSED BY THE OWNER OR A SEPARATE CONTRACTOR, IN WHICH EVENT THE OWNER SHALL BE RESPONSIBLE FOR PAYMENT OF SUCH COSTS.

CORRECTION OF WORK

BEFORE FINAL COMPLETION.

PRIOR TO FINAL COMPLETION, THE CONTRACTOR SHALL PROMPTLY CORRECT WORK REJECTED BY THE ARCHITECT OR WORK THAT FAILS TO CONFORM TO THE REQUIREMENTS OF THE CONTRACT DOCUMENTS, WHETHER DISCOVERED BEFORE OR AFTER SUBSTANTIAL COMPLETION AND WHETHER OR NOT FABRICATED, INSTALLED OR COMPLETED. COSTS

OF CORRECTING SUCH REJECTED WORK, INCLUDING ADDITIONAL TESTING AND INSPECTIONS AND COMPENSATION FOR THE ARCHITECT'S SERVICES AND EXPENSES MADE NECESSARY THEREBY, SHALL BE AT THE CONTRACTOR'S EXPENSE.

AFTER FINAL COMPLETION

IN ADDITION TO THE CONTRACTOR'S OBLIGATIONS UNDER PARAGRAPH 3.5, IF, WITHIN ONE (1) YEAR AFTER THE DATE OF FINAL COMPLETION OF THE WORK OR DESIGNATED PORTION THEREOF, OR AFTER COMMENCEMENT OF WARRANTIES BY TERMS OF AN APPLICABLE WARRANTY REQUIRED BY THE CONTRACT DOCUMENTS, WHICHEVER IS LONGER, ANY OF THE WORK IS FOUND TO BE NOT IN ACCORDANCE WITH THE REQUIREMENTS OF THE CONTRACT DOCUMENTS, THE CONTRACTOR SHALL COMMENCE TO CORRECT SUCH WORK WITHIN SEVENTY-TWO (72) HOURS AFTER RECEIPT OF WRITTEN NOTICE FROM THE OWNER TO DO SO, AND THEREAFTER PROMPTLY AND DILIGENTLY CORRECT IT. IF THE CONTRACTOR FAILS TO COMMENCE OR CORRECT NONCONFORMING WORK WITHIN SUCH TIME, THE OWNER MAY CORRECT IT AND CONTRACTOR SHALL WITHIN FIVE (5) BUSINESS DAYS FOLLOWING REQUEST THEREFOR REPAY OWNER THE ACTUAL COST OF SUCH CORRECTIVE WORK. IF RETAINED FUNDS ARE STILL HELD BY OWNER, OWNER MAY OFFSET SUCH COSTS OF CORRECTION AGAINST RETAINED FUNDS. CORRECTION OF WORK AFTER FINAL COMPLETION SHALL BE WARRANTY WORK AND NOT A CONTINUATION OF THE WORK. THE ONE (1) YEAR PERIOD FOR CORRECTION OF WORK SHALL NOT BE EXTENDED BY CORRECTIVE WORK PERFORMED BY THE CONTRACTOR PURSUANT TO THIS PARAGRAPH 12.2, EXCEPT THAT ANY CORRECTIVE WORK SHALL ITSELF BE WARRANTIED ONE (1) YEAR FROM COMPLETION OF THE CORRECTIVE WORK.

THE CONTRACTOR SHALL REMOVE FROM THE SITE PORTIONS OF THE WORK OR REPAIR THE WORK TO OWNER'S SATISFACTION, WHICH ARE NOT IN ACCORDANCE WITH THE REQUIREMENTS OF THE CONTRACT DOCUMENTS AND ARE NEITHER CORRECTED BY THE CONTRACTOR NOR ACCEPTED BY THE OWNER.

THE CONTRACTOR SHALL BEAR THE COST OF CORRECTING DESTROYED OR DAMAGED CONSTRUCTION, WHETHER COMPLETED OR PARTIALLY COMPLETED, OF THE OWNER OR SEPARATE CONTRACTORS CAUSED IN WHOLE OR IN PART BY THE CONTRACTOR'S CORRECTION OR REMOVAL OF WORK WHICH IS NOT IN ACCORDANCE WITH THE REQUIREMENTS OF THE CONTRACT DOCUMENTS.

NOTHING CONTAINED IN PARAGRAPH 12.2 SHALL BE CONSTRUED TO ESTABLISH A PERIOD OF LIMITATION WITH RESPECT TO OTHER OBLIGATIONS WHICH THE CONTRACTOR MIGHT HAVE UNDER THE CONTRACT DOCUMENTS. ESTABLISHMENT OF THE ONE (1) YEAR PERIOD FOR CORRECTION OF WORK AS DESCRIBED IN SUBPARAGRAPH 12.2.2 RELATES ONLY TO THE SPECIFIC OBLIGATION OF THE CONTRACTOR TO CORRECT THE WORK, AND HAS NO RELATIONSHIP TO THE TIME WITHIN WHICH THE OBLIGATION TO COMPLY WITH THE CONTRACT DOCUMENTS MAY BE SOUGHT TO BE ENFORCED, NOR TO THE TIME WITHIN WHICH PROCEEDINGS MAY BE COMMENCED TO ESTABLISH THE CONTRACTOR'S LIABILITY WITH RESPECT TO THE CONTRACTOR'S OBLIGATIONS OTHER THAN SPECIFICALLY TO CORRECT THE WORK.

THE CORRECTIVE REMEDIES SET FORTH IN THIS PARAGRAPH 12.2 ARE NOT EXCLUSIVE AND SHALL NOT DEPRIVE THE OWNER OF ANY ACTION, RIGHT OR REMEDY OTHERWISE AVAILABLE TO IT FOR BREACH OF ANY OF THE PROVISIONS OF THE CONTRACT DOCUMENTS. WARRANTIES MAY BE REQUIRED IN THE RETAINAGE PAYMENT PACKAGE WHICH WILL EXPAND, LENGTHEN, OR OTHERWISE ADD TO THE WARRANTIES REQUIRED IN PARAGRAPH 3.5 AND PARAGRAPH 12.2.

ACCEPTANCE OF NONCONFORMING WORK

IF THE OWNER PREFERS TO ACCEPT WORK WHICH IS NOT IN ACCORDANCE WITH THE REQUIREMENTS OF THE CONTRACT DOCUMENTS, THE OWNER MAY DO SO INSTEAD OF REQUIRING ITS REMOVAL AND CORRECTION, IN WHICH CASE THE CONTRACT SUM WILL BE REDUCED AS DEEMED APPROPRIATE BY THE ARCHITECT. ANY ADJUSTMENT SHALL BE EFFECTIVE, WHETHER OR NOT FINAL PAYMENT HAS BEEN MADE.

NO CHANGE IN THE WORK, WHETHER BY WAY OF ALTERATION OR ADDITION TO THE WORK, SHALL BE THE BASIS OF AN ADDITION TO THE CONTRACT SUM OR A CHANGE IN THE CONTRACT TIME UNLESS AND UNTIL SUCH ALTERATION OR ADDITION HAS BEEN AUTHORIZED BY A CHANGE ORDER, EXECUTED AND ISSUED IN ACCORDANCE WITH AND IN STRICT COMPLIANCE WITH THE REQUIREMENTS OF THE CONTRACT DOCUMENTS. THE REQUIREMENT OF A CHANGE ORDER IS OF THE ESSENCE OF THE CONTRACT DOCUMENTS; ACCORDINGLY, NO COURSE OF CONDUCT OR DEALINGS BETWEEN THE PARTIES, NO EXPRESS OR IMPLIED ACCEPTANCE OF ALTERATIONS OR ADDITIONS TO THE WORK, AND/OR NO CLAIM THAT THE OWNER HAS BEEN UNJUSTLY ENRICHED BY ANY ALTERATION OR ADDITION TO THE WORK, WHETHER OR NOT THERE IS IN FACT ANY SUCH UNJUST ENRICHMENT, SHALL BE THE BASIS FOR ANY CLAIM TO AN INCREASE IN THE CONTRACT SUM OR CHANGE IN THE CONTRACT TIME.

ARTICLE 13 MISCELLANEOUS PROVISION

GOVERNING LAW THE CONTRACT SHALL BE GOVERNED BY THE LAWS OF THE STATE OF TEXAS, AND THE PARTIES HERETO AGREE THAT THE CONTRACT IS TO BE PERFORMED IN LIVE OAK COUNTY, TEXAS AND THAT ANY CAUSE OF ACTION, CLAIM, OR SUIT ARISING FROM OR RELATED TO THIS CONTRACT SHALL BE BROUGHT IN LIVE OAK COUNTY, TEXAS.

SUCCESSORS AND ASSIGNS

CONTRACTOR MAY NOT ASSIGN ITS RIGHTS UNDER THE CONTRACT DOCUMENTS OR ASSIGN ANY RIGHTS TO ANY MONEYS DUE OR TO BECOME DUE. ANY ASSIGNMENT BY CONTRACTOR, OR WITHOUT PRIOR WRITTEN CONSENT FROM OWNER, IS VOID.

WRITTEN NOTICE WRITTEN NOTICE SHALL BE DEEMED TO HAVE BEEN DULY SERVED IF DELIVERED IN PERSON OR IF DELIVERED AT OR SENT BY REGISTERED OR CERTIFIED MAIL TO THE REPRESENTATIVE OF THE NOTIFIED PARTY SPECIFIED IN THE CONTRACT.

RIGHTS AND REMEDIES

DUTIES AND OBLIGATIONS IMPOSED BY THE CONTRACT DOCUMENTS AND RIGHTS AND REMEDIES AVAILABLE THEREUNDER SHALL BE IN ADDITION TO AND NOT A LIMITATION OF DUTIES, OBLIGATIONS, RIGHTS AND REMEDIES OTHERWISE IMPOSED OR AVAILABLE BY LAW.

NO ACTION OR FAILURE TO ACT BY THE OWNER, ARCHITECT OR CONTRACTOR SHALL CONSTITUTE A WAIVER OF A RIGHT OR DUTY AFFORDED THEM UNDER THE CONTRACT, NOR SHALL SUCH ACTION OR FAILURE TO ACT CONSTITUTE APPROVAL OF OR ACQUIESCENCE IN A BREACH THEREUNDER, EXCEPT AS MAY BE SPECIFICALLY AGREED IN WRITING.

THE INVALIDITY OF ANY PART OR PROVISION OF THE CONTRACT DOCUMENTS SHALL NOT IMPAIR OR AFFECT, IN ANY MANNER WHATSOEVER, THE VALIDITY, ENFORCEABILITY OR EFFECT OF THE REMAINDER OF THE CONTRACT DOCUMENTS.

ARTICLE 14

TERMINATION OR SUSPENSION OF THE CONTRACT

TERMINATION BY THE CONTRACTOR

THE CONTRACTOR MAY TERMINATE THE CONTRACT IF THE WORK IS STOPPED FOR A PERIOD OF SIXTY (60) CONSECUTIVE DAYS THROUGH NO ACT OR FAULT OF THE CONTRACTOR OR A SUBCONTRACTOR, SUB-SUBCONTRACTOR OR THEIR AGENTS OR EMPLOYEES THEREOF OR ANY OTHER PERSONS OR ENTITIES PERFORMING PORTIONS OF THE WORK UNDER DIRECT OR INDIRECT CONTRACT WITH THE CONTRACTOR, FOR ANY OF THE FOLLOWING REASONS:

ISSUANCE OF AN ORDER OF A COURT OR OTHER PUBLIC AUTHORITY HAVING JURISDICTION WHICH REQUIRES ALL WORK TO BE STOPPED;

AN ACT OF GOVERNMENT, SUCH AS A DECLARATION OF NATIONAL EMERGENCY WHICH REQUIRES ALL WORK TO BE STOPPED; OR

BECAUSE THE ARCHITECT HAS NOT ISSUED A CERTIFICATE FOR PAYMENT AND HAS NOT NOTIFIED THE CONTRACTOR OF THE REASON FOR WITHHOLDING CERTIFICATION AS PROVIDED IN SUBPARAGRAPH 9.4.1, OR BECAUSE THE OWNER HAS NOT MADE PAYMENT ON A CERTIFICATE FOR PAYMENT WITHIN THE TIME STATED IN THE CONTRACT DOCUMENTS.

THE CONTRACTOR MAY TERMINATE THE CONTRACT IF, THROUGH NO ACT OR FAULT OF THE CONTRACTOR OR A SUBCONTRACTOR, SUB-SUBCONTRACTOR OR AGENTS OR EMPLOYEES THEREOF OR ANY OTHER PERSONS OR ENTITIES PERFORMING PORTIONS OF THE WORK UNDER DIRECT OR INDIRECT CONTRACT WITH THE CONTRACTOR, REPEATED SUSPENSIONS, DELAYS OR INTERRUPTIONS OF THE ENTIRE WORK BY THE OWNER, AS DESCRIBED IN PARAGRAPH 14.3, CONSTITUTE, IN THE AGGREGATE, MORE THAN ONE HUNDRED PERCENT (100%) OF THE TOTAL NUMBER OF DAYS SCHEDULED FOR COMPLETION, OR ONE HUNDRED TWENTY (120) DAYS IN ANY THREE HUNDRED SIXTY FIVE (365) DAY PERIOD, WHICHEVER IS LESS.

IF ONE (1) OF THE REASONS DESCRIBED IN SUBPARAGRAPH 14.1.1 OR 14.1.2 EXISTS, THE CONTRACTOR MAY, UPON FOURTEEN (14) DAYS' WRITTEN NOTICE TO THE OWNER AND ARCHITECT, TERMINATE THE CONTRACT AND RECOVER FROM THE OWNER PAYMENT FOR WORK EXECUTED.

TERMINATION BY THE OWNER FOR CAUSE

THE OWNER MAY, IN THE EXERCISE OF ITS SOLE DISCRETION, TERMINATE THE CONTRACT IF THE CONTRACTOR:

REFUSES OR FAILS TO SUPPLY ENOUGH PROPERLY SKILLED WORKERS OR PROPER MATERIALS;

FAILS TO MAKE PROMPT AND FULL PAYMENT TO SUBCONTRACTORS FOR MATERIALS OR LABOR IN ACCORDANCE WITH THE RESPECTIVE AGREEMENTS BETWEEN THE CONTRACTOR AND THE SUBCONTRACTORS;

DISREGARDS LAWS, ORDINANCES, OR RULES, REGULATIONS OR ORDERS OF A PUBLIC AUTHORITY HAVING JURISDICTION OVER THE PROJECT INCLUDING, WITHOUT LIMITATION, OSHA REGULATIONS AND WORKERS' COMPENSATION LAWS;

DISREGARDS THE INSTRUCTION OF ARCHITECT OR OWNER (WHEN SUCH INSTRUCTIONS ARE BASED ON THE REQUIREMENTS OF THE CONTRACT DOCUMENTS);

FILES OR RECORDS OR ALLOWS ANYONE CLAIMING BY, THROUGH OR UNDER CONTRACTOR TO FILE OR RECORD A LIEN OR OTHER CLAIM AGAINST OWNER, OWNER'S LOAN PROCEEDS, IF ANY, OR OWNER'S PROPERTY WITHOUT REMOVING AND DISCHARGING SAME AS REQUIRED UNDER THE CONTRACT DOCUMENTS;

FAILS TO TIMELY PROSECUTE THE WORK OR PERFORM THE WORK IN STRICT ACCORDANCE WITH THE CONSTRUCTION SCHEDULE APPROVED BY OWNER UNDER PARAGRAPH 3.10; OR

OTHERWISE DOES NOT FULLY COMPLY WITH THE CONTRACT DOCUMENTS.

WHEN ANY OF THE REASONS DESCRIBED IN SUBPARAGRAPH 14.2.1 EXIST, THE OWNER MAY, WITHOUT PREJUDICE TO ANY OTHER RIGHTS OR REMEDIES OF THE OWNER AND AFTER GIVING THE CONTRACTOR AND CONTRACTOR'S SURETY, IF ANY, IMMEDIATE WRITTEN NOTICE, TERMINATE EMPLOYMENT OF THE CONTRACTOR AND MAY, SUBJECT TO ANY PRIOR RIGHTS OF THE SURETY:

TAKE POSSESSION OF THE SITE AND OF ALL MATERIALS, EQUIPMENT, TOOLS, CONSTRUCTION EQUIPMENT AND MACHINERY LOCATED THEREON OWNED BY THE CONTRACTOR;

ACCEPT ASSIGNMENT OF SUBCONTRACTS PURSUANT TO PARAGRAPH 5.4; AND

FINISH THE WORK BY WHATEVER REASONABLE METHOD THE OWNER MAY DEEM EXPEDIENT. UPON REQUEST OF THE CONTRACTOR, THE OWNER SHALL FURNISH TO THE CONTRACTOR A DETAILED ACCOUNTING OF THE COSTS INCURRED BY THE OWNER IN FINISHING THE WORK.

WHEN THE OWNER TERMINATES THE CONTRACT FOR ONE OF THE REASONS STATED IN SUBPARAGRAPH 14.2.1, THE CONTRACTOR SHALL NOT BE ENTITLED TO RECEIVE FURTHER PAYMENT ON THE PROJECT.

IF COSTS AND DAMAGES OF FINISHING THE WORK, INCLUDING COMPENSATION FOR THE ARCHITECT'S SERVICES AND EXPENSES MADE NECESSARY THEREBY, AND OTHER CHARGES INCURRED BY OWNER AND NOT EXPRESSLY WAIVED EXCEED THE UNPAID BALANCE OF THE CONTRACT SUM, THE CONTRACTOR SHALL PAY THE DIFFERENCE TO THE OWNER. THE AMOUNT TO BE PAID TO OWNER SHALL BE CERTIFIED BY THE ARCHITECT, UPON APPLICATION, AND THIS OBLIGATION FOR PAYMENT SHALL SURVIVE TERMINATION OF THE CONTRACT.

SUSPENSION BY THE OWNER FOR CONVENIENCE

THE OWNER MAY, WITHOUT CAUSE, ORDER THE CONTRACTOR, IN WRITING, TO SUSPEND, DELAY OR INTERRUPT THE WORK, IN WHOLE OR IN PART, FOR SUCH PERIOD OF TIME AS THE OWNER MAY DETERMINE.

THE CONTRACT SUM AND CONTRACT TIME SHALL BE ADJUSTED FOR INCREASES IN THE COST AND TIME CAUSED BY SUSPENSION, DELAY OR INTERRUPTION AS DESCRIBED IN SUBPARAGRAPH 14.3.1 FOR GREATER THAN THIRTY (30) CONSECUTIVE DAYS. NO ADJUSTMENT SHALL BE MADE TO THE EXTENT:

THAT PERFORMANCE IS, WAS OR WOULD HAVE BEEN SO SUSPENDED, DELAYED OR INTERRUPTED BY ANOTHER CAUSE FOR WHICH THE CONTRACTOR IS RESPONSIBLE; OR

THAT AN EQUITABLE ADJUSTMENT IS MADE OR DENIED UNDER ANOTHER PROVISION OF THE CONTRACT.

TERMINATION BY THE OWNER FOR CONVENIENCE

THE OWNER MAY, AT ANY TIME, TERMINATE THE CONTRACT FOR THE OWNER'S CONVENIENCE AND WITHOUT CAUSE.

UPON RECEIPT OF WRITTEN NOTICE FROM THE OWNER OF TERMINATION FOR THE OWNER'S CONVENIENCE, THE CONTRACTOR SHALL:

CEASE OPERATIONS AS DIRECTED BY THE OWNER IN THE NOTICE;

TAKE ACTIONS NECESSARY, OR THAT THE OWNER MAY DIRECT, FOR THE PROTECTION AND PRESERVATION OF THE WORK; AND

EXCEPT FOR WORK DIRECTED TO BE PERFORMED PRIOR TO THE EFFECTIVE DATE OF TERMINATION STATED IN THE NOTICE, TERMINATE ALL EXISTING SUBCONTRACTS AND PURCHASE ORDERS AND ENTER INTO NO FURTHER SUBCONTRACTS AND PURCHASE ORDERS.

IN THE EVENT OF TERMINATION AS DESCRIBED IN SUBPARAGRAPH 14.4.1, OWNER SHALL PAY, AS THE SOLE AMOUNT DUE TO CONTRACTOR IN CONNECTION WITH THIS PROJECT: (A) SUMS DUE FOR WORK PERFORMED TO DATE (EXCEPT RETAINAGE SUMS SHALL NOT BE PAID PRIOR TO NINETY (90) DAYS FOLLOWING THE DATE OF TERMINATION); AND (B) REASONABLE COSTS OF TERMINATION.

END OF GENERAL CONDITIONS

END OF SECTION 006000

SECTION 00 6100

PERFORMANCE BOND

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

CONTRACTOR:
(Name)
(Address 1)
(Address 2)

SURETY:
(Name)
(Address 1)
(Address 2)

OWNER:
Live Oak County
301 Houston St.,
George West, Texas 78022

CONTRACT
Date:
Amount: $
Description:
2308 A1 Phase II Restoration & Rehabilitation of the Live Oak County Courthouse
Live Oak County

BOND
Date (Not earlier than Contract Date):
Amount:
Modifications to this Bond Form:

Surety and Contractor, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Performance Bond to be duly executed on its behalf by its authorized officer, agent or representative.

CONTRACTOR AS PRINCIPAL	SURETY
Company: (Corp. Seal)	Company: (Corp. Seal)
Signature: _____	Signature: _____
Name and Title:	Name and Title:
(Space below is for additional signatures, if required.)	(Attach Power of Attorney)
CONTRACTOR AS PRINCIPAL	SURETY
Company: (Corp. Seal)	Company: (Corp. Seal)
Signature: _____	Signature:_____
Name and Title:_____	Name and Title: _____

EJCDC No. 1910-28-A (1996 Edition)
Originally prepared through the joint efforts of the Surety Association of America, Engineers Joint Contract Documents Committee, the Associated General Contractors of America, and the American Institute of Architects.

1. The CONTRACTOR and the Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner for the performance of the Contract, which is incorporated herein by reference.

2. If the CONTRACTOR performs the Contract, the Surety and the CONTRACTOR have no obligation under this Bond, except to participate in conferences as provided in paragraph 3.1.

3. If there is no OWNER Default, the Surety's obligation under this Bond shall arise after:

   3.1. The OWNER has notified the CONTRACTOR and the Surety at the addresses described in paragraph 10 below, that the OWNER is considering declaring a CONTRACTOR Default and has requested and attempted to arrange a conference with the CONTRACTOR and the Surety to be held not later than fifteen days after receipt of such notice to discuss methods of performing the Contract. If the OWNER, the CONTRACTOR and the Surety agree, the CONTRACTOR shall be allowed a reasonable time to perform the Contract, but such an agreement shall not waive the OWNER's right, if any, subsequently to declare a CONTRACTOR Default; and

   3.2. The OWNER has declared a CONTRACTOR Default and formally terminated the CONTRACTOR's right to complete the Contract. Such CONTRACTOR Default shall not be declared earlier than twenty days after the CONTRACTOR and the Surety have received notice as provided in paragraph 3.1; and

   3.3. The OWNER has agreed to pay the Balance of the Contract Price to:

      3.3.1. The Surety in accordance with the terms of the Contract;

      3.3.2 Another contractor selected pursuant to paragraph 4.3 to perform the Contract.

4. 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:

   4.1. Arrange for the CONTRACTOR, with consent of the OWNER, to perform and complete the Contract; or

   4.2. Undertake to perform and complete the Contract itself, through its agents or through independent contractors; or

   4.3. Obtain bids or negotiated proposals from qualified contractors acceptable to the OWNER for a contract for performance and completion of the Contract, arrange for a contract to be prepared for execution by the OWNER and the contractor selected with the OWNER's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the Bonds issued on the Contract, and pay to the OWNER the amount of damages as described in paragraph 6 in excess of the Balance of the Contract Price incurred by the OWNER resulting from the CONTRACTOR Default; or

   4.4. Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances;

      4.4.1 After investigation, determine the amount for which it may be liable to the OWNER and, as soon as practicable after the amount is determined, tender payment therefor to the OWNER; or

      4.4.2 Deny liability in whole or in part and notify the OWNER citing reasons therefor.

5. If the Surety does not proceed as provided in paragraph 4 with reasonable promptness, the Surety

shall be deemed to be in default on this Bond fifteen 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 4.4, and the OWNER refuses the payment tendered or the Surety has denied pliability, in whole or in part, without further notice the OWNER shall be entitled to enforce any remedy available to the OWNER.

6. After the OWNER has terminated the CONTRACTOR's right to complete the Contract, and if the Surety elects to act under paragraph 4.1, 4.2, or 4.3 above, then the responsibilities of the Surety to the OWNER shall not be greater than those of the CONTRACTOR under the Contract, and the responsibilities of the OWNER to the Surety shall not be greater than those of the OWNER under the Contract. To a limit of the amount of this Bond, but subject to commitment by the OWNER of the Balance of the Contract Price to mitigation of costs and damages on the Contract, the Surety is obligated without duplication for:

   6.1. The responsibilities of the CONTRACTOR for correction of defective Work and completion of the Contract;

   6.2. 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 4; and

   6.3. Liquidated damages, or if no liquidated damages are specified in the Contract, actual damages caused by delayed performance or non-performance of the CONTRACTOR.

7. The Surety shall not be liable to the OWNER or others for obligations of the CONTRACTOR that are unrelated to the Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the OWNER or its heirs, executors, administrators, or successors.

8. The Surety hereby waives notice of any change, including changes of time, to the Contract or to related subcontracts, purchase orders and other obligations.

9. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the Work or part of the Work is located and shall be instituted within two years after 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 period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

10. Notice to the Surety, the OWNER or the CONTRACTOR shall be mailed or delivered to the address shown on the signature page.

11. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the Contract was be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted here from and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

12. Definitions.

    12.1 Balance of the Contract Price: The total amount payable by the OWNER to the CONTRACTOR under the Contract after all proper adjustments have been made, including allowance to the CONTRACTOR of 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 Contract.

12.2. Contract: The agreement between the OWNER and the CONTRACTOR identified on the signature page, including all Contract Documents and changes thereto.

12.3. CONTRACTOR Default: Failure of the CONTRACTOR, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Contract.

12.4. OWNER Default: Failure of the OWNER, which has neither been remedied nor waived, to pay the CONTRACTOR as required by the Contract or to perform and complete or comply with the other terms thereof.

SECTION 00 6200

PAYMENT BOND

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

CONTRACTOR:
(Name)
(Address 1)
(Address 2)

SURETY:
(Name)
(Address 1)
(Address 2)

OWNER:
Live Oak County
301 Houston St.,
George West, Texas 78022

CONTRACT
Date:
Amount: $
Description:
2308 A1 Phase II Restoration & Rehabilitation of the Live Oak County Courthouse
Live Oak County

BOND
Date (Not earlier than Contract Date):
Amount:
Modifications to this Bond Form:

Surety and Contractor, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Payment Bond to be duly executed on its behalf by its authorized officer, agent or representative.

CONTRACTOR AS PRINCIPAL		SURETY	
Company:	(Corp. Seal)	Company:	(Corp. Seal)
Signature: _____		Signature: _____	
Name and Title:		Name and Title:	
(Space below is for additional signatures, if required.)		(Attach Power of Attorney)	
CONTRACTOR AS PRINCIPAL			
Company:	(Corp. Seal)	Company:	(Corp. Seal)
Signature: _____		Signature: _____	
Name and Title:		Name and Title:	

EJCDC No. 1910-28-B (1996 Edition)
Originally prepared through the joint efforts of the Surety Association of America, Engineers Joint Contract Documents Committee, the Associated General Contractors of America, and the American Institute of Architects.

1. The CONTRACTOR and the 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 Contract, which is incorporated herein by reference.

2. With respect to the OWNER, this obligation shall be null and void if the CONTRACTOR:

   2.1 Promptly makes payment, directly or indirectly, for all sums due Claimants, and

   2.2. Defends, indemnifies and holds harmless the OWNER from all claims, demands, liens or suits by any person or entity who furnished labor, materials or equipment for use in the performance of the Contract, provided the OWNER has promptly notified the CONTRACTOR and the Surety (at the addresses described in paragraph 12) of any claims, demands, liens or suits and tendered defense of such claims, demands, liens or suits to the CONTRACTOR and the Surety, and provided there is no OWNER Default.

3. With respect to Claimants, this obligation shall be null and void if the CONTRACTOR promptly makes payment, directly or indirectly, for all sums due.

4. The Surety shall have no obligation to Claimants under this Bond until:

   4.1. Claimants who are employed by or have a direct contract with the CONTRACTOR have given notice to the Surety (at the addresses described in paragraph 12) and sent a copy, or notice thereof, to the OWNER, stating that a claim is being made under this Bond and, with substantial accuracy, the amount of the claim.

   4.2 Claimants who do not have a direct contract with the CONTRACTOR:

      4.2.1. Have furnished written notice to the CONTRACTOR and sent a copy, or notice thereof, to the OWNER, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials were furnished or supplied or for whom the labor was done or performed; and

      4.2.2. Have either received a rejection in whole or in part from the CONTRACTOR, or not received within 30 days of furnishing the above notice any communication from the CONTRACTOR by which the CONTRACTOR had indicated the claim will be paid directly or indirectly; and

      4.2.3. Not having been paid within the above 30 days, have sent a written notice to the Surety and sent a copy, or notice thereof, to the OWNER, stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to the CONTRACTOR.

5. If a notice required by paragraph 4 is given by the OWNER to the CONTRACTOR or to the Surety, that is sufficient compliance.

6. When the Claimant has satisfied the conditions of paragraph 4, the Surety shall promptly and at the Surety's expense take the following actions:

   6.1. Send an answer to the Claimant, with a copy to the OWNER, within 45 days after receipt of the claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed.

   6.2. Pay or arrange for payment of any undisputed amounts.

7. The Surety's total obligation shall not exceed the amount of this Bond, and the amount of this Bond

shall be credited for any payments made in good faith by the Surety.

8. Amounts owed by the OWNER to the CONTRACTOR under the Contract shall be used for the performance of the Contract and to satisfy claims, if any, under any 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 Contract are dedicated to satisfy obligations of the CONTRACTOR and the Surety under this Bond, subject to the OWNER's priority to use the funds for the completion of the Work.

9. The Surety shall not be liable to the OWNER, Claimants or others for obligations of the CONTRACTOR that are unrelated to the Contract. The OWNER shall not be liable for payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligations to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.

10. The Surety hereby waives notice of any change, including changes of time, to the Contract or to related Subcontracts, purchase orders and other obligations.

11. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the location in which the Work or part of the Work is located or after the expiration of one year from the date (1) on which the Claimant gave the notice required by paragraph 4.1 or paragraph 4.2.3, 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 shall be applicable.

12. Notice to the Surety, the OWNER or the CONTRACTOR shall be mailed or delivered to the addresses shown on the signature page. Actual receipt of notice by Surety, the OWNER or the CONTRACTOR, however accomplished, shall be sufficient compliance as of the date received at the address shown on the signature page.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the Contract was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted here from and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is, that this Bond shall be construed as a statutory Bond and not as a common law bond.

14. Upon request of any person or entity appearing to be a potential beneficiary of this Bond, the CONTRACTOR shall promptly furnish a copy of this Bond or shall permit a copy to be made.

15. DEFINITIONS

15.1. 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 Contract. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the 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.

15.2. Contract: The agreement between the OWNER and the CONTRACTOR identified on the signature page, including all Contract Documents and changes thereto.

15.3. OWNER Default: Failure of the OWNER, which has neither been remedied nor waived, to pay the

CONTRACTOR as required by the Contract or to perform and complete or comply with the other terms thereof.

END OF SECTION

SECTION 007300
SUPPLEMENTARY CONDITIONS

PART 1 GENERAL

1.01 SUMMARY

A. These Supplementary Conditions amend and supplement the General Conditions defined in Document 007200 - General Conditions and other provisions of Contract Documents as indicated below. Provisions that are not so amended or supplemented remain in full force and effect.

B. The terms used in these Supplementary Conditions that are defined in the General Conditions have the meanings assigned to them in the General Conditions.

1.02 MODIFICATIONS TO GENERAL CONDITIONS

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 007300

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SECTION 011000
SUMMARY

PART 1 GENERAL

1.01 PROJECT

A. Project Name: Live Oak County Courthouse Phase II Restoration & Rehabilitation

B. Owner's Name: Live Oak County, Texas.

C. Architect's Name: Fisher Heck Architects.

D. The Project consists of the restoration of the of the Live Oak County Courthouse.

1.02 CONTRACT DESCRIPTION

1.03 DESCRIPTION OF ALTERATIONS WORK

A. Scope of demolition and removal work is indicated on drawings and specified in Section 024100.

B. Scope of alterations work is indicated on drawings.

C. Plumbing: Alter existing and add new construction.

D. HVAC: Replace existing system with new construction, keeping existing in operation until ready for changeover.

E. Electrical Power and Lighting: Alter existing system and add new construction, keeping existing in operation.

F. Fire Suppression Sprinklers: N/A this phase. _____.

G. Fire Alarm: Alter existing system and add new construction, keeping existing in operation.

H. Telephone: Alter existing system and add new construction, keeping existing in operation.

I. Security System: Alter existing system and add new construction, keeping existing in operation.

1.04 OWNER OCCUPANCY

A. Owner intends to continue to occupy adjacent portions of the existing building during the entire construction period.

B. Owner intends to occupy the Project upon Substantial Completion.

C. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

D. Schedule the Work to accommodate Owner occupancy.

1.05 CONTRACTOR USE OF SITE AND PREMISES

A. Arrange use of site and premises to allow:
   1. Owner occupancy.
   2. Work by Others.
   3. Work by Owner.
   4. Use of site and premises by the public.

B. Provide access to and from site as required by law and by Owner:
   1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
   2. Do not obstruct roadways, sidewalks, or other public ways without permit.

C. Existing building spaces may not be used for storage.

D. Time Restrictions:
   1. Coordinate with County officials when loud, malodorous work is to occur and whether it may be in conflict with courtroom activities..

E. Utility Outages and Shutdown:

1. Limit disruption of utility services to hours the building is unoccupied.
2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
3. Prevent accidental disruption of utility services to other facilities.

1.06 WORK SEQUENCE

A. Coordinate construction schedule and operations with Owner.

B. Coordinate construction schedule and operations with Architect.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 011000

SECTION 012000
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedures for preparation and submittal of applications for progress payments.

B. Documentation of changes in Contract Sum and Contract Time.

C. Correlation of Contractor submittals based on changes.

D. Procedures for preparation and submittal of application for final payment.

1.02 SCHEDULE OF VALUES

A. Use Schedule of Values Form: AIA G703, edition stipulated in the Agreement.

B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.

C. Forms filled out by hand will not be accepted.

D. Submit Schedule of Values in duplicate within 15 days after date of Owner-Contractor Agreement.

E. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section. Identify site mobilization.

F. Include in each line item, the amount of Allowances specified in this section. For unit cost Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.

G. Include separately from each line item, a direct proportional amount of Contractor's overhead and profit.

H. Revise schedule to list approved Change Orders, with each Application For Payment.

1.03 APPLICATIONS FOR PROGRESS PAYMENTS

A. Payment Period: Submit at intervals stipulated in the Agreement.

B. Use Form AIA G702 and Form AIA G703, edition stipulated in the Agreement.

C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.

D. Forms filled out by hand will not be accepted.

E. For each item, provide a column for listing each of the following:
   1. Item Number.
   2. Description of work.
   3. Scheduled Values.
   4. Previous Applications.
   5. Work in Place and Stored Materials under this Application.
   6. Authorized Change Orders.
   7. Total Completed and Stored to Date of Application.
   8. Balance to Finish.
   9. Retainage.

F. Execute certification by signature of authorized officer.

G. Submit one electronic and three hard-copies of each Application for Payment.

1.04 MODIFICATION PROCEDURES

A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.

B. For other required changes, Architect will issue a document signed by Owner instructing

Contractor to proceed with the change, for subsequent inclusion in a Change Order.

1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
2. Promptly execute the change.

C. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 7 days.

D. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.

1.05 APPLICATION FOR FINAL PAYMENT

END OF SECTION 012000

SECTION 012100
ALLOWANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cash allowances.

B. Contingency allowance.

C. Inspecting and testing allowances.

D. Payment and modification procedures relating to allowances.

1.02 RELATED REQUIREMENTS

A. Section 012000 - Price and Payment Procedures: Additional payment and modification procedures.

1.03 CASH ALLOWANCES

A. Costs Included in Cash Allowances: Cost of product to Contractor or subcontractor, less applicable trade discounts, less cost of delivery to site , less applicable taxes .

B. Costs Not Included in Cash Allowances: Product delivery to site and handling at the site, including unloading, uncrating, and storage; protection of products from elements and from damage; and labor for installation and finishing. _____ .

C. Differences in costs will be adjusted by Change Order.

1.04 CONTINGENCY ALLOWANCE

A. Contractor's costs for products, delivery, installation, labor, insurance, payroll, taxes, bonding, equipment rental, overhead and profit will be included in Change Orders authorizing expenditure of funds from this Contingency Allowance.

B. Contingency Allowance shall be 10% of the total contract amount. Funds will be drawn from the Contingency Allowance only by Change Order.

C. At closeout of Contract, funds remaining in Contingency Allowance will be credited to Owner by Change Order.

1.05 INSPECTING AND TESTING ALLOWANCES

A. Costs Included in Inspecting and Testing Allowances: Cost of engaging an inspecting or testing agency; execution of inspecting and tests; and reporting results.

B. Costs Not Included in the Inspecting and Testing Allowances:
   1. Costs of incidental labor and facilities required to assist inspecting or testing agency.
   2. Costs of testing services used by Contractor separate from Contract Document requirements.
   3. Costs of retesting upon failure of previous tests as determined by Architect.

C. Payment Procedures:
   1. Submit one copy of the inspecting or testing firm's invoice with next application for payment.

1.06 ALLOWANCES SCHEDULE

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 012100

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SECTION 012500
SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedural requirements for proposed substitutions.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
   2. Agrees to provide the same warranty for the substitution as for the specified product.
   3. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
   4. Waives claims for additional costs or time extension that may subsequently become apparent.

B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.

C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.

D. Limit each request to a single proposed substitution item.

3.02 RESOLUTION

A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.

B. Architect will notify Contractor in writing of decision to accept or reject request.

3.03 ACCEPTANCE

A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.04 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.

B. Include completed Substitution Request Forms as part of the Project record. Include both approved and rejected Requests.

END OF SECTION 012500

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SECTION 013000
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preconstruction meeting.

B. Site mobilization meeting.

C. Progress meetings.

D. Submittals for review, information, and project closeout.

E. Number of copies of submittals.

F. Submittal procedures.

1.02 RELATED REQUIREMENTS

A. Section 013216 - Construction Progress Schedule: Form, content, and administration of schedules.

B. Section 017000 - Execution and Closeout Requirements: Additional coordination requirements.

C. Section 017800 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRECONSTRUCTION MEETING

A. Architect will schedule a meeting after Notice of Award.

B. Attendance Required:
   1. Owner.
   2. Architect.
   3. Contractor.

C. Agenda:
   1. Execution of Owner-Contractor Agreement.
   2. Submission of executed bonds and insurance certificates.
   3. Distribution of Contract Documents.
   4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
   5. Designation of personnel representing the parties to Contract, Project Coordinator and Architect.
   6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
   7. Scheduling.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.02 PROGRESS MEETINGS

A. Attendance Required:
   1. Contractor.
   2. Owner.
   3. Architect.
   4. Contractor's superintendent.
   5. Major subcontractors.

B. Agenda:
   1. Review minutes of previous meetings.

2. Review of work progress.
3. Field observations, problems, and decisions.
4. Identification of problems that impede, or will impede, planned progress.
5. Review of submittals schedule and status of submittals.
6. Maintenance of progress schedule.
7. Corrective measures to regain projected schedules.
8. Planned progress during succeeding work period.
9. Maintenance of quality and work standards.
10. Effect of proposed changes on progress schedule and coordination.
11. Other business relating to work.

C. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.03 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
1. Product data.
2. Shop drawings.
3. Samples for selection.
4. Samples for verification.

B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.

C. Samples will be reviewed for aesthetic, color, or finish selection.

D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 017800 - Closeout Submittals.

3.04 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:
1. Design data.
2. Certificates.
3. Test reports.
4. Inspection reports.
5. Manufacturer's instructions.
6. Manufacturer's field reports.
7. Other types indicated.

B. Submit for Architect's knowledge as contract administrator or for Owner.

3.05 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit Correction Punch List for Substantial Completion.

B. Submit Final Correction Punch List for Substantial Completion.

C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 017800 - Closeout Submittals:
1. Project record documents.
2. Operation and maintenance data.
3. Warranties.
4. Bonds.
5. Other types as indicated.

D. Submit for Owner's benefit during and after project completion.

3.06 SUBMITTAL PROCEDURES

A. General Requirements:

END OF SECTION 013000

SECTION 013216
CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preliminary schedule.

B. Construction progress schedule, bar chart type.

1.02 REFERENCE STANDARDS

A. AGC (CPSM) - Construction Planning and Scheduling Manual; 2004.

B. M-H (CPM) - CPM in Construction Management - Project Management with CPM; 2016, with Addendum (2021).

1.03 SUBMITTALS

A. Within 10 days after date of Agreement, submit preliminary schedule.

B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
   1. Include written certification that major contractors have reviewed and accepted proposed schedule.

D. Within 10 days after joint review, submit complete schedule.

E. Submit updated schedule with each Application for Payment.

F. Submit in PDF format.

1.04 QUALITY ASSURANCE

A. Scheduler: Contractor's personnel or specialist Consultant specializing in CPM scheduling with one years minimum experience in scheduling construction work of a complexity comparable to this Project, and having use of computer facilities capable of delivering a detailed graphic printout within 48 hours of request.

1.05 SCHEDULE FORMAT

A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.

B. Diagram Sheet Size: Maximum 22 x 17 inches.

C. Sheet Size: Multiples of 8-1/2 x 11 inches.

D. Scale and Spacing: To allow for notations and revisions.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRELIMINARY SCHEDULE

A. Prepare preliminary schedule in the form of a horizontal bar chart.

3.02 CONTENT

A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.

B. Identify each item by specification section number.

C. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.

D. Provide separate schedule of submittal dates for shop drawings, product data, and samples, owner-furnished products, products identified under Allowances, and dates reviewed submittals will be required from Architect. Indicate decision dates for selection of finishes.

E. Provide legend for symbols and abbreviations used.

3.03 BAR CHARTS

A. Include a separate bar for each major portion of Work or operation.

B. Identify the first work day of each week.

3.04 REVIEW AND EVALUATION OF SCHEDULE

A. Participate in joint review and evaluation of schedule with Architect at each submittal.

B. Evaluate project status to determine work behind schedule and work ahead of schedule.

C. After review, revise as necessary as result of review, and resubmit within 10 days.

3.05 UPDATING SCHEDULE

A. Maintain schedules to record actual start and finish dates of completed activities.

B. Indicate progress of each activity to date of revision, with projected completion date of each activity.

C. Annotate diagrams to graphically depict current status of Work.

D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.

E. Indicate changes required to maintain Date of Substantial Completion.

F. Submit reports required to support recommended changes.

G. Provide narrative report to define problem areas, anticipated delays, and impact on the schedule. Report corrective action taken or proposed and its effect.

3.06 DISTRIBUTION OF SCHEDULE

A. Distribute copies of updated schedules to Contractor's project site file, to subcontractors, suppliers, Architect, Owner, and other concerned parties.

B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

END OF SECTION 013216

SECTION 013553
SECURITY PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Security measures including formal security program, entry control, personnel identification, guard service, and miscellaneous restrictions.

1.02 RELATED REQUIREMENTS

A. Section 015000 - Temporary Facilities and Controls: Temporary lighting.

1.03 SECURITY PROGRAM

A. Protect Work , existing premises and Owner's operations from theft, vandalism, and unauthorized entry.

B. Initiate program in coordination with Owner's existing security system at project mobilization.

C. Maintain program throughout construction period until Owner acceptance precludes the need for Contractor security.

1.04 ENTRY CONTROL

A. Restrict entrance of persons and vehicles into Project site and existing facilities.

B. Allow entrance only to authorized persons with proper identification.

C. Owner will control entrance of persons and vehicles related to Owner's operations.

D. Coordinate access of Owner's personnel to site in coordination with Owner's security forces.

1.05 GUARD SERVICE

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 013553

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SECTION 014000
QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittals.

B. References and standards.

C. Testing and inspection agencies and services.

D. Control of installation.

E. Mock-ups.

F. Tolerances.

G. Manufacturers' field services.

H. Defect Assessment.

1.02 RELATED REQUIREMENTS

A. Document 007200 - General Conditions: Inspections and approvals required by public authorities.

B. Section 012100 - Allowances: Allowance for payment of testing services.

C. Section 013000 - Administrative Requirements: Submittal procedures.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.

C. Test Reports: After each test/inspection, promptly submit electronic copies of report to Architect and to Contractor.
   1. Include:
      a. Date issued.
      b. Project title and number.
      c. Name of inspector.
      d. Date and time of sampling or inspection.
      e. Identification of product and specifications section.
      f. Location in the Project.
      g. Type of test/inspection.
      h. Date of test/inspection.
      i. Results of test/inspection.
      j. Compliance with Contract Documents.
      k. When requested by Architect, provide interpretation of results.
   2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.

D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
   1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

E. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special

attention, and special environmental criteria required for application or installation.

1.04 REFERENCES AND STANDARDS

A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.

C. Obtain copies of standards where required by product specification sections.

D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.

E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.

F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from Contract Documents by mention or inference otherwise in any reference document.

1.05 TESTING AND INSPECTION AGENCIES AND SERVICES

A. Owner will employ services of an independent testing agency to perform certain specified testing; payment for cost of services will be derived from allowance specified in Section 012100; see Section 012100 and applicable sections for description of services included in allowance.

B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS

A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.

B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.

C. Notify Architect fifteen (15) working days in advance of dates and times when mock-ups will be constructed.

D. Provide supervisory personnel who will oversee mock-up construction. Provide workers that will be employed during the construction at Project.

E. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.

F. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

G. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
   1. Architect will issue written comments within seven (7) working days of initial review and each subsequent follow up review of each mock-up.

H. Architect will use accepted mock-ups as a comparison standard for the remaining Work.

I. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

J. Where possible salvage and recycle the demolished mock-up materials.

3.03 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

3.04 TESTING AND INSPECTION

A. See individual specification sections for testing and inspection required.

B. Testing Agency Duties:
   1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
   2. Perform specified sampling and testing of products in accordance with specified standards.
   3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
   5. Perform additional tests and inspections required by Architect.
   6. Submit reports of all tests/inspections specified.

C. Limits on Testing/Inspection Agency Authority:
   1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency may not approve or accept any portion of the Work.
   3. Agency may not assume any duties of Contractor.
   4. Agency has no authority to stop the Work.

D. Contractor Responsibilities:
   1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
   2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
   3. Provide incidental labor and facilities:
      a. To provide access to Work to be tested/inspected.
      b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
      c. To facilitate tests/inspections.
      d. To provide storage and curing of test samples.

4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

E. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.

F. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.05 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.

B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.06 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not complying with specified requirements.

END OF SECTION 014000

SECTION 015000
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary utilities.

B. Temporary sanitary facilities.

C. Temporary Controls: Barriers, enclosures, and fencing.

D. Security requirements.

E. Waste removal facilities and services.

1.02 RELATED REQUIREMENTS

A. Section 013553 - Security Procedures

B. Section 015100 - Temporary Utilities.

C. Section 015213 - Field Offices and Sheds.

1.03 TEMPORARY UTILITIES - SEE SECTION 015100

A. Owner will provide the following:
   1. Electrical power and metering, consisting of connection to existing facilities.
   2. Water supply, consisting of connection to existing facilities.

1.04 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.

B. Maintain daily in clean and sanitary condition.

1.05 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.

C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.06 FENCING

A. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.07 INTERIOR ENCLOSURES

A. Provide temporary partitions and ceilings as indicated to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.

B. Construction: Framing and reinforced polyethylene sheet materials with closed joints and sealed edges at intersections with existing surfaces:

1.08 SECURITY - SEE SECTION 013553

A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

1.09 WASTE REMOVAL

A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.

B. Provide containers with lids. Remove trash from site periodically.

C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.

D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.10 FIELD OFFICES - SEE SECTION 015213

A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.

B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.

C. Locate offices a minimum distance of 30 feet from existing and new structures.

1.11 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.

B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.

C. Clean and repair damage caused by installation or use of temporary work.

D. Restore existing facilities used during construction to original condition.

E. Restore new permanent facilities used during construction to specified condition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 015000

SECTION 015813
TEMPORARY PROJECT SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project identification sign.

1.02 QUALITY ASSURANCE

A. Design sign and structure to withstand 50 miles/hr wind velocity.

B. Finishes, Painting: Adequate to withstand weathering, fading, and chipping for duration of construction.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Shop Drawing: Show content, layout, lettering, color, foundation, structure, sizes and grades of members.

PART 2 PRODUCTS

2.01 SIGN MATERIALS

A. Structure and Framing: New, wood, structurally adequate.

B. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4 inch thick, standard large sizes to minimize joints.

C. Paint and Primers: Exterior quality, two coats; sign background of white color.

D. Lettering: Pre-cut vinyl self-adhesive products, white.

2.02 PROJECT IDENTIFICATION SIGN

A. One painted sign, 48 sq ft area, bottom 6 feet above ground.

B. Graphic Design, Colors, Style of Lettering: Designated by Architect and approved by owner and the THC.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install project identification sign within 30 days after date fixed by Notice to Proceed.

B. Erect at designated location.

C. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.

D. Install sign surface plumb and level, with butt joints. Anchor securely.

E. Paint exposed surfaces of sign, supports, and framing.

3.02 MAINTENANCE

A. Maintain signs and supports clean, repair deterioration and damage.

3.03 REMOVAL

A. Remove signs, framing, supports, and foundations at completion of Project and restore the area.

END OF SECTION 015813

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SECTION 016000
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General product requirements.

B. Re-use of existing products.

C. Transportation, handling, storage and protection.

D. Product option requirements.

E. Substitution limitations.

F. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

A. Section 012500 - Substitution Procedures: Substitutions made during procurement and/or construction phases.

B. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.

C. Section 017419 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

1.03 SUBMITTALS

A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
   1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

A. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.

B. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.

2.02 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by Contract Documents.

B. Use of products having any of the following characteristics is not permitted:
   1. Containing lead, cadmium, or asbestos.

C. Where other criteria are met, Contractor shall give preference to products that:
   1. If used on interior, have lower emissions, as defined in Section 016116.
   2. If wet-applied, have lower VOC content, as defined in Section 016116.

2.03 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.04 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

A. See Section 012500 - Substitution Procedures.

3.02 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.

B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

D. Transport and handle products in accordance with manufacturer's instructions.

E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.03 STORAGE AND PROTECTION

A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 017419.

B. Store and protect products in accordance with manufacturers' instructions.

C. Store with seals and labels intact and legible.

D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.

E. For exterior storage of fabricated products, place on sloped supports above ground.

F. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

G. Comply with manufacturer's warranty conditions, if any.

H. Do not store products directly on the ground.

I. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

J. Prevent contact with material that may cause corrosion, discoloration, or staining.

K. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

L. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION 016000

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SECTION 017000
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.

B. Requirements for alterations work, including selective demolition, _____.

C. Pre-installation meetings.

D. Cutting and patching.

E. Surveying for laying out the work.

F. Cleaning and protection.

G. Starting of systems and equipment.

H. Demonstration and instruction of Owner personnel.

I. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

J. General requirements for maintenance service.

1.02 RELATED REQUIREMENTS

A. Section 011000 - Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.

B. Section 013000 - Administrative Requirements: Submittals procedures, Electronic document submittal service.

C. Section 014000 - Quality Requirements: Testing and inspection procedures.

D. Section 015000 - Temporary Facilities and Controls: Temporary exterior enclosures.

E. Section 015000 - Temporary Facilities and Controls: Temporary interior partitions.

F. Section 017800 - Closeout Submittals: Project record documents, operation and maintenance data, warranties, and bonds.

G. Section 078400 - Firestopping.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
   1. On request, submit documentation verifying accuracy of survey work.
   2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
   3. Submit surveys and survey logs for the project record.

C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather exposed or moisture resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   4. Visual qualities of sight exposed elements.
   5. Work of Owner or separate Contractor.

D. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.04 QUALIFICATIONS

A. For demolition work, employ a firm specializing in the type of work required.
   1. Minimum of 5 years of documented experience.

B. For surveying work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,

C. For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.05 PROJECT CONDITIONS

A. Use of explosives is not permitted.

B. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

C. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
   1. Provide dust-proof enclosures to prevent entry of dust generated outdoors.
   2. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.

D. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.

1.06 COORDINATION

A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

B. Notify affected utility companies and comply with their requirements.

C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

F. Coordinate completion and clean-up of work of separate sections.

G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS

A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.

B. Require attendance of parties directly affecting, or affected by, work of the specific section.

C. Notify Architect four days in advance of meeting date.

D. Prepare agenda and preside at meeting:
   1. Review conditions of examination, preparation and installation procedures.
   2. Review coordination with related work.

E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.

B. Promptly notify Architect of any discrepancies discovered.

C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.

F. Utilize recognized engineering survey practices.

G. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
   1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
   2. Grid or axis for structures.
   3. Building foundation, column locations, ground floor elevations, and _____.

H. Periodically verify layouts by same means.

I. Maintain a complete and accurate log of control and survey work as it progresses.

3.05 GENERAL INSTALLATION REQUIREMENTS

A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.

B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of alterations work constitutes acceptance of existing conditions.

B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
   1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 015000 in locations indicated on drawings.

C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
   1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
   2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.

D. Remove existing work as indicated and as required to accomplish new work.
   1. Remove items indicated on drawings.
   2. Relocate items indicated on drawings.
   3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
   4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.

E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
   2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
   3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
      a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
      b. Provide temporary connections as required to maintain existing systems in service.
   4. Verify that abandoned services serve only abandoned facilities.

5. Remove abandoned pipe, ducts, conduits, and equipment , including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.

F. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.

G. Adapt existing work to fit new work: Make as neat and smooth transition as possible.

H. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.

I. Refinish existing surfaces as indicated:
   1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
   2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.

J. Clean existing systems and equipment.

K. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.

L. Do not begin new construction in alterations areas before demolition is complete.

M. Comply with all other applicable requirements of this section.

3.07 CUTTING AND PATCHING

A. Whenever possible, execute the work by methods that avoid cutting or patching.

B. See Alterations article above for additional requirements.

C. Perform whatever cutting and patching is necessary to:
   1. Complete the work.
   2. Fit products together to integrate with other work.
   3. Provide openings for penetration of mechanical, electrical, and other services.
   4. Match work that has been cut to adjacent work.
   5. Repair areas adjacent to cuts to required condition.
   6. Repair new work damaged by subsequent work.
   7. Remove samples of installed work for testing when requested.
   8. Remove and replace defective and non-complying work.

D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.

E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

G. Restore work with new products in accordance with requirements of Contract Documents.

H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 078400, to full thickness of the penetrated element.

J. Patching:

1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
2. Match color, texture, and appearance.
3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.08 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.09 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.

B. Provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.10 SYSTEM STARTUP

A. Coordinate schedule for start-up of various equipment and systems.

B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.

C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

D. Verify that wiring and support components for equipment are complete and tested.

E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.

F. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.11 DEMONSTRATION AND INSTRUCTION

A. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.

B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

C. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner's personnel.

3.12 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.13 FINAL CLEANING

A. Execute final cleaning prior to final project assessment.
   1. Clean areas to be occupied by Owner prior to final completion before Owner occupancy.

B. Use cleaning materials that are nonhazardous.

C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.

E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

F. Clean filters of operating equipment.

G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, drainage systems, and other areas affected by construction.

H. Clean site; sweep paved areas, rake clean landscaped surfaces.

I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.14 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.
   1. Provide copies to Owner.

B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.

C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.

D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.

E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.

F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.

G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.

H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

3.15 MAINTENANCE

A. Provide service and maintenance of components indicated in specification sections.

B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.

C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.

D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.

E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION 017000

SECTION 017800
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project record documents.

B. Operation and maintenance data.

C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

A. Section 007200 - General Conditions and 007300 - Supplementary Conditions: Performance bond and labor and material payment bonds, warranty, and correction of work.

B. Section 013000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.

C. Section 017000 - Execution and Closeout Requirements: Contract closeout procedures.

D. Individual Product Sections: Specific requirements for operation and maintenance data.

E. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.

B. Operation and Maintenance Data:
   1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
   2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
   3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
   4. Submit two sets of revised final documents in final form within 10 days after final inspection.

C. Warranties and Bonds:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
   2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
   3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. Reviewed shop drawings, product data, and samples.
   6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Changes made by Addenda and modifications.

F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Field changes of dimension and detail.
   2. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

A. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

B. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

C. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. For Each Product, Applied Material, and Finish:
   1. Product data, with catalog number, size, composition, and color and texture designations.
   2. Information for re-ordering custom manufactured products.

B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

D. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. For Each Item of Equipment and Each System:
   1. Description of unit or system, and component parts.
   2. Identify function, normal operating characteristics, and limiting conditions.
   3. Include performance curves, with engineering data and tests.
   4. Complete nomenclature and model number of replaceable parts.

B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

C. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

D. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

E. Provide servicing and lubrication schedule, and list of lubricants required.

F. Include manufacturer's printed operation and maintenance instructions.

G. Include sequence of operation by controls manufacturer.

H. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

I. Provide control diagrams by controls manufacturer as installed.

J. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.

K. Include test and balancing reports.

L. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.

B. Where systems involve more than one specification section, provide separate tabbed divider for each system.

C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.

F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.

G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.

H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.

I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

J. Arrangement of Contents: Organize each volume in parts as follows:
   1. Project Directory.
   2. Table of Contents, of all volumes, and of this volume.
   3. Operation and Maintenance Data: Arranged by system, then by product category.
      a. Source data.
      b. Operation and maintenance data.
      c. Field quality control data.
      d. Photocopies of warranties and bonds.

3.06 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

E. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.

F. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.

END OF SECTION 017800

SECTION 020342
REMOVAL AND SALVAGE OF PERIOD CONSTRUCTION MATERIALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Work includes deconstruction and salvage of identified historic items and materials and removal of rubbish and debris.

B. Specified procedures required for preservation, rehabilitation, restoration, and reconstruction treatment areas.

1.02 RELATED REQUIREMENTS

A. Section 013591 - Period Treatment Procedures for general historic preservation project requirements.

1.03 DEFINITIONS

A. Debris: Nonhistoric building materials and contents destroyed during demolition.

B. Deconstruction: Systematic dismantling and removal of a structure or its parts and salvage of elements and components for reuse, recycling, and retaining maximum value.

1.04 REFERENCE STANDARDS

A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.

1.05 QUALITY ASSURANCE

A. Deconstruction Crew Qualifications: Workers trained and experienced in removal and salvage of historic materials.

1.06 FIELD CONDITIONS

A. Protection of Existing Historic Property: Before beginning removal, salvage, or demolition work, survey the site and examine the drawings and specifications to determine the extent of the work. Take necessary precautions to avoid damage to existing items to remain in place, be reused, or remain Owner's property. Repair or restore to original condition items damaged by Contractor, using approved means, methods, and techniques. Replace items that cannot be successfully repaired or restored to original condition.
   1. Construct and maintain shoring, bracing, and supports required as a result of cutting, removal, or demolition work
   2. Ensure that structural elements are not overloaded.

B. Store materials to be salvaged or recycled daily, out of contact with the ground, under weathertight covering, in areas designated by Owner, and in the manner direct by Owner.

C. Hazardous Materials: Comply with 29 CFR 1926 and state and local regulations.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PERIOD TREATMENT, GENERAL

A. See Section 013591 for special procedure requirements related to elements and features of historical significance and value.

3.02 GENERAL PROCEDURES

A. Drawings indicating existing construction, building services, and site utilities are based on casual field observation and existing record documents only.
   1. Report discrepancies to Architect before disturbing existing historic elements.
   2. Beginning of work constitutes acceptance of existing conditions that are apparent upon examination at that time.

B. Separate spaces in which removals and salvage operations are conducted from occupied spaces.

1. Provide, erect, and maintain temporary dustproof partitions; see Section 015000.

3.03 ENVIRONMENTAL CONTROLS

A. Comply with federal, state, and local regulations pertaining to water, air, solid waste, recycling, chemical waste, sanitary waste, sediment, and noise pollution.

3.04 ITEMS TO BE SALVAGED

A. General: Salvage elements and components to the maximum extent possible. Maintain a chain of custody of salvaged materials, including the condition of such materials before and after salvage operations.

3.05 MATERIALS TO BE REMOVED

A. Remove existing nonhistoric elements as indicated and as required to allow direct access to period construction elements indicated to be restored or salvaged for reuse.

B. Protect existing historic elements.
   1. Prevent movement of structure; provide temporary, removable shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly, minimizing overcutting.

3.06 MATERIALS TO BE RECYCLED

A. Recycle removed nonhistoric materials to the maximum extent possible. Remove recyclable materials by hand wherever possible.

B. Recycle items indicated on drawings.

3.07 CLEANING

A. Upon completion of work, clean dust, dirt, and debris caused by salvage and demolition operations from portions of existing structure to remain and adjacent areas. Remove and transport debris and rubbish in a manner that prevents spillage on streets or adjacent areas. Obey local regulations regarding hauling and disposal.

END OF SECTION 020342

SECTION 024100
DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Selective demolition of building elements for alteration purposes.

1.02 RELATED REQUIREMENTS

A. Section 011000 - Summary: Limitations on Contractor's use of site and premises.

B. Section 011000 - Summary: Sequencing and staging requirements.

C. Section 011000 - Summary: Description of items to be salvaged or removed for re-use by Contractor.

D. Section 015000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.

E. Section 016000 - Product Requirements: Handling and storage of items removed for salvage and relocation.

F. Section 017000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.

1.03 REFERENCE STANDARDS

A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.

B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.05 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Company specializing in the type of work required.
   1. Minimum of five years of documented experience similar in complexity of Scope.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 SCOPE

A. Remove portions of existing buildings as indicated on Drawings.

B. Remove other items indicated, for salvage, relocation, recycling, and reinstallation.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
   3. Provide, erect, and maintain temporary barriers and security devices.
   4. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
   5. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
   6. Conduct operations to minimize obstruction of public and private entrances and exits; do

not obstruct required exits at any time; protect persons using entrances and exits from removal operations.

B. Do not begin removal until receipt of notification to proceed from Owner.

C. Do not begin removal until built elements to be salvaged or relocated have been removed.

D. Protect existing structures and other elements that are not to be removed.

E. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

F. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.

G. Perform demolition in a manner that maximizes salvage and recycling of materials.
   1. Dismantle existing construction and separate materials.
   2. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

3.03 EXISTING UTILITIES

A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

3.04 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

B. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.

C. Remove existing work as indicated and as required to accomplish new work.
   1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
   2. Remove items indicated on drawings.

D. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.

2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
3. Verify that abandoned services serve only abandoned facilities before removal.
4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.

E. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
3. Repair adjacent construction and finishes damaged during removal work.
4. Patch as specified for patching new work.

3.05 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION 024100

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SECTION 028333.13
LEAD-BASED PAINT REMOVAL AND DISPOSAL

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies abatement and disposal of lead-based paint (LBP) and controls needed to limit occupational and environmental exposure to lead hazards.

RELATED WORK

A. Section 01 3100 - Available Project Information: Lead Based Paint Surveys.

B. Section 02 4100 - Demolition.

C. Section 09 9000 - Painting and Coating.

APPLICABLE PUBLICATIONS

A. National Fire Protection Association (NFPA): NFPA 701-2004 - Methods of Fire Test for Flame-Resistant Textiles and Films.

B. National Institute for Occupational Safety And Health (NIOSH) NIOSH OSHA Booklet 3142 Lead in Construction.

C. Underwriters Laboratories (UL) UL 586-1996 (Rev 2009) High-Efficiency, Particulate, Air Filter Units.

DEFINITIONS

A. Action Level: Employee exposure, without regard to use of respirations, to an airborne concentration of lead of 30 micrograms per cubic meter of air averaged over an 8-hour period. As used in this section, ”30 micrograms per cubic meter of air" refers to the action level.

B. Area Monitoring: Sampling of lead concentrations within the lead control area and inside the physical boundaries which is representative of the airborne lead concentrations which may reach the breathing zone of personnel potentially exposed to lead.

C. Physical Boundary: Area physically roped or partitioned off around an enclosed lead control area to limit unauthorized entry of personnel. As used in this section, "inside boundary" shall mean the same as "outside lead control area."

D. Certified Industrial Hygienist: As used in this section, refers to an Industrial Hygienist employed by the Contractor and is certified by the American Board of Industrial Hygiene in comprehensive practice.

E. Competent Person: A person capable of identifying lead hazards in the work area and is authorized by the contractor to take corrective action.

F. Decontamination Room: Room for removal of contaminated personal protective equipment (PPE).

G. Eight-Hour Time Weighted Average (TWA): Airborne concentration of lead averaged over an 8-hour workday to which an employee is exposed.

H. High Efficiency Particulate Air (HEPA) Filter Equipment: HEPA filtered vacuuming equipment with a UL 586 filter system capable of collecting and retaining lead-contaminated paint dust. A high efficiency particulate filter means 99.97 percent efficient against 0.3 micron size particles.

I. Lead: Metallic lead, inorganic lead compounds, and organic lead soaps. Excluded from this definition are other organic lead compounds.

J. Lead Control Area: An enclosed area or structure with full containment to prevent the spread of lead dust, paint chips, or debris of lead-based paint removal operations. The lead control area is isolated by physical boundaries to prevent unauthorized entry of personnel.

K. Lead Permissible Exposure Limit (PEL): Fifty micrograms per cubic meter of air as an 8-hour time weighted average. If an employee is exposed for more than 8 hours in a work day, the PEL shall be determined by the following formula. PEL (micrograms/cubic meter of air) =

400/No. of hrs worked per day

L. Personnel Monitoring: Sampling of lead concentrations within the breathing zone of an employee to determine the 8-hour time weighted average concentration. Samples shall be representative of the employee's work tasks. Breathing zone shall be considered an area within a hemisphere, forward of the shoulders, with a radius of 150 mm to 225 mm (6 to 9 inches) and the center at the nose or mouth of an employee.

QUALITY ASSURANCE

A. The Contractor shall employ a Certified Industrial Hygienist who will be responsible for the following:
   1. Certify Training.
   2. Review and approve lead-based paint removal plan for conformance to the applicable referenced standards.
   3. Inspect lead-based paint removal work for conformance with the approved plan.
   4. Direct monitoring.
   5. Ensure work is performed in strict accordance with specifications at all times.
   6. Ensure hazardous exposure to personnel and to the environment are adequately controlled at all times.

B. Training: Train each employee performing paint removal, disposal, and air sampling operations prior to the time of initial job assignment.

C. Training Certification: Submit certificates signed and dated by the Certified Industrial Hygienist and by each employee stating that the employee has received training.

D. Respiratory Protection Program:
   1. Furnish each employee required to wear a negative pressure respirator or other appropriate type with a respirator fit test at the time of initial fitting and at least every 6 months thereafter.
   2. Establish and implement a respiratory protection program as required by.

E. Hazard Communication Program: Establish and implement a Hazard Communication Program.

F. Hazardous Waste Management: The Hazardous Waste Management plan shall comply with applicable requirements of Federal, State, and local hazardous waste regulations and address:
   1. Identification of hazardous wastes associated with the work.
   2. Estimated quantities of wastes to be generated and disposed of.
   3. Names and qualifications of each contractor that will be transporting, storing, treating, and disposing of the wastes. Include the facility location and a 24-hour point of contact. Furnish two copies of EPA, state, and local hazardous waste permit applications, permits, and EPA Identification numbers.
   4. Spill prevention, containment, and cleanup contingency measures to be implemented.
   5. Work plan and schedule for waste containment, removal and disposal. Wastes shall be cleaned up and containerized daily.
   6. Cost for hazardous waste disposal according to this plan.

G. Safety and Health Compliance:
   1. In addition to the detailed requirements of this specification, comply with laws, ordinances, rules, and regulations of federal, state, and local authorities regarding removing, handling, storing, transporting, and disposing of lead waste materials.
   2. Where specification requirements and the referenced documents vary, the most stringent requirements shall apply.

H. Pre-Construction Conference: Along with the, meet with the Certified Industrial Hygienist to discuss in detail the lead-based paint removal work plan, including work procedures and precautions for the work plan.

SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Manufacturer's Catalog Data:
   1. Vacuum filters.
   2. Respirators.

C. Instructions: Paint removal materials. Include applicable material safety data sheets.

D. Statements Certifications and Statements:
   1. Qualifications of certified industrial hygienist : Submit name, address, and telephone number of the selected to perform the specified responsibilities. Provide previous experience. Submit proper documentation that the Industrial Hygienist is certified by the American Board of Industrial Hygiene in comprehensive practice, including certification number and date of certification/recertification.
   2. Testing Laboratory: Submit the name, address, and telephone number of the testing laboratory selected to perform the monitoring, testing, and reporting of airborne concentrations of lead. Provide proper documentation that persons performing the analysis have been judged proficient by successful participation within the last year in the National Institute for Occupational Safety and Health (NIOSH) Proficiency Analytical Testing (PAT) Program. The laboratory shall be accredited by the American Industrial Hygiene Association (AIHA). Provide AIHA documentation along with date of accreditation/reaccreditation.
   3. Lead Based Paint Removal Plan:
      a. Submit a detailed job-specific plan of the work procedures to be used in the removal of lead-based paint. The plan shall include a sketch showing the location, size, and details of lead control areas, location and details of decontamination rooms, change rooms, shower facilities, and mechanical ventilation system.
      b. Include in the plan, eating, drinking, smoking and restroom procedures, interface of trades, sequencing of lead related work, collected wastewater and paint debris disposal plan, air sampling plan, respirators, protective equipment, and a detailed description of the method of containment of the operation to ensure that airborne lead concentrations of 30 micrograms per cubic meter of air are not exceeded outside of the lead control area.
      c. Include air sampling, training and strategy, sampling methodology, frequency, duration of sampling, and qualifications of air monitoring personnel in the air sampling portion on the plan.
   4. Field Test Reports: Monitoring Results: Submit monitoring results to the Owner and Architect within 3 working days, signed by the testing laboratory employee performing the air monitoring, the employee that analyzed the sample, and the Certified Industrial Hygienist.
   5. Records:
      a. Completed and signed hazardous waste manifest from treatment or disposal facility.
      b. Employee training certification.

PART 2 PRODUCTS

7.01 MATERIALS

A. Paint Removal Products: Submit applicable Material Safety Data Sheets for paint removal products used in paint removal work. Use the least toxic product, suitable for the job and acceptable to the Industrial Hygienist.

PART 3 EXECUTION

8.01 PROTECTION

A. Notification: Notify the Owner 20 days prior to the start of any paint removal work.

B. Lead Control Area Requirements.
   1. Establish a lead control area by completely enclosing with containment screens the area or structure where lead-based paint removal operations will be performed.
   2. Contain removal operations by the use of a negative pressure full containment system with at least one change room and with HEPA filtered exhaust.

C. Protection of Existing Work to Remain: Perform paint removal work without damage or contamination of adjacent areas. Where existing work is damaged or contaminated, restore work to its original condition.

D. Boundary Requirements: Provide physical boundaries around the lead control area by roping off the area or providing curtains, portable partitions or other enclosures to ensure that airborne concentrations of lead will not reach 30 micrograms per cubic meter of air outside of the lead control area.

E. Heating, Ventilating and Air Conditioning (HVAC) Systems: Shut down, lock out, and isolate HVAC systems that supply, exhaust, or pass through the lead control areas. Seal intake and exhaust vents in the lead control area with 6-mil plastic sheet and tape. Seal seams in HVAC components that pass through the lead control area.

F. Mechanical Ventilation System:
   1. Use adequate ventilation to control personnel exposure to lead in accordance with 29 CFR 1926.57.
   2. To the extent feasible, use fixed local exhaust ventilation connected to HEPA filters or other collection systems, approved by the industrial hygienist. Local exhaust ventilation systems shall be designed, constructed, installed, and maintained in accordance with ANSI Z9.2.
   3. If air from exhaust ventilation is recirculated into the work place, the system shall have a high efficiency filter with reliable back-up filter and controls to monitor the concentration of lead in the return air and to bypass the recirculation system automatically if it fails. Air may be recirculated only where exhaust to the outside is not feasible.

G. Personnel Protection: Personnel shall wear and use protective clothing and equipment as specified herein. Eating, smoking, or drinking is not permitted in the lead control area. No one will be permitted in the lead control area unless they have been given appropriate training and protective equipment.

H. Warning Signs: Provide warning signs at approaches to lead control areas. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering the area.

WORK PROCEDURES

A. Perform removal of lead-based paint in accordance with approved removal plan. Use procedures and equipment required to limit occupational and environmental exposure to lead when lead- based paint is removed, except as specified herein. Dispose of removed paint chips and associated waste in compliance with Environmental Protection Agency (EPA), federal, state, and local requirements.

B. Personnel Exiting Procedures:
   1. Whenever personnel exist the lead-controlled area, they shall perform the following procedures and shall not leave the work place wearing any clothing or equipment worn during the work day:
      a. Vacuum themselves off.
      b. Remove protective clothing in the decontamination room, and place them in an approved impermeable disposal bag.
      c. Shower.
      d. Change to clean clothes prior to leaving the physical boundary designated around the lead-contaminated job site.

C. Monitoring: Monitoring of airborne concentrations of lead shall be as specified herein. Air monitoring, testing, and reporting shall be performed by a certified industrial hygienist or an Industrial Hygiene Technician who is under the direction of the Certified Industrial Hygienist:
   1. The Certified Industrial Hygienist or the Industrial Hygiene Technician under the direction of the Certified Industrial Hygienist shall be on the job site directing the monitoring, and inspecting the lead-based paint removal work to ensure that the requirements of the Contract have been satisfied during the entire lead-based paint removal operation.

2. Take personal air monitoring samples on employees who are anticipated to have the greatest risk of exposure as determined by the Certified Industrial Hygienist. In addition, take air monitoring samples on at least 25 percent of the work crew or a minimum of two employees, whichever is greater, during each work shift.
3. Submit results of air monitoring samples, signed by the Certified Industrial Hygienist, within 24 hours after the air samples are taken. Notify the Architect immediately of exposure to lead at or in excess of the action level of 30 micrograms per cubic meter of air outside of the lead control area.

D. Monitoring During Paint Removal Work:
1. Perform personal and area monitoring during the entire paint removal operation. Sufficient area monitoring shall be conducted at the physical boundary to ensure unprotected personnel are not exposed above 30 micrograms per cubic meter of air at all times. If the outside boundary lead levels are at or exceed 30 micrograms per cubic meter of air, work shall be stopped and the Certified Industrial Hygienist shall immediately correct the condition(s) causing the increased levels and notify the Architect immediately.
2. The certified industrial hygienist shall review the sampling data collected on that day to determine if condition(s) requires any further change in work methods. Removal work shall resume when approval is given by the Certified Industrial Hygienist. The Contractor shall control the lead level outside of the work boundary to less than 30 micrograms per cubic meter of air at all times. As a minimum, conduct area monitoring daily on each shift in which lead paint removal operations are performed in areas immediately adjacent to the lead control area.
3. For outdoor operations, at least one sample on each shift shall be taken on the downwind side of the lead control area. If adjacent areas are contaminated, clean and visually inspect contaminated areas. The Certified Industrial Hygienist shall certify that the area has been cleaned of lead contamination.

LEAD-BASED PAINT REMOVAL

A. Remove paint within the areas designated on the drawings in order to completely expose the substrate. Take whatever precautions are necessary to minimize damage to the underlying substrate.

B. Indoor Lead Paint Removal: Select paint removal processes to minimize contamination of work areas with lead-contaminated dust or other lead-contaminated debris/waste. This paint removal process should be described in the lead-based paint removal plan. Perform manual sanding and scraping to the maximum extent feasible.

C. Mechanical Paint Removal and Blast Cleaning: Perform mechanical paint removal and blast cleaning in lead control areas using negative pressure full containments with HEPA filtered exhaust. Collect paint residue and spent grit (used abrasive) from blasting operations for disposal in accordance with EPA, state and local requirements.

D. Outside Lead Paint Removal: Select removal processes to minimize contamination of work areas with lead-contaminated dust or other lead-contaminated debris/waste. This paint removal process should be described in the lead-based paint removal plan. Perform manual sanding and scraping to the maximum extent feasible.

SURFACE PREPARATIONS

A. Avoid flash rusting or other deterioration of the substrate. Provide surface preparations for painting in accordance with Section 09 9000 Painting and Coating.

CLEANUP AND DISPOSAL

A. Cleanup: Maintain surfaces of the lead control area free of accumulations of paint chips and dust. Restrict the spread of dust and debris; keep waste from being distributed over the work area. Do not dry sweep or use compressed air to clean up the area. At the end of each shift and when the paint removal operation has been completed, clean the area of visible lead paint contamination by vacuuming with a HEPA filtered vacuum cleaner and wet mopping the area.

B. Certification: The Certified Industrial Hygienist shall certify in writing that the inside and outside the lead control area air monitoring samples are less than 30 micrograms per cubic meter of air, the respiratory protection for the employees was adequate, the work procedures were performed in accordance with the most stringent jurisdictional guidelines and requirements, and that there were no visible accumulations of lead-contaminated paint and dust on the worksite. Do not remove the lead control area or roped-off boundary and warning signs prior to the issuance of the Certified Industrial Hygienist's certification. Reclean areas showing dust or residual paint chips.

C. Testing of Lead-Based Paint Residue and Used Abrasive: Where indicated test lead-based paint residue and used abrasive for hazardous waste.

D. Disposal:
   1. Collect lead-contaminated waste, scrap, debris, bags, containers, equipment, and lead-contaminated clothing which may produce airborne concentrations of lead particles and label the containers. Dispose of lead-contaminated waste material at a EPA or state approved hazardous waste treatment, storage, or disposal facility off Government property.
   2. Store waste materials in U.S. Department of Transportation approved 55-gallon drums. Properly label each drum to identify the type of waste and the date the drum was filled.
   3. Handle, store, transport, and dispose lead or lead-contaminated waste in accordance with jurisdictional regulations.

E. Disposal Documentation Submit written evidence that the hazardous waste treatment, storage, or disposal facility (TSD) is approved for lead disposal by the EPA and state or local regulatory agencies.

END OF SECTION 028333.13

SECTION 030516
UNDERSLAB VAPOR BARRIER - STEGO

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2018a.

B. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017.

PART 2 PRODUCTS

2.01 MATERIALS

A. Underslab Vapor Barrier:
   1. Water Vapor Permeance: Not more than 0.010 perms, maximum.
   2. Thickness: 15 mils.
   3. Product:
      a. Stego Industries LLC; Stego Wrap Vapor Barrier (15-mil): www.stegoindustries.com/#sle.

B. Accessory Products: Vapor barrier manufacturer's recommended tape, adhesive, mastic, etc., for sealing seams and penetrations in vapor barrier.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E1643.

B. Install vapor barrier under interior slabs on grade; lap sheet over footings and seal to foundation walls.

C. Lap joints minimum 6 inches.

D. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions.

E. No penetration of vapor barrier is allowed except for reinforcing steel and permanent utilities.

F. Repair damaged vapor retarder before covering with other materials.

END OF SECTION 030516

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SECTION 031521
TERMITE BARRIER - STEGO

PART 2 PRODUCTS

1.01 TERMITE BARRIER SHEET

A. Termite-Resistant Vapor Barrier Sheet: Plastic sheet complying with ASTM E1745, Class C; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs, and for exclusion of subterranean termites.

B. Accessory Products: Barrier sheet manufacturer's recommended tape, adhesive, etc., for sealing seams and penetrations in termite barrier.

C. Manufacturer: Stego Technology LLC; Pango Wrap with Pango Tape: www.stegoindustries.com/#sle.

END OF SECTION 031521

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SECTION 033000
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete formwork.

B. Miscellaneous concrete elements, including equipment pads, equipment pits, light pole bases, flagpole bases, thrust blocks, and manholes.

1.02 RELATED REQUIREMENTS

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.

C. Mix Design: Submit proposed concrete mix design.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

END OF SECTION 033000

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SECTION 040140
MASONRY RESTORATION AND CLEANING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:
   1. Restoration of exposed exterior brick masonry.
   2. Repointing of existing mortar at existing brick masonry.
   3. Low-pressure cleaning.

1.02 SALVAGE AND REUSE OF MASONRY

A. Damaged and deteriorated masonry units will be completely replaced. Masonry dutchman will be used only for special conditions after visual review by Architect.

B. Cut out damaged and deteriorated masonry with care in a manner to prevent damage to any adjacent remaining materials and store for reuse.

C. Install salvaged masonry with coursing to match and align with existing joints, faces, plumb, and in line.

1.03 SPECIAL PROPERTIES

A. Mortar shall contain admixtures, such as pigments, to match the characteristics of the original mortar. Use of all admixtures shall be subject to approval.

1.04 CLEANING AND RESTORATION METHODS

A. Submit for approval the cleaning and restoration methods, and materials selected for a specific structure, before work starts, taking into account the total construction system of the building to be worked upon, including different masonry and mortar materials, as well as non-masonry elements which may be affected by the work.

1.05 SUBMITTALS

A. Mortar Material Testing: Provide laboratory testing of original mortar to determine required matching for composition and color of new mortar.

1.06 QUALITY ASSURANCE

A. Basis for Standard of Care: U.S. Department of the Interior – National Park Service – Standards and Guidelines.

B. Provide required qualifications for workers trained and experienced in restoration of masonry in historic structures, and furnish documentation of 5 consecutive years of work of this type.

C. No masonry or mortar shall be used in the work until the samples and the represented mixture have been approved.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Furnish mortar in suitable bags used for packaging mortars. Labeling of packages shall clearly define contents, manufacturer, and batch identification.

B. Detergents, masonry cleaners, paint removers, solvents, epoxies and other chemicals used for masonry cleaning shall be in sealed containers that legibly show the designated name, formula or specification number, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name of manufacturer.

C. Store materials in weathertight structures which will exclude moisture and contaminants. Accessories shall be stored avoiding contamination and deterioration.

D. Admixtures which have been in storage onsite for six months or longer, or which have been subjected to freezing, shall not be used unless retested and proven to meet the specified requirements.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Masonry, mortar, and epoxy adhesives shall not be placed when weather conditions detrimentally affect the quality of the finished product. No masonry or mortar shall be placed when the air temperature is below 40 degrees F in the shade.

B. When air temperature is likely to exceed 90 degrees F masonry and mortar shall have a temperature not exceeding 90 degrees F when deposited. Materials to be used in the work shall be neither produced nor placed during periods of rain or other precipitation. Stop material placements, and protect all in-place material from exposure, during periods of rain or other precipitation.

C. Masonry surfaces shall be cleaned only when air temperatures are above 40 degrees F and will remain so until masonry has dried out, but for not less than 7 days after completion of the work.

1.09 WARRANTIES

A. Cleaning Warranty: Cleaning procedures shall be warranted for a period of two years against harm to substrate (masonry and mortar) or to adjacent materials including, but not limited to, discoloration of substrate from improper procedures or usage, chemical damage from inadequate rinse procedures, and abrasive damage from improper procedures.

B. Repair Warranty: Repair procedures, including repointing, shall be warranted for a period of two years against: discoloration or mismatch of new mortar to adjacent original historic mortar, discoloration or damage to masonry from improper mortar clean-up, loss of bond between masonry and mortar, fracturing of masonry edges from improper mortar joint preparation procedures or improper mortar formulation, and occurrence of efflorescence.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials, physical and chemical properties, and composition of masonry and mortar used in renovation work shall match that of original existing masonry and mortar to be repaired, unless samples and testing determine that existing mixtures and materials are faulty or non-performing.

2.02 EQUIPMENT AND TECHNIQUES DEMONSTRATION

A. Sandblasting equipment will not be allowed for cleaning masonry surfaces.

B. Water Cleaning
   1. Provide water cleaning equipment including a trailer-mounted water tank, pumps, high-pressure hose, wand with safety release cutoff control, nozzle, and auxiliary water re-supply equipment.
   2. The equipment shall not be operated at a pressure which will cause etching or other damage to the masonry surface or mortar joints.
   3. Operate the equipment at a discharge capacity of 55 psi and 2.5 to 3 gpm for general surface cleaning operations.
   4. The water tank and auxiliary re-supply equipment shall be of sufficient capacity to permit continuous operations.
   5. Provide protective covers and barriers as required to prevent over-spray onto adjacent surfaces.

C. Equipment and hand tools used for placing, finishing and texturing masonry and mortar shall be commercially available and commonly used in masonry construction and repair.
   1. Surface grinders, impact tools, and other equipment shall conform to the specified requirements, except as specifically required by the type of finish and texture.

D. Compressed air equipment shall deliver clean, oil and moisture free compressed air at the surface to be cleaned.
   1. The compressed air line shall have at least two in-line air filters to remove oil and moisture from the air supply. Test the compressed air supply during each shift for the presence of oil and moisture.

2.03 MATERIAL HANDLING AND ASSOCIATED EQUIPMENT

A. Provide equipment used for mixing, transporting, placing, and confining masonry and mortar placements capable of satisfactorily mixing material and supporting placement operations in an uninterrupted manner.

B. Defects and deficiencies in operation or capacity shall be resolved prior to use in the work.

C. Equipment used for mixing, conveying, and placing of materials shall be clean, free of old materials and contaminants, and shall conform to the material manufacturer's recommendations.

D. Provide associated equipment, such as mixer timing equipment, valves, pressure gauges, pressure hoses, other hardware, and tools, as required to ensure a continuous supply of material and operation control.

2.04 REPAIR MATERIALS

A. Masonry and mortar materials used for repair and renovation shall match the original existing historic materials as closely as possible in composition, color, texture, strength, size, finishing and porosity based on results of mortar materials testing.

B. Mortar Patching Mix For Epoxy Injection
   a. Use salvaged mortar ground into powder consistency and mix into manufacturer’s epoxy masonry adhesive used for both epoxy injection.

2.05 EPOXY MASONRY ADHESIVE FOR EPOXY INJECTION

A. Manufacturer: Edison Coatings; 3 Northwest Drive; Plainville, CT 06062; www.edisoncoatings.com.
   1. Flexi-seal 510 for cracks 1/16” in width or smaller.
   2. Flexi-seal 510-U for cracks larger than 1/16” in width, and a maximum width of 1/8”.

PART 3 - EXECUTION

3.01 TESTING, EVALUATION, AND ANALYSIS

A. Masonry renovation shall be undertaken only after complete evaluation and analysis of the areas to be repaired are completed including sampling and testing of the existing mortar to determine its composition and qualities.

B. No repair work shall be undertaken until conditions that have caused masonry deterioration have been identified; such conditions shall be corrected, if possible, prior to start of the work.

3.02 MASONRY CLEANING

A. Historic materials shall not be damaged or marred in the process of cleaning. Cleaning shall conform to ASTM C 1515.

B. Temporarily caulk or otherwise protect open joints to prevent water and cleaner intrusion into the interior of the structure from pressure spraying.

C. Protect non-masonry materials and severely deteriorated masonry by approved methods prior to initiation of cleaning operations.

D. Masonry cleaning shall remove all organic and inorganic contaminants from the surface and pores of the substrate, returning the masonry to its natural color. Surfaces shall be evenly cleaned with no evidence of streaking or bleaching. The cleaning process shall not affect the density, porosity, or color of the masonry or mortar.

E. Cleaned masonry shall have a neutral pH. Use the gentlest methods possible for cleaning historic masonry to achieve the desired results. Make test patches to determine a satisfactory cleaning result.

F. Cleaning shall proceed in an orderly manner, working from top to bottom of each scaffold width and from one end of each elevation to the other. Perform cleaning in a manner which results in uniform coverage of all surfaces, including corners, moldings, interstices and which produces an even effect without streaking or damage to masonry.

G. The cleaning materials, equipment, and methods shall not result in staining, erosion, marring, or other damage to the surfaces of the structure. Following an initial inspection and evaluation of the structure and surfaces, give the structure a surface cleaning which shall be completed prior to start of repair work, and sampling and testing of mortars. The work shall provide for the complete cleaning of all exterior masonry surfaces of the structures, removing all traces of moss, dirt, and other contaminants to allow determination of the masonry's color and shades, finish and texture, and other properties.

H. Following completion of the surface cleaning of the structure (or side of structure) the masonry shall be dried prior to the start of any repair work.

I. The following sequence of methods shall be used to determine the least aggressive, effective cleaning method:
   1. Water with brushes.
   2. Water with mild soap.
   3. Water with sodium hypocholorite (household beach).
   4. Water with stronger soap plus vinegar (but not on calcareous masonry).
   5. Stronger chemical cleaners, only when above methods are determined to be ineffective by the Architect.
      a. Acidic chemical cleaners shall not be used on limestone, marble, concrete and other calcareous (calcium containing) masonry materials.

3.03 TEST PATCHES

A. The materials, equipment, and methods to be used in cleaning shall be demonstrated in a test section approximately 3 by 3 ft square.

B. The location of the test section, and the completed test section shall be subject to approval. Adjust the cleaning process as required and the test section rerun until an acceptable process is obtained. Test patches shall be located in inconspicuous areas of the building.

C. The areas tested shall exhibit soiling characteristics representative of those larger areas to be cleaned.

D. Tested areas shall be allowed to dry before a determination is made on the effectiveness of a particular treatment.

3.04 PRESSURE SPRAYING

A. Spray apply water to masonry surfaces to comply with requirements indicated by test patches for location, purpose, water temperature, pressure, volume, and equipment.

B. Unless otherwise indicated, the surface washing shall be done with clean, low pressure water (pressure of less than 55 psi and 2.5 to 3 gpm discharge) and the spray nozzle shall not be held less than 12 inches from surface of masonry.

C. Water shall be applied side to side in overlapping bands to produce uniform coverage.

3.05 HANDSCRUBBING

A. Pre-wetted surfaces shall be scrubbed using hand-held natural bristle or nylon brushes.

B. Wire brushes shall not be used.

3.06 RINSING

A. Scrubbed surfaces shall be rinsed clean of all contaminants and cleaning solutions with water in a low-to-moderate pressure spray, working upwards from bottom to top of each treated area.

B. The rinsing cycle shall remove all traces of contaminants and cleaning solutions.

3.07 MASONRY REPAIR

A. Repaired surfaces shall match adjacent existing surfaces in all respects.

B. Masonry repair shall proceed only after the cause of deterioration has been identified and corrected.

C. Masonry repair shall proceed only after the area to be repaired has been cleaned.

D. The materials, methods and equipment proposed for use in the repair work shall be demonstrated in test panels.

E. The location, number, size and completed test panels shall be subject to approval.

F. Use products in accordance with the manufacturer's instructions.

3.08 REPOINTING

A. Repointing work shall be in accordance with Guidelines for Rehabilitating Historic Buildings: Masonry, Procedure Code 0109106S provided by United States General Services Administration.

B. Deteriorated caulking, grout, or mortar shall be removed from previously repaired cracks where it is failing. Remove loose particles from cracks.

C. Cracks shall be cleaned, rinsed with water followed by blowing with filtered, dry, compressed air.

3.09 MORTAR ANALYSIS

A. Test and analyze existing original historic mortar before repointing in order to provide a match with the new repointing mortar.

B. Historic mortars are usually softer than newer mortars, often using lime as a binder rather than cement. Lime for repointing mortar shall conform to ASTM C 207, Type S, unless otherwise specified.

C. Full laboratory analysis of the existing mortar shall conform to ASTM C 1324.

3.10 TAKING AND PREPARATION OF SAMPLES

A. Take and analyze samples of unweathered original historic mortar and different type of mortar in the structure in order to match the new mortar to be used for repointing.

B. Four samples of each type of mortar to be matched shall be removed with a hand chisel from several locations on each building. Set aside the largest sample for comparison with the repointing mortar.

C. The remaining samples shall be broken apart with a wooden mallet, powdering them into their constituent parts.

3.11 TOOLS AND EQUIPMENT

A. Clean tools and equipment to be used again in the work before the epoxy-resin grout sets.

3.12 HEALTH AND SAFETY PRECAUTIONS

A. Provide full-face shields for mixing, blending, and placing operations as required and protective coveralls and neoprene-coated gloves for workers engaged in the operations.

B. Supply protective creams of a suitable nature for the operation. Adequate fire protection shall be maintained at mixing and placing operations.

C. Smoking or the use of spark- or flame-producing devices shall be prohibited within 50 feet of mixing and placing operations.

3.13 MASONRY REPLACEMENT

A. Replace masonry with salvaged stone from existing building, or approved sources.

B. If a few isolated masonry units are to be replaced, remove each without disturbing the surrounding masonry. Deteriorated masonry units and mortar requiring replacement shall be removed by hand chiselling.

C. Adjoining masonry units shall not be damaged during the removal of deteriorated units and mortar.

D. Test the new element for fitting into its space without mortar. If wedges are used to support and align the new unit, they shall be covered with at least 1-1/2 inches of mortar when pointing is complete.

E. Cover the four sides and back of the space with sufficient mortar to ensure that there will be no air spaces when the new unit is set. The new unit shall be lined up and set by tapping it into place with a wooden or rubber mallet.

F. Align face of new unit with that of existing masonry.

G. Joints shall be repointed to match the rest of the wall after new units have been properly installed and adjusted.

H. Clean replacement areas with a non-metallic brush and water to remove excess mortar.

3.14 MASONRY AND MORTAR FINISHES AND COLOR

A. The exposed surfaces of masonry and mortar repair shall match the finish, color, texture, and surface detail of the original surface.

B. Mechanical finishing and texturing may be required to produce the required finish and appearance.

C. The finishing and texturing shall conceal bond lines between the repaired area and adjacent surfaces. The texturing shall provide replication of all surface details, including tooling and machine marks.

D. The equipment used in finishing and texturing shall be a low-impact energy type which will not weaken the patch or damage the patch bond and the adjacent concrete.

3.15 JOINT SEALING

A. Provide joint sealing as specified in Section 07 0005 JOINT SEALERS.

3.16 FINAL CLEANING

A. No sooner than 72 hours after completion of the repair work and after joints are sealed, faces and other exposed surfaces of masonry shall be washed down with water applied with a soft bristle brush, then rinsed with clean water.

B. Discolorations which cannot be removed by these procedures shall be considered defective work.

C. Perform cleaning work when temperature and humidity conditions allow the surfaces to dry rapidly.

D. Protect adjacent surfaces from damage during cleaning operations.

3.17 FINAL INSPECTION

A. Following completion of the work, inspect the structure for damage, staining, and other distresses. The patches shall be inspected for cracking, crazing, delamination, unsoundness, staining and other defects.

B. The finish, texture, color and shade, and surface tolerances of the patches shall be inspected to verify that all requirements have been met.

C. Repair surfaces exhibiting defects as directed.

END OF SECTION 040140

SECTION 042000
UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete block.

B. Clay facing brick.

C. Common brick.

D. Mortar and grout.

E. Reinforcement and anchorage.

F. Flashings.

G. Lintels.

H. Accessories.

1.02 REFERENCE STANDARDS

A. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.

B. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction; 2012 (Reapproved 2019).

C. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.

D. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale); 2021.

E. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.

F. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.

G. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2017.

H. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls; 2017.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Samples: Submit samples of brick units to illustrate full color, texture, and extremes of color range to match existing exterior brick.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

1.05 MOCK-UPS

A. Construct a masonry wall as a mock-up panel sized 6 feet long by 4 feet high; include mortar, accessories, structural backup, and flashings (with lap joint, corner, and end dam) in mock-up The approved sample panel shall be standard of workmanship.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

A. Concrete Block: Comply with referenced standards and as follows:
   1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depth

of 8 inches.

2.02 BRICK UNITS

A. Manufacturers:
   1. Belden Brick; _____: www.beldenbrick.com/#sle.
   2. Endicott Clay Products Co; Face Brick - FBX: www.endicott.com/#sle.
   3. General Shale Brick; _____: www.generalshale.com/#sle.
   4. Meridian Brick LLC; Athens Architectural Series: www.meridianbrick.com/#sle.
   5. Pacific Clay Products Inc; ____: www.pacificclay.com/#sle.
   6. Yankee Hill Brick Mfg. Co; ____: www.yankeehillbrick.com/#sle.
   7. Acme Brick Company; https://brick.com/.
   8. Substitutions: See section 016000 - Product Requirements.

B. Facing Brick: ASTM C216, Type FBS Smooth, Grade SW.
   1. Color and texture: Match existing.
   2. Nominal size: Match existing.
   3. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.

2.03 MORTAR AND GROUT MATERIALS

A. Hydrated Lime: ASTM C207, Type S.

B. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
   1. Color(s): Match existing.

2.04 REINFORCEMENT AND ANCHORAGE

A. Manufacturers:
   1. Hohmann & Barnard, Inc; X-Seal Anchor: www.h-b.com/#sle.
   2. Heckman Bldg. Products.
   3. Substitutions: See Section 016000 - Product Requirements.

2.05 FLASHINGS

A. Metal Flashing Materials:
   1. Copper Flashing: ASTM B370, 060 soft annealed; 20 oz/sq ft thick; natural finish.
   2. Stainless Steel Flashing: ASTM A666/A666M, Type 304, soft temper; 26 gauge, 0.0187 inch thick; finish 2B to 2D.

2.06 ACCESSORIES

A. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self expanding; in maximum lengths available.

B. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
   1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.

C. Weeps: Open head joints every third brick at lintels and other locations.
   1. Type: Molded PVC grilles, insect resistant.
   2. Color(s): Match existing grout joint color.

D. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.07 LINTELS

A. Prefabricated Steel Lintels:
   1. Manufacturers:
      a. FERO Corporation; FERO Engineered Concealed Lintel Systems: www.ferocorp.com/#sle.
      b. Hohmann & Barnard, Inc; Engineered Concealed Lintel Systems: www.h-b.com/#sle.

c. Substitutions: See Section 016000 - Product Requirements.

2.08 MORTAR AND GROUT MIXING

A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COURSING

A. Establish lines, levels, and coursing to match existing. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Concrete Masonry Units:

D. Brick Units:

3.04 WEEPS/CAVITY VENTS

A. Install weeps in veneer and cavity walls at 24 inches on center horizontally on top of through-wall flashing above shelf angles and lintels and at bottom of walls.

3.05 CAVITY MORTAR CONTROL

A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.

B. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.06 MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.

B. Terminate flashing up 8 inches minimum on vertical surface of backing:

C. Install flashing in accordance with manufacturer's instructions and BIA Technical Notes No. 7.

D. Extend metal flashings through exterior face of masonry and terminate in an angled drip with hemmed edge. Install joint sealer below drip edge to prevent moisture migration under flashing.

3.07 LINTELS

A. Install loose steel lintels over openings.

B. Maintain minimum 6 inch bearing on each side of opening.

3.08 CLEANING

A. Remove excess mortar and mortar droppings.

B. Clean soiled surfaces with cleaning solution.

3.09 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION 042000

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SECTION 053100
STEEL DECKING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof deck.

1.02 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittals procedures.

B. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.

PART 2 PRODUCTS

2.01 STEEL DECK

A. Roof Deck: Non-composite type, fluted steel sheet:

END OF SECTION 053100

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SECTION 054000
COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Formed steel stud exterior wall framing.

1.02 REFERENCE STANDARDS

A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2016, with Supplement (2020).

B. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).

C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

D. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.

E. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.

F. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on cold-formed steel structural members; include material descriptions and base steel thickness.

C. Design Data:

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Design Requirements: Design cold-formed framing systems, components and connectors to withstand specified design loads in compliance with ICC (IBC), ASCE 7, AISI S100, and AISI S240.

B. Design Criteria: In accordance with applicable codes.
   1. Live load deflection meeting the following, unless otherwise indicated:
   2. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
   3. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

2.02 MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S240.

2.03 STRUCTURAL FRAMING COMPONENTS

A. Wall Studs and Track Sections: AISI S240; c-shaped studs and u-shaped track sections in stud-matching nominal width and compatible height.

2.04 CONNECTIONS

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that abutting building framing components are ready to receive work.

3.02 INSTALLATION - GENERAL

A. Install structural members and connections in compliance with ASTM C1007.

3.03 INSTALLATION OF STUDS

A. Install wall studs plumb and level.

B. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.

C. Install load-bearing studs full length in one piece. Splicing of studs is not permitted.

D. Install load-bearing studs; brace, and reinforce to develop full strength and achieve design requirements.

E. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.

F. Install intermediate studs above and below openings to align with wall stud spacing.

G. Provide deflection allowance in stud track, directly below horizontal building framing at non-loadbearing framing.

END OF SECTION 054000

SECTION 055213
PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Stair railings and guardrails.

B. Free-standing railings at steps.

1.02 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Handrails and Railings:
   1. Alumi-Guard; ____: www.alumi-guard.com/#sle.
   2. ATR Technologies Inc; Aluminum Multi-Line Railing: http://www.atr-technologies.com/#sle.
   3. Avcon Railing Systems; Presidential Aluminum: www.avcon.com/#sle.
   4. Kane Innovations; ____: www.kaneinnovations.com/#sle.
   5. Patriot Custom Metals DBA PalmSHIELD; _____: www.palmshieldlouvers.com/#sle.
   6. The Wagner Companies; ____: www.wagnercompanies.com/#sle.
   7. Worthington Millwork LLC; _____: www.worthingtonmillwork.com/#sle.

2.02 RAILINGS - GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.

B. Allow for expansion and contraction of members and building movement without damage to connections or members.

C. Dimensions: See drawings for configurations and heights.

D. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.

E. Provide slip-on non-weld mechanical fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.03 STEEL RAILING SYSTEM

A. Non-Weld Mechanical Fittings: Slip-on, galvanized malleable iron castings, for Schedule 40 pipe, with flush setscrews for tightening by standard hex wrench, no bolts or screw fasteners.

B. Exposed Fasteners: No exposed bolts or screws.

2.04 FABRICATION

A. Accurately form components to suit specific project conditions and for proper connection to building structure.

B. Fit and shop assemble components in largest practical sizes for delivery to site.

C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.

C. Anchor railings securely to structure.

END OF SECTION 055213

SECTION 060300
CONSERVATION TREATMENT FOR PERIOD WOOD

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Repair of damaged wood components.

B. Replacement of damaged wood components.

C. Removal of existing wood finishes and refinishing.

1.02 DEFINITIONS

A. Consolidant: Chemical product to strengthen loose or deteriorated wood.

B. Dutchman: Repair method in which deteriorated wood component is removed in part and replaced with salvaged, harvested, or new wood.

C. In situ: Repair procedure in which wood elements and components remain in place and are repaired without removal from the system they are a part of.

D. New Elements: New, nonhistoric materials added to wood structures to aid in resistance to structural loads or water infiltration.

E. Patch: Use of substitute repair materials to treat damaged or deteriorated components in situ.

F. Surface Treatment: Application of traditional materials or contemporary chemical products to the surface of wood components to provide protection and reduce water infiltration.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Samples: Submit four samples of replacement units to show matching color, texture, and finish.

PART 2 PRODUCTS

2.01 REPLACEMENT ROUGH CARPENTRY MATERIALS

A. Sizes: Nominal sizes as indicated on drawings, S4S.

B. Moisture Content: S-dry or MC19.

C. Wood fabricated from old growth timber is not permitted.

D. Provide sustainably harvested wood; see Section 016000 - Product Requirements for requirements.

E. Lumber and timbers salvaged from deconstruction of existing buildings or structures are permitted in lieu of sustainably harvested lumber, clean, without nails, and free of paint and finish materials and other contamination; identify source.

F. Lumber and timbers fabricated from recovered timber, timber previously abandoned in transit to riverbeds or lakes, are permitted in lieu of sustainably harvested lumber, unless indicated otherwise.

2.02 REPLACEMENT FINISH CARPENTRY MATERIALS

A. Wood or Wood-Based Materials:
   1. Wood fabricated from old growth timber is not permitted.
   2. Provide sustainably harvested wood, certified or labeled; see Section 016000 - Product Requirements.

2.03 PAINT REMOVERS

A. Manufacturers:
   1. American Building Restoration Products, Inc; _____: www.abrp.com/#sle.
   2. Dumond Chemicals, Inc; _____: www.dumondchemicals.com/#sle.
   3. PROSOCO, Inc; _____: www.prosoco.com/#sle.

B. Water-Based: Formulated without methylene chloride or methanol and intended for removal of multiple coats of oil-based, water-based, acrylic-based, epoxy-based, urethane-based, elastomeric, and lead-based paints.
   1. Formulation: Thixotropic paste or gel.
   2. Neutral Types: 5.5 pH.
   3. Acidic Type: 2.1 pH.
   4. Surface Neutralization after Use: Not required.

C. Solvent Based: Formulated without chlorinated solvents, acids, and caustics for removal of multiple coats of oil-based, water-based, acrylic-based, epoxy-based, urethane-based, elastomeric, and lead-based paints and lacquers and enamels.
   1. Formulation: Thixotropic paste or gel.
   2. Neutral Types: 8.02 pH.
   3. Alkaline Types: 14.0 pH.
   4. Surface Neutralization After Use: Not required.

D. Methylene Chloride Based: For removal of multiple coats of oil-based, water-based, acrylic-based, epoxy-based, urethane-based, elastomeric, and lead-based paints.
   1. Viscosity: Thixotropic paste or gel.
   2. Temperature at Application: Coating and substrate temperature must be between 65 degrees F and 85 degrees F at time of application.
   3. Surface Neutralization After Use: Not required.

2.04 WOOD REPAIR MATERIALS

A. Source Limitations: Obtain compatible consolidants and patching and filling compounds from single manufacturer.

B. Consolidants:
   1. Water Based: Single-component, low-viscosity adhesive to penetrate and restore deteriorated wood.
   2. Epoxy Based: Two-component clear epoxy liquid system to penetrate and restore deteriorated wood.

C. Patching and Filling Compounds:
   1. Epoxy Based: Two-part, adhesive system designed to fill voids in wood and be painted, stained, sawed, nailed, planed, sanded carved, and machined like wood.

END OF SECTION 060300

SECTION 061000
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Rough opening framing for doors, windows, and roof openings.

B. Preservative treated wood materials.

C. Miscellaneous framing and sheathing.

D. Concealed wood blocking, nailers, and supports.

E. Miscellaneous wood nailers, furring, and grounds.

1.02 RELATED REQUIREMENTS

A. Section 092116 - Gypsum Board Assemblies: Gypsum-based sheathing.

1.03 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

B. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.

C. AWPA U1 - Use Category System: User Specification for Treated Wood; 2025.

D. PS 20 - American Softwood Lumber Standard; 2021.

E. WWPA G-5 - Western Lumber Grading Rules; 2025.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide technical data on insulated sheathing, wood preservative materials, and application instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. Species: Douglas Fir-Larch, unless otherwise indicated.
   2. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
   3. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
   4. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Grading Agency: Western Wood Products Association; WWPA G-5.

B. Sizes: Nominal sizes as indicated on drawings, S4S.

C. Moisture Content: S-dry or MC19.

D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade.
   2. Boards: Standard or No. 3.

2.03 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
   2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.

2.04 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
   1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
   2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

B. Preservative Treatment:
   1. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
      a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
      b. Treat lumber in contact with masonry or concrete.
      c. Treat lumber in other locations as indicated.

PART 3 EXECUTION

3.01 PREPARATION

A. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to authorities having jurisdiction may be used in lieu of solid wood blocking.

C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

F. Provide the following specific nonstructural framing and blocking:
   1. Cabinets and shelf supports.
   2. Wall brackets.
   3. Handrails.

4. Grab bars.
5. Towel and bath accessories.
6. Wall-mounted door stops.
7. Chalkboards and marker boards.
8. Wall paneling and trim.
9. Joints of rigid wall coverings that occur between studs.

3.04 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.05 CLEANING

A. Waste Disposal: See Section 017419 - Construction Waste Management and Disposal.
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 061000

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SECTION 062000
FINISH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Finish carpentry items.

B. Wood door frames, glazed frames.

C. Wood casings and moldings.

1.02 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Support framing, grounds, and concealed blocking.

B. Section 064100 - Architectural Wood Casework: Shop fabricated custom cabinet work.

C. Section 081433 - Stile and Rail Wood Doors.

D. Section 085200 - Wood Windows.

E. Section 099113 - Exterior Painting: Painting of finish carpentry items.

F. Section 099123 - Interior Painting: Painting of finish carpentry items.

G. Section 099300 - Staining and Transparent Finishing: Staining and transparent finishing of finish carpentry items.

1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).

C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.

E. BHMA A156.9 - Cabinet Hardware; 2020.

F. PS 20 - American Softwood Lumber Standard; 2021.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.

B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data:
   1. Provide manufacturer's product data, storage and handling instructions for factory-fabricated units.

C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
   1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.

D. Samples: Submit two samples of wood trim 12 inch long.

1.06 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
   1. Company with at least five projects within the past 5 years with value of woodwork within 20 percent of cost of woodwork for this project.

2. Single Source Responsibility: Provide and install this work from single fabricator.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect from moisture damage.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

A. Surface Burning Characteristics: Provide materials having fire and smoke properties as required by applicable code.

B. Exterior Woodwork Items:
   1. Window Casings and Moldings: Hardwood; prepare for paint finish.

C. Interior Woodwork Items:
   1. Moldings, Bases, Casings, and Miscellaneous Trim: Match existing species; prepare for stain finish.
   2. Door, Glazed Light, and Pocket Door Frames: Match existing species; prepare for stain finish.
   3. Window Sills: Match existing species; prepare for stain finish.

2.02 FASTENINGS

A. Fasteners: Of size and type to suit application; zinc finish in concealed locations and zinc finish in exposed locations.

2.03 ACCESSORIES

A. Lumber for Shimming and Blocking: Softwood lumber of suitable species.

B. Safety Glass: Laminated glass complying with 16 CFR 1201 and ANSI Z97.1; clear; nominally 6 mm thick.

C. Primer: Alkyd primer sealer.

D. Wood Filler: Solvent base, tinted to match surface finish color.

2.04 FABRICATION

A. Shop assemble work for delivery to site, permitting passage through building openings.

B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

2.05 SHOP FINISHING

A. Sand work smooth and set exposed nails and screws.

B. Apply wood filler in exposed nail and screw indentations.

C. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended for the applicable finish.

D. Stain, seal, and varnish exposed to view surfaces. Brush apply only.

E. Prime paint surfaces in contact with cementitious materials.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.02 INSTALLATION

A. Set and secure materials and components in place, plumb and level.

B. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.

3.03 PREPARATION FOR SITE FINISHING

A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.

B. Site Finishing: See Section 099113 and 099123.

C. Before installation, prime paint surfaces of items or assemblies to be in contact with cementitious materials.

3.04 TOLERANCES

A. Maximum Variation from True Position: 1/16 inch.

B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

END OF SECTION 062000

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SECTION 064100
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specially fabricated cabinet units.

B. Countertops.

C. Hardware.

1.02 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Support framing, grounds, and concealed blocking.

B. Section 099300 - Staining and Transparent Finishing: Field finishing of cabinet exterior.

C. Section 123600 - Countertops.

1.03 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.

C. BHMA A156.9 - Cabinet Hardware; 2020.

D. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
   1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
   2. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).

C. Product Data: Provide data for hardware accessories.

D. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches square, illustrating proposed cabinet, countertop, and shelf unit substrate and finish.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

1.06 MOCK-UPS

A. See Section 014000 - Quality Requirements for additional requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect units from moisture damage.

1.08 FIELD CONDITIONS

A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 CABINETS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Cabinets at Break Room:
   1. Finish - Exposed Surfaces: Wood, stained, rotary cut, book-matched.
   2. Finish - Semi-Exposed Surfaces: Wood, stained, rotary cut, random-matched.
   3. Cabinet Design Series: As indicated on drawings.

4. Adjustable Shelf Loading: 40 psf.
5. Cabinet Style: Reveal overlay.
6. Cabinet Doors and Drawer Fronts: Stile and rail, raised panel style.
7. Drawer Side Construction: Multiple-dovetailed.
8. Drawer Construction Technique: Dovetail joints.

2.02 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

2.03 COUNTERTOPS

A. Countertops: See Section 123600.

2.04 HARDWARE

A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.

B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch spacing adjustments.

C. Drawer and Door Pulls: "U" shaped wire pull, bronze with satin finish, 4 inch centers.

D. Keyed Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, bronze with satin finish.

E. Cabinet Catches and Latches:

F. Drawer Slides:
1. Type: Extension types as indicated.
2. Static Load Capacity: Commercial grade.
3. Mounting: Side mounted.
4. Stops: Integral type.
5. Features: Provide self closing/stay closed type.

G. Soft-Close, Door and Drawer Adjustable Dampers:

H. Hinges: European style concealed self-closing type, bronze with satin finish.

2.05 SHOP TREATMENT OF WOOD MATERIALS

A. Provide UL (DIR) listed and approved identification on fire retardant treated material.

B. Deliver fire retardant treated materials cut to required sizes. Minimize field cutting.

2.06 SITE FINISHING MATERIALS

A. Stain, Shellac, Varnish, and Finishing Materials: In compliance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Finishing: Field finished, see Section 099300.

2.07 FABRICATION

A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.

D. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

2.08 SHOP FINISHING

A. Sand work smooth and set exposed nails and screws.

B. For opaque finishes, apply wood filler in exposed nail and screw indentations and sand smooth.

C. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.

B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.

C. Use concealed joint fasteners to align and secure adjoining cabinet units.

D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

E. Secure cabinets to floor using appropriate angles and anchorages.

F. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.03 ADJUSTING

A. Adjust installed work.

B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION 064100

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SECTION 071416
SIKALASTIC® HLM 5000 GC

SECTION 07 14 16

1.01 REFERENCE STANDARDS

A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).

B. ISO 9001 - Quality Management Systems — Requirements; 2015, with Amendment (2024).

PART 1 – GENERAL

2.01 SUMMARY

A. Section Includes
   1. Application of cold fluid-applied waterproofing.

B. Related Sections:
   1. Section 03 30 00 – Cast-In-Place Concrete.
   2. Section 04 20 00 – Unit Masonry.
   3. Section 07 92 00 – Joint Sealants.

TWO SYSTEMS AVAILABLE; HIGH BUILD VALUES ARE SLIGHTLY DIFFERENT THAN VALUES LISTED BELOW. MODIFY ACCORDINGLY.

3.01 SYSTEM DESCRIPTION

3.02 SUBMITTALS

A. Comply with Section 01 33 00.

B. Product Data: Submit manufacturer's technical bulletins and SDS on each product.

C. LEED Submittals: Comply with requirements for each product to achieve points indicated in LEED Project Checklist provided by the Architect/Engineer.

D. Submit list of project references as documented in this Specification under Quality Assurance Article. Include contact name and phone number of the person charged with oversight of each project.

E. Quality Control Submittals:
   1. Provide protection plan of surrounding areas.

3.03 QUALITY ASSURANCE

A. Comply with Section 01 40 00.

B. Qualifications:
   1. Applicator: Minimum of 5 years' experience in application of similar systems and products on projects of
      a. similar size and scope.
         1) Successful completion for a minimum of 5 projects of similar size and complexity to specified Work.
   2. Manufacturer Qualifications: Company shall be ISO 9001:2015 Certified.
   3. Manufacturer: Minimum 15 years of experience in manufacturing of high build coatings.

C. Field Sample:

PART 2 – PRODUCTS

4.01 MANUFACTURERS

A. Subject to compliance with requirements, provide products from the following manufacturer:
   a. Sika Corporation St. Louis,
   b. 3400 Tree Court Industrial Boulevard, St. Louis, MO 63122;
   c. Phone: 800-325-9504;
   d. Fax: 800-551-5145;

e. E-mail: info@greenstreak.com; Website: usa.sika.com

B. Substitutions: Not permitted.

C. Specifications and drawings are based on manufacturer's proprietary literature from Sika Corporation. Architect/Engineer will be sole judge of appropriateness of substitutions.

4.02 MATERIALS

A. A one-component, moisture-curing, bitumen-modified polyurethane, elastomeric waterproofing membrane for exterior below-grade or between slab applications.
   a. Acceptable Product: Sikalastic® HLM 5000 GC by Sika Corporation.

B. Performance Requirements: The following properties are based on product's standard system.
   a. Compliances:
      1) ASTM C836
      2) National Standard of Canada 37.58 – M86 developed by CGSB.
   b. Minimum Recovery: 90 percent.
   c. Swelling in Water (3 days at room temperature): None.
   d. Service Temperature Range:
      1) Minimum: Minus 40 degrees Fahrenheit.
      2) Maximum: 120 degrees Fahrenheit.
   e. Hardness, Shore OO: 85, ASTM C836.
   f. Tensile Strength: 150 psi, ASTM D412.
   g. Average Elongation: 600 percent, ASTM D412.
   h. 100% Modulus: 80 psi, ASTM D412.
   i. Moisture-Vapor Permeability (dry perms): ??? 0.1, ASTM E96.
   j. Crack Bridging Test: Passed 1/16 inch, ASTM C836.
   k. Extensibility After Heat Aging: No cracking, ASTM C836.
   l. Weight Loss (20 percent maximum): 16 percent, ASTM C836.

C. Color: Black.

4.03 ACCESSORIES

A. MasterSeal 995 & Masterseal 996: A reinforcing fabric is available for high-build systems requiring multiple coats of the Sikalastic® HLM 5000 GC.

B. MasterSeal 977: A fiberboard sheet impregnated with water repellant material in 50 mils and 120 mils thicknesses.

C. Sika Drainage Mat 420 / 720 / 1000: Prefabricated drainage composite with high flow dimpled core and high crush resistant geonet constructions.

PART 3 – EXECUTION

5.01 EXAMINATION

A. Comply with Section 01 70 00.
   1. SURFACE PREPARATION

B. Lightly steel trowel concrete deck to flat, uniform surface. Light broom finish is acceptable. Properly cure new concrete for a minimum of 72 hours. Mechanically remove concrete curing compounds.

C. For extremely porous block, apply parge coat of cementitious block filler or prime with a coat of waterproofing membrane diluted up to 25 percent with reducer recommended by membrane manufacturer. Apply
   1. cementitious block filler at a rate of approximately 400 sq feet per bag for parge coat. Allow curing minimum of 7 days before applying waterproofing membrane.

D. Patch voids and deep depressions in substrates with appropriate patching material before applying waterproofing membrane.

E. Before applying waterproofing membrane, dam drains and drain openings.

F. Carefully work material over irregular concrete to avoid pinholes and holidays.

G. Remove dust, dirt and other contaminants just before or during application.

H. Open air-void pockmarks or honeycombs to allow waterproofing membrane to fill cavities completely. Air entrapment within voids may cause blisters. Extreme cases may require a parge coat.

5.02 PRESTRIPING

A. Before applying final membrane, seal joints, cracks, and openings around protrusions by caulking or prestriping (a preliminary coating of waterproofing membrane applied with trowel or stiff bristled brush). Allow drying overnight before applying final membrane.

B. When final membrane is applied, verify overall thickness over joints and cracks, at coves, and around penetrations of approximately 100 wet mils 0.1 inch on standard system, or approximately 200 wet mils on high build system.

C. Static Joints and Cracks: Fill joints and cracks less than 1/16 inch by prestriping. Apply material so it both fills and overlaps joint or crack to 4-inch (4.02 inch) width on each side.

D. Working or Expansion Joints:

1) Seal joints over 1/8 inch with joint sealant. Rout moving joints less than 1/8-inch (0.12 inch) to 1/8-inch (3 mm) minimum and fill with joint sealant. Prevent waterproofing membrane from adhering to joint sealant, which could cause sealant or membrane failure, by applying coat of wax or PTFE tape over cured sealant and then prestriping.
   (a) Metal:
2) Clean metal to bright metal by wire brush or sandblast. Prime with quality rust-inhibiting metal primer before application of waterproofing membrane.
   (a) Vent, Drain Pipe, and Post Penetrations:
3) Clean metal surfaces to bright metal and prime with quality rust-inhibiting metal primer. Remove dust, debris, and other contaminants from voids. Seal with appropriate joint sealant.
4) Seal openings exceeding 1/8 inch with joint sealant. Next, prestripe to 4-inch (4.02 inch) minimum width on base slab and continue up penetration to height of top-course wearing surface.
   (a) APPLICATION
      (1) Standard System:
5) For horizontal applications, empty contents of pail and spread immediately to ensure workability. Best results are obtained by marking off 125 sq foot areas and evenly spreading contents of 5-gallon (18.93 L) unit with rubber-edged notched squeegee. Repeat above procedure until entire surface is covered.
6) For vertical applications, apply roller at rate of 25 sq feet per gallon (0.6 square m per L). Best results are obtained by marking off 125 sq foot areas and evenly applying contents of 5 gallon (18.93 L) pail.
7) Verify applied thickness with wet mil gauge as Work progresses.
      (1) High-Build System:
8) Concrete Substrate: Apply 60 wet mils (1.5 mm) of waterproofing membrane, followed by setting reinforcing fabric into wet material. Overlap seams 3 inches minimum. Additional material may be required to properly embed reinforcing fabric where it overlaps. Allow first coat to cure overnight and follow with second 60 wet-mil (1.5 mm) application of waterproofing membrane.
9) Plywood Substrate: Comply with APA (American Plywood Association) standards for plywood construction. Seal joints with recommended joint sealant then proceed with waterproofing membrane high-build system.
   (a) INSTALLATION OF PROTECTION COURSE
      (1) Install protection layer as soon as possible following cure of membrane. Protect membrane from traffic before placement of

protection layer. Ensure waterproofing membrane has cured before installation of topping.

(b) CURING
  (1) Appreciable properties develop within 24 to 48 hours at 75 degrees Fahrenheit and 50 precent relative humidity. Protect waterproofing membrane from traffic during curing.

(c) Drainage and Protection:
  (1) For protection during backfill and where hydrostatic pressure is anticipated, use appropriate drain board system.
  (2) For protection during backfill only, install protection layer as soon as possible following cure of waterproofing membrane.

(d) FIELD QUALITY CONTROL
  (1) Site tests:
  (2) Test integrity of cured membrane on horizontal surface by damming entire area and flooding with water to minimum depth of 2 inches. Allow water to stand for 24 to 48 hours. Visually inspect bottom surface to check for water penetration. If repairs are necessary, drain area and allow drying before reapplying waterproofing membrane. After reapplication, test area again for membrane integrity. Repeat procedure until no leaks appear in membrane.

(e) CLEANING AND PROTECTION
  (1) Remove temporary coverings and protection from adjacent work areas. Clean up areas not to be coated of over-spray and droppings. Remove construction debris from project site.

(f) Clean tools and equipment immediately after application with manufacturer’s recommended cleaning solution.

END OF SECTION

DISCLAIMER:

THE INFORMATION, AND, IN PARTICULAR, THE RECOMMENDATIONS RELATING TO THE APPLICATION AND END-USE OF SIKA PRODUCTS, ARE GIVEN IN GOOD FAITH BASED ON SIKA'S CURRENT KNOWLEDGE AND EXPERIENCE OF THE PRODUCTS WHEN PROPERLY STORED, HANDLED AND APPLIED UNDER NORMAL CONDITIONS IN ACCORDANCE WITH SIKA'S RECOMMENDATIONS. IN PRACTICE, THE DIFFERENCES IN MATERIALS, SUBSTRATES AND ACTUAL SITE CONDITIONS ARE SUCH THAT NO WARRANTY IN RESPECT OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE, NOR ANY LIABILITY ARISING OUT OF ANY LEGAL RELATIONSHIP WHATSOEVER, CAN BE INFERRED EITHER FROM THIS INFORMATION, OR FROM ANY WRITTEN RECOMMENDATIONS, OR FROM ANY OTHER ADVICE OFFERED. THE USER OF THE PRODUCT MUST TEST THE PRODUCT’S SUITABILITY FOR THE INTENDED APPLICATION AND PURPOSE. SIKA RESERVES THE RIGHT TO CHANGE THE PROPERTIES OF ITS PRODUCTS. THE PROPRIETARY RIGHTS OF THIRD PARTIES MUST BE OBSERVED. ALL ORDERS ARE ACCEPTED SUBJECT TO OUR CURRENT TERMS OF SALE AND DELIVERY. USERS MUST ALWAYS REFER TO THE MOST RECENT ISSUE OF THE LOCAL PRODUCT DATA SHEET FOR THE PRODUCT CONCERNED, COPIES OF WHICH WILL BE SUPPLIED ON REQUEST.

8.01 SIKA CORPORATION - USA

8.02 201 POLITO AVENUE

8.03 LYNDHURST, NJ 07071 UNITED STATES USA.SIKA.COM

SECTION 081433
STILE AND RAIL WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wood doors, stile and rail design; fire rated and non-fire rated.

B. Panels of wood and glass.

1.02 RELATED REQUIREMENTS

A. Section 062000 - Finish Carpentry: Wood door frames.

B. Section 099300 - Staining and Transparent Finishing: Field finishing.

1.03 REFERENCE STANDARDS

A. AWI (QCP) - Quality Certification Program; Current Edition.

B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.

D. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Indicate stile and rail core materials and construction; veneer species, type and characteristics.

C. Shop Drawings: Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required, special beveling, special blocking for hardware, factory machining criteria, factory finishing criteria, cutouts for glazing, and cutouts for louvers.

D. Samples: Submit two samples of door construction, 12 by 12 inches in size cut from top corner of door.

E. Manufacturer's qualification statement.

F. Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.

1. Company with at least one project within past five years with value of woodwork within at least 20 percent of cost of woodwork for this project.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package, deliver, and store doors in accordance with quality standard specified.

B. Accept doors on site in manufacturer's packaging, and inspect for damage.

C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Interior Doors: Provide manufacturer's warranty for the life of the installation.

C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 DOORS

A. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless otherwise indicated.

B. Interior Doors: 1-3/8 inches thick unless otherwise indicated; solid lumber construction; mortise and tenon joints. stained finish as indicated on drawings.

2.02 DOOR AND PANEL FACINGS

A. Adhesive: Type I - Waterproof.

2.03 DOOR CONSTRUCTION

A. Bond edge banding to cores.

B. Panels: Flat.

C. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.

D. Factory install glazing in doors in compliance with quality standards specified, using manufacturer's standard elastomeric glazing sealant.

2.04 ACCESSORIES

A. Glazed Openings:

B. Panel or Glass Retention Molding: Wood of same species as door facing, flat bead stop, with butted corners; prepared for countersink style tamper proof screws.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out of tolerance for size or alignment.

3.02 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standards.

B. Field-Finished Doors: Trimming to fit is acceptable.
   1. Adjust width of non-rated doors by cutting equally on both jamb edges.
   2. Trim door height by cutting bottom edges to a maximum of 3/4 inch.
   3. Trim fire-rated doors in strict compliance with fire rating limitations.

C. Machine cut for hardware.

D. Coordinate installation of doors with installation of frames and hardware.

3.03 TOLERANCES

A. Comply with specified quality standard for fit, clearance, and joinery tolerances.

B. Maximum Width Distortion (Cup): 1/8 inch measured with straight edge or taut string, edge to edge, over an imaginary 36 by 84 inch surface area.

3.04 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

3.05 SCHEDULE

A. See Door and Frame Schedule appended to this section.

END OF SECTION 081433

SECTION 086100
WINDOW RESTORATION AND REPLICATION

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. Window work is defined as three general types, 1) Replicate, 2) Repair, and 3) Prepare and Paint:
   1. Replicate: Reconstruction of windows in their entirety.
      a. Replace existing windows with newly constructed wood windows as detailed on Drawings.
   2. Repair: Including all Scope of Work in Prepare and Paint and also, Replace damaged or deteriorated window elements with new components, including but not limited to:
      a. Replace deteriorated elements as indicated on Window Schedules on the Drawings.
      b. Reinforce, straighten and align, sagging or warping upper sash meeting rail/lower sash bottom rails.
      c. Replace sash members meeting rail requiring replacement with a new as noted on schedules.
      d. Realign and reglue loose sash joints.
      e. Set nails in sash, frame, or trim members not fully set and fill resulting holes with epoxy patch.
      f. Replacement of structurally damaged sash sections as well as various elements of the window frame and trim.
      g. Small areas of decayed wood shall be removed and the area epoxy patched/consolidated. If 10% or more of the element is rotted, replace entire element.
      h. Elements missing in their entirety (e.g. a window sill, parting stop, etc.) shall be replaced.
      i. Broken glass shall be replaced.
      j. Renovation of structurally damaged sash sections not to be replaced as well as designated elements of the window frame and trim:
         1) Repair as necessary, damaged elements, including chips, gouges, and splits, which hold water, allow water to penetrate, or which would tend to accelerate deterioration, to promote rapid runoff of water and eliminate pounding water within 1 hour of precipitation.
         2) Remove non-original elements and resultant holes patched (e.g. surface applied weather-stripping, eyehooks reinforcing angles at sash joints, sheet metal patches at rotten wood jamb/sill, wood blocks holding up upper sash, etc.)
         3) Reinforce, straighten and realign sagging or warped upper sash meeting rail/lower sash bottom rail.
         4) Replace upper sash meeting rails requiring replacement.
         5) Realign and reglue loose sash joints.
         6) Repair damaged existing weather-stripping to remain.
      k. Coordination of replacement of missing, cracked, and/or damaged glass:
         1) Reglaze, using existing glass, at sash indicated to receive structural repairs or joint realignment. Seal sash glazing groove continuously inside and out with specified sealant and glazing compound.
      l. With the completion of the work specified in this section, it is required that the condition of indicated windows be as follows:
         1) Selected sash units shall be restored as indicated ready for glazing and painting, all lower sash fully operational, with original or replicated hardware installed. Upper sash shall be fixed as indicated and sealed to prelude air and water penetration.
         2) Selected frame and trim shall be restored as indicated with damaged areas replaced or renovated, missing elements replaced, surface damage repaired

and ready for painting or finishing and installation of sealant.

3) Indicated meeting rail sections shall be reinforced with metal and bow removed from wood section.

4) Weather-stripping of operable sash shall be restored, reworked, or replaced as indicated to produce no crack widths at sash junctures to frame in excess of 1/64".

m. Exposed Replacement Hardware:

1) Provide each restored window with full complement of hardware and fasteners matching that on original windows. Use salvaged, restored existing hardware insofar as possible and new hardware to match existing hardware where hardware is missing or existing hardware is damaged or deteriorated so as to be unrestorable.

3. Prepare and Paint: Replacing weatherstripping, sash cords, and sash weights with new components to make windows fully operable prior to application of paint.
   a. Replace all weatherstripping on all windows.
   b. Replacement of all sash cords and damaged weights on all windows.
   c. Paint removal and general repair to selected historic wood window assemblies, including removal of wood window elements as required to effect restoration and alterations.
   d. Finish painting: Applying paint system on all wood windows. On existing windows, minor chips and gouges, need not be repaired, except as accomplished by general preparation for painting.
   e. Refer Window Schedules on the Drawings for windows requiring painting.
   f. Fill screw and nail holes with epoxy patch.

1.02 QUALITY ASSURANCE

A. General:
   1. Comply with repair guidelines contained in Preservation Briefs number 9, The Repair of Historic Wooden Windows, published by the U.S. Dept. of Interior and available from the Preservation Assistance Division. (202-343-9573)
   2. Comply with the general requirements for epoxy consolidation and repair of wood contained in Epoxies for Wood Repairs in Historic Buildings, published by the U.S. Dept. of the Interior and available from the Preservation Assistance Division. (202-343-9573)
   3. Qualified Manufacturer: To function as Contractor's Specialist for documentation of unit price work and to perform, modifications and repairs on historic window sash indicated to be removed and on window units indicated to be restored to operational condition, employ a specialized firm with not less than five years of previous experience replicating or remanufacturing historic wood windows.
   4. Installer Qualifications: Restoration work done shall be performed by a firm with successful experience in similar work on not less than five complete previous projects comparable to this project in historic reconstruction/ repair scope, nature, and complexity. Workmen shall be skilled finish carpenters (where applicable), and experienced in the type of historical repair work required. Submit references with name of contact person and telephone number for the two (2) submitted similar projects.
      a. Only skilled workers who are familiar and experienced with the methods specified for consolidation, fill, and replication of new elements are to be used for wood door and frame restoration.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's data sheets for every item of specified weather-stripping and window accessories.

1.04 PROJECT/SITE CONDITIONS

A. Remove and replace existing window sash element, frames, mullions, muntins, casings, sills, stools, aprons, and trim, or portions thereof, where:
   1. Indicated.

2. Identified as damaged beyond repair during examination by Contractor's repair specialist and approved by Owner's representation.
3. Damaged beyond repair during the Work under this Contract.

B. Remove and replace entire sash unit, reglazed with original glass, and finished as indicated, where:
1. Indicated.
2. Required restoration procedures are so extensive that replacement is considered more practical by specialist and Owner's representative concurs.

C. Contractor shall establish, during initial inspection of each work area with Owner's representative and Architect which sash units shall be completely replaced.

D. Sash removal may be required to perform the following repair procedures:
1. Reinforce or replace warped sash rails.
2. Repair, realign sash joints separated in excess of 1/8" cumulative across the width of window on operable window sash.
3. Replace missing weather-stripping on operable windows.
4. Adjust, repair, or replace weather-stripping on operable windows.
5. Repair or replace sash weights and chain on operable windows.
6. Where it is necessary to remove original sash to perform repair procedures, mark sash and frame in a concealed location with waterproof, non-staining to exposed surfaces marker with unique number for frame and corresponding sash element. Install restored sash at the same location from which it was removed.

E. Removal of existing glass and reinstallation (reglazing with existing glass) is required where interior wood stops are altered or replaced.

F. Coordinate glass and glazing work as follows:
1. Where window sashes are to be removed and window sashes reinstalled, ensure that decorative glass (if any) and original polished plate glass have been removed from the sash and properly stored or sent to shop for repair as specified in Section "Glass and Glazing". Cooperate with glazier in removal of existing glass for protection or repair of existing glass.
2. Note: Not all existing glass is believed to be original polished plate glass. Architect has not surveyed the locations of original polished plate glass. There is no known contemporary source for polished plate glass in the sizes required for replacement.
3. Protecting existing glass to remain in place during indicated repair procedures and which do not otherwise require sash removal. Replace glass which is broken during repair procedures with products complying with the requirements indicated in the applicable "Glass and Glazing" Sections.
4. Should it become necessary to remove existing interior window coverings, such as shutters, blinds, draperies, etc., in order to perform the restoration of the windows, the Contractor shall record, remove store, and reinstall window coverings in their original locations.

PART 2 PRODUCTS

2.01 FABRICATION OF REPLICATED UNITS

A. Replicated Units: Replacement sash, sill, other frame and trim sections shall match the existing in configuration, sash pattern and construction.

2.02 MATERIALS FOR REPLICATING AND REPAIRING WINDOWS

A. Epoxy Consolidant: Penetrating two part epoxy compound. A product complying with the requirement is Arcon Seep-N-Seal, as manufactured by Allied Resin Corporation, East Weymouth, Massachusetts.

B. Three-part, semi-rigid compound consisting of one part epoxy resin, polysulfide polymer and curing agent, and fillers. Compound shall be equal to Compound No. 1 as set forth in the referenced standard Epoxies for Wood Repairs in Historic Buildings, or at Contractor's option,

provide proprietary patching compound as follows:

C. Epoxy patching compounds: Marine-Tex as manufactured by Travaco Laboratories, 345 Eastern Avenue, Chelsea MA. Abatron, Inc., 33 Center Drive, Gilberts, IL 60136.

D. Replacement wood for sash repair/replacement: Clear, Long Leaf Pine lumber which has been treated with water repellent preservative in conformance with NWMA IS-4 standard after machining and kiln-dried to be moisture content of 6 to 12 percent at time of fabrication.

E. Replacement wood for sills repair/replacement: Clear Cypress lumber which has been treated with water repellent preservative in conformance with NWMA IS-4 standard after machining and kiln-dried to be moisture content of 6 to 12 percent at time of fabrication.

F. Replacement wood for exterior trim, frame: Clear, longleaf, heart pine which has been salvaged from historical buildings by suppliers experienced in providing such lumber. Subject to compliance with requirements, suppliers or acceptable product include but are not limited to:

Mountain Lumber
Route 2, Box 43-1
Ruckersville, VA 22968
(804) 295-1922

Albany Woodwork Co.
PO Box 729
Albany, LA 70711
(504) 567-1155

G. Replacement wood for interior trim: Clear White Oak kiln-dried to be moisture content of 6 to 12 percent at time of fabrication.

H. Adhesive: Resorcinal formaldehyde resin waterproof adhesive per CS 35 Type 1.

I. Wood primer/sealer: Product compatible with finish specified in Division 9 Sections and which is compatible with mildewcide additives as follows:

J. Paint additive for Primer: An acceptable product is ADD-X Mildewcide Paint Additive manufactured by Zehrung Corporation, Portland, Oregon.

K. Fasteners: Comply with NWMA requirements for fabrication and with manufacturer's recommendations and standard industry practices for type and size of installation fasteners.
   1. For fabrication and installation of wood elements, use only countersunk stainless steel or brass structural reinforcements, screws, dowels, and resorcinol adhesives, or combinations of listed fasteners and adhesive.
   2. For hardware and accessory installation use brass screws.
   3. Pulls, latches, and other hardware items: Match existing fastener hardware on visible elements.

L. Compression Weather-stripping for Operable Windows: Bronze spring metal, designed for permanently resilient sealing under bumper or wiper action, completely concealed when window sash is closed.

M. Sash weights: Where sash weights are missing provide cast iron weights of the same weight of the existing units.

N. Sash weight cords: Provide new copper coated steel chains, sized for the sash hardware, for repair of existing windows.

O. Provide replicated replacement hardware on visible window elements or reinstall repaired, cleaned, salvaged hardware. Replacement hardware shall replicate the appearance of existing hardware elements visible when windows are closed.

PART 3 EXECUTION

3.01 GENERAL PREPARATION REQUIRED FOR WINDOW ELEMENTS:

A. Remove heavy paint build-up from all exterior window elements. Protect interior finishes from staining or damage associated with paint removal techniques employed on exterior. Comply with Division 9 Section "Finish Removal" for general finish removal criteria for wood substrates. Accessible window elements will be considered free of heavy paint build-up if all loose paint is removed, paint is removed to bare wood at areas to receive patching, re-gluing, or chemical consolidation, and areas not required to be patched or consolidated have firmly adhered smooth paint film remaining.

B. Where refinishing, replacement, or repair of interior sash elements or interior trim and parting stops is required, finish removal and refinishing of element may be performed at a remote location and reinstalled completely finished.

C. Paint Removal: Remove paint which is peeling, crazing, alligatoring, or showing other similar defects by chemical stripping, or wet sanding. In extreme cases, a hot air gun may be required to loosen paint. It is not desirable to remove all paint. Remove to the degree necessary to perform repair operations, as herein specified, and to permit application of uniform finish.

D. Remove wood elements indicated to be replaced or removed. Coordinate removal of glass which is broken or indicated to be replaced. Sand to feather junctions between paint to remain and bare wood.

E. Remove applied sealant materials and unsound previous repair materials.

F. Bare sound wood areas shall be treated with a paintable mildewcide preservative solution.

G. Except where epoxy consolidation “in situ” is indicated or as recommended by Contractor’s specialist and approved by Architect, decayed or unsound wood areas shall be removed with a plane or specialized tool which minimizes damage to adjacent sound wood prior to treatment and patching.

H. Remove penetrating elements and foreign materials from window.

I. Paint Disposal: Process debris shall remain segregated from all other waste material and disposed of in containers provided by Owner.

J. Contractor’s window specialist shall inspect window unit and mark repair areas with a non-staining marker which will not bleed through specified finishes. Specialist shall particularly note condition of areas which were concealed or not accessible for Architect’s initial observations. Contractor shall mark and log location and extent of serious damage in these areas. Serious damage shall be defined to include warpage or deformation so extreme as to preclude proper operation (on windows to be made operable), impending structural failure due to rot or termite damage, and joint separation of intersecting sash parts in excess of 1/16” on operable sash units.

K. Identify, mark and log locations of original polished plate glass. Indicate where original glass is intact. Indicate extent and nature of cracks or other damage to original glass in place.

L. At intervals convenient to the Owner, assist Architect and Owner’s representative in performing survey of prepared exterior window areas on the ground, first, second, third and fourth floors.

M. Perform logs and inspections prior to work by separate asbestos abatement contractor. Photograph conditions at vulnerable areas.

3.02 GENERAL REPAIR PROCEDURES

A. Remove indicated sash units. Remove loose paint, glazing, glazing compound and hardware. Fill screw and nail holes with epoxy patch.
   1. While sash is out of frame openings, the openings are to be provided with temporary covers to exclude wind driven rain.

B. Resecure loose frame sections so that frame members fit tightly and the entire frame fits securely in the wall.

C. Fill minor holes, gouges, weather worn areas, etc with epoxy patching compound applied in conformance with recommendations referenced. Sand surfaces so that new paint will smoothly blend in over areas which have been patched.

D. Repair intact decayed wood with Epoxy Consolidant: Where required to consolidate, drill 1/8” to ¼” diameter holes along the length of piece perpendicular to the grain. Fill holes with epoxy consolidant, repeating as wood absorbs the fluid. Cure according to referenced standards. Where approved by the Architect, consolidate existing wood in place, in lieu of complete replacement of piece. This option will only be considered by the Architect for repair of localized rot at frame and sill components.

E. Repair of Wood Sections with Epoxy Patching Compound: Preparation and application shall be in accordance with the requirements as set forth in the publication referenced in Part 1, General, and as follows:
   1. Brush apply area to be patched with epoxy consolidant immediately prior to patching.

F. Replace sill, frame, sash or trim members indicated to be replaced with the members of same configuration as original of material specified.

3.03 REPAIR PROCEDURES FOR OPAQUE FINISHED WOOD

A. Epoxy Patch: Strengthen and stabilize wood using consolidant epoxies which saturate the bare wood. Confine application of epoxy consolidant to the immediate area to be patched. Apply epoxy patch while consolidant is still tacky. Then fill with epoxy patching compound and sand. Use epoxy compounds to building up missing damaged parts of members; duplicate existing profiles.

B. Wood Replacement: Remove and discard damaged portion and cut and fit in a matching portion. Where window parts are damaged beyond practical repair by the indicated method, Contractor may elect with approval of Owner's representative to remove the entire part (such as an operating sash or an entire frame) and provide a new matching part. Where portions are indicated to be removed and new portions provided, the new portion shall be the entire portion (entire bottom sash rail, for example). Do not splice members. Where entire members have been removed and new members provided, provide joint reinforcements where new and existing or two members join. Retain and match existing woodwork joinery configurations adapting only as required to incorporate joint reinforcements and adhesive.

C. Holes larger than 3/8" diameter (except for holes through sash): Install wood plug or "Dutchmen" with resorcinol adhesive.

D. Seal bare areas immediately after repair work is complete with a clear primer sealer.

3.04 INSTALLATION OF WINDOWS

A. Install replacement sash units, frame elements and trim elements with units of specified material to visually match the original missing elements.

B. Re-install existing and install new sash weights on chain as specified. Replace sash weight access panels in jamb members so joints are flush and smooth.

C. Replace missing or inoperative sash locks, weights and chains.

3.05 WINDOW OPERATIONS AND HARDWARE:

A. Repair or remove and provide new parts for existing window operator parts at operable windows, such as counterbalances and sash-weight chains (or cords). New parts shall match existing, except substitute chains for cords.

B. Rework existing bronze weather-stripping where salvageable, or where not feasible to reuse or where missing, provide new weather-stripping for each operable window within the Contract limit line. Weather-strip each side of each operator, including meeting rails.

C. Remove existing window hardware which is deteriorated or damaged, salvaging items suitable for reuse. Where existing hardware has been removed or is missing, provide replacement hardware, including reinforcement, fasteners, and other hardware and devices required for proper window operation.

D. Fix and seal operating panels at fixed sash locations, but provide, or retain, acceptable existing exposed to view hardware.

E. Adjust hardware at operable windows for easy operation.

3.06 ADJUST AND CLEAN

A. Adjust operating sash and hardware to provide smooth operation with tight, weatherproof closure. Lubricate hardware and moving parts.

B. Refer to Division 9 Sections for required finish to be applied on wood window units at project site. Glaze each unit before application of final finish coat where coat extends over removable

glazing bead or over exposed face glazing.

C. Clean glass of window units promptly after installation; comply with requirements of “Glass and Glazing” Section for cleaning and maintenance.

D. Institute protection required through remainder of construction period, to ensure that wood window units will be without damage or deterioration (other than normal weathering) at time of acceptance.

END OF SECTION 086100

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SECTION 087100
DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hardware for wood doors.

B. Thresholds.

C. Weatherstripping and gasketing.

1.02 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

B. Provide individual items of single type, of same model, and by same manufacturer.

C. Provide door hardware products that comply with the following requirements:
   1. Applicable provisions of federal, state, and local codes.

2.02 FINISHES

END OF SECTION 087100

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SECTION 087100
FINISH HARDWARE

PART 1 - GENERAL

1.01 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.

C. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.02 1.01 DESCRIPTION OF WORK

A. A. Work under this section comprises of furnishing hardware specified herein and noted on drawings for a complete and operational system, including any electrified hardware components, systems, controls and hardware for aluminum entrance doors. Any door shown on the drawing and not specifically referenced in the hardware sets shall be provided with identical hardware as specified on other similar openings and shall be included in the General Contractor's base bid. All fire rated door shall be provided with fire rated hardware as required by local code Authority as part of the General Contractor's base bid. The hardware supplier shall verify all cylinder types specified for locking devices supplied as part of the door system with the door manufacturer and/or door supplies.

B. B. The General Contractor shall notify the Architect in writing of any discrepancies (five (5) days prior to bid date) that could and/or would result in hardware being supplied that is none functional, hardware specified and/or hardware that has not been specified that will result in any code violations and any door that is not covered in this specification. Failure of the General Contractor to address any such issue could be considered acceptance of the hardware specified and any and/or all discrepancies could be corrected at the General Contractor's expense.

1. C. Items include but are not limited to the following:

1. HINGES - PIVOTS

2. FLUSH BOLTS

3. EXIT DEVICES

4. LOCKSETS AND CYLINDERS

5. PUSH PLATES - PULLS

6. COORDINATORS

7. CLOSERS

8. KICK, MOP AND PROTECTION PLATES

9. STOPS, WALL BUMPERS, OVERHEAD CONTROLS

10. ELECTRIFIED HOLD OPEN DEVICES

11. THRESHOLDS, SEALS AND DOOR BOTTOMS

12. SILENCERS

13. MISCELLANEOUS TRIM AND ACCESSORIES

a. 1.02 RELATED DOCUMENTS, drawings and general provisions of contract, including General and Supplementary Conditions, and Division 1 Specification sections, apply to this section.

b. 1.03 RELATED WORK specified elsewhere that should be examined for its effect upon this section:

2. A. Section 06 20 00 - Finish Carpentry
3. B. Section 08 11 13 – Steel Doors and Frames
4. C. Section 08 14 16 – Flush Wood Doors
5. D. Sections 08 31 13 – Access Doors
6. E. Section 08 39 00 – Watertight Doors

B. E. Section 08 41 13 – Aluminum Entrances, Storefront and Window Framing
1. F. Sections 08 80 00 – Glass and Glazing
2. G. Sections 09 91 00 - Painting
3. H. Division 26 – Electrical
4. I. Division 28 – Access Control

1.04 REFERENCES SPECIFIED IN THIS SECTION SUBJECT TO COMPLIANCE AS DIRECTED:

1. A. NFPA 80 - Standard for Fire Doors and Windows
2. B. NFPA 101 - Life Safety Code
3. C. ADA - The Americans with Disabilities Act - Title III - Public Accommodations
4. D. ANSI-A 117.1 - American National Standards Institute - Accessible and Usable

BUILDINGS AND FACILITIES

A. E. ANSI-A 156.5 - American National Standards institute -Auxiliary Locks and Associated Products
1. F. UFAS - Uniform Federal Accessibility Standards
2. G. UL - Underwriter's Laboratories
3. H. WHI - Warnock Hersey International, Testing Services
4. I. State and Local Codes including Authority Having Jurisdiction
5. J. UL 10C – Positive Pressure
6. K. IBC-2021 – International Building Code
7. L. NFPA 70 – International Electrical Code

1.05 SUBMITTALS

A. A. HARDWARE SCHEDULES submit copies of schedule in accordance with Division 1, General Requirements. Schedule to be in vertical format, listing each door opening, including: handing of opening, all hardware scheduled for opening or otherwise required to allow for proper function of door opening as intended, and finish of hardware. At doors with door closers or door controls include degree of door opening. Supply the schedules all Finish Hardware within two (2) weeks from date purchase order is received by the hardware supplier.

B. B. Submit manufacturer's cut/catalog sheets on all hardware items and any required special mounting instructions with the hardware schedule.

C. CERTIFICATION OF COMPLIANCE:

1. 1. Submit any information necessary to indicate compliance to these specifications as required.
2. 2. Submit a statement from the manufacturer that electronic hardware and systems being supplied comply with the operational descriptions exactly as specified.

D. SUBMIT ANY SAMPLES NECESSARY AS REQUIRED BY THE ARCHITECT.

A. E. Templates for finish hardware items to be sent to related door and frame suppliers within three (3) working days of receipt of approved hardware schedule.
1. F. Doors and Frames used in positive pressure opening assemblies shall meet UL 10C in areas where this specification includes Seals for smoke door.

1.06 QUALITY ASSURANCE

A. A. Hardware supplier to be a qualified, Factory Authorized, direct distributor of the products to be furnished. In addition, the supplier to have in their regular employment an AHC or AHC /CDC and/or a person of equivalent experience (minimum fifteen (15) years in the industry) who will be made available at reasonable times to consult with the Architect/Contractor and/or the Owners Representative regarding any matters affecting the finish hardware on this project.

B. B. All hardware used in labeled fire or smoke rated openings to be listed for those types of openings and bear the identifying label or mark indicating UL. (Underwriter's Laboratories) approved for fire. Exit devices in non-labeled openings to be listed for panic.

C. C. Pre-Installation Instructional Meeting: Contractor shall schedule and hold a pre-installation meeting that includes the Contractor, the Architect and/or his chosen representative, the Hardware Supplier, and all installers of hardware. Instructional meeting shall be conducted by the Hardware Supplier, covering proper installation of all items of hardware to be incorporated into the Project.

D. D. For openings with access control, a coordination meeting shall be coordinated with Owner or Owner's representative, General Contractor, Security Contractor and Hardware Consultant to ensure that all openings requiring access control are included and to coordinate the ordering of any and all electronic components related to access control.

1.07 DELIVERY, HANDLING AND PACKAGING

A. A. Furnish all hardware with each unit clearly marked and numbered in accordance with the hardware schedule. Include door and item number for each.

1. B. Pack each item of hardware completes with all necessary parts and fasteners.

B. C. Properly wrap and cushion each item to prevent scratches and dents during delivery and storage.

1.08 SEQUENCING AND SCHEDULING

1. Any part of the finish hardware required by the frame or door manufacturers or other suppliers that is needed to produce doors or frames is to be sent to those suppliers in a timely manner, so as not to interrupt job progress.

1.09 WARRANTY

1. All finish hardware shall be supplied with a one- (1) year warranty against defects in materials and workmanship, commencing with substantial completion of the project except as follows:

1. ALL CLOSERS SHALL HAVE A THIRTY- (30) YEAR WRITTEN WARRANTY.

2. ALL GRADE 1 AND GRADE 2 LOCKSETS SHALL HAVE A TEN- (10) YEAR WRITTEN WARRANTY.

3. ALL EXIT DEVICES SHALL HAVE A TEN (10) YEAR WRITTEN WARRANTY.

4. ALL CONTINUOUS HINGES SHALL HAVE A LIFE OF INSTALLATION WRITTEN WARRANTY.

PART 2 – PRODUCTS

28.01 2.01 FASTENERS

A. A. Furnish with finish hardware all necessary screws, bolts and other fasteners of suitable size and type to anchor the hardware in position for a long life under hard use.

B. B. Furnish fastenings where necessary with expansion shields, toggle bolts and other anchors designated by the Architect according to the material to which the hardware is to be applied and the recommendations of the hardware manufacturer. All closers and exit devices on labeled wood doors shall be through-bolted if required by the door manufacturer. Where specified in the hardware sets, security type fasteners of the type called for are to be supplied.

C. Design of all fastenings shall harmonize with the hardware as to material and finish.

D. D. All hardware shall be installed with the Manufacturers standard screws as provided. The use of any other type of fasteners shall not be permitted. The general contractor shall provide wood blocking in all stud walls specified and/or scheduled to receive wall stops, No Exception.

2.02 ENVIRONMENTAL CONCERN FOR PACKAGING

1. The hardware shall ship to the job site is to be packaged in biodegradable packs such as paper or cardboard boxes and wrapping.

2.03 HINGES

A. A. All hinges to be of one manufacturer as hereafter listed for continuity and consideration of warranty. Provide one of the following manufacturers Ives, Hager, Mc Kinney or Stanley.

B. Unless otherwise specified provide five-knuckle, heavy-duty, button tip, full mortise template type hinges with non-rising loose pins. Provide non-removable pins for out swinging doors at secured areas or as called for in this specification (Refer to 3.02 Hardware Sets).

C. C. Provide all out-swinging doors with non-removable pins or security studs as called for in 3.02 Hardware Sets. Furnish three (3) hinges up to 90 inches high and one (1) additional hinge for every 30 inches or fraction thereof.

D. D. Furnish three (3) hinges up to 90 inches high and one (1) additional hinge for every 30 inches or fraction thereof.

E. E. Provide size 4½" x 4½" for all 1¾" thick doors up to and including 36 inches wide. Doors over 1¾" through 2¼" thick, use 5" x 5" hinges. Doors over 36 inches use 5" x 4½" unless otherwise noted in 3.02 Hardware Sets.

F. F. Were required to clear the trim and/or to permit the doors to swing 180 degrees furnish hinges of sufficient throw.

1. G. Provide heavy weight hinges on all doors over 36 inches in width.

G. H. At labeled door's stainless steel, bearing-type hinges shall be provided. For all doors equipped with closers provide bearing-type hinges.

2.04 MORTISE LOCKS

1. A. Locks shall have all functions available in one size case, manufactured from heavy gauge steel, minimum thickness of 3/32", complete chrome plated for corrosion resistance and lubricity of parts. Cases are to be closed on all sides to protect internal parts. Locks are to have adjustable, beveled and armored fronts, standard 2 3/4" backset, a full 3/4" throw two-piece mechanical anti-friction latchbolt, a one-piece stainless steel 1" throw deadbolt, and shall be available for a minimum door thickness of 1 3/8". Internal parts shall be heavy gauge steel, zinc dichromate plated for corrosion resistance.
2. B. All locksets with latchbolts, regardless of trim, shall be listed by Underwriters Laboratories for A label and less class doors, 4' x 8' single or 8' x 8' pair.
3. C. Lock trim (knob, lever, sectional or escutcheon) shall be throughbolted through the lock case to assure correct alignment and proper operation.
4. D. Locksets shall conform to Federal Specification FF-H-106C, and be certified as meeting ANSI A156.13 Series 1000, Grade 1 requirements, ANSI A117.1, Accessibility Code (lever handle trim), and California State Reference Code, 1989 (formerly Title 19, California State Fire Marshall Standard) (lever handle trim).

E. ACCEPTABLE AND APPROVED: SCHLAGE L SERIES

2.05 CYLINDERS AND KEYING

A. A. Provide all exterior and interior locks or Exit Devices requiring cylinders keyed to the New Large Format Interchangeable Core Mater Key System as instructed by the Owners Representative. Cylinders shall comply with performance requirements of ANSI A156.5. All keys shall be of nickel silver material only. The hardware supplier shall meet with the General Contractor, the Architect and the Owners Representative at the project jobsite to determine all permanent keying requirements.

B. B. Cylinders shall be factory keyed and factory maintained as directed by the owners Representative and the Architect. Provide two- (2) keys per cylinder and four- (4) master keys per master used.

C. Factory stamp all keys "Do not duplicate" and with key symbol as directed by the Owners Representative. Visual key control shall be provided on all permanent keys and cylinders.

D. Provide temporary keyed construction cores for the duration of the construction phase. Provide ten (10) construction keys and two (2) construction control keys. All construction cores shall be

returned to the hardware supplier upon installation of permanent cores.

1. EXIT DEVICES

E. All exit devices and trim, including electrified items, to be of one manufacturer as hereafter listed and in the hardware sets for continuity of design and consideration of warranty; electrified devices and trim to be the same series and design as mechanical devices and trim.

F. B. Exit Devices to be “UL” listed for life safety. All exit devices for labeled doors shall have “UL” label for “Fire Exit Hardware”. All devices mounted on labeled wood doors are to be through-bolted or per the manufacturer’s listing requirements. All devices shall conform to NFPA 80 and NFPA 101 requirements.

G. C. All exit devices to be of a heavy duty, chassis mounted design, with a one-piece removable cover, eliminating necessity of removing the device from the door for standard maintenance and keying requirements.

H. D. All trims to be through-bolted to the lock stile case. Lever design to be the same as specified with the lock sets.

I. E. Exit Devices shall be the modern push rail design. All exit devices shall be mounted with sex bolts and installed with the manufactures standard screws. Exit Hardware Devices found to be installed with self-drilling and self-tapping screws shall be removed and reinstalled at the installer expenses.

J. F. All devices shall carry a ten - (10) year warranty against manufacturing defects and workmanship.

K. G. Furnish roller strikes for all rim and surface vertical rod exit devices. Internal springs shall be coil compression type. Furnish security dead latching for all active latch bolts.

L. H. All Exit Devices shall be field modifiable as incorporate an Electric Latch Retraction Feature without the purchase of new Panic Exit Hardware.

M. J. Exit Devices shall be the Von Duprin “55 & 99” series as specified

2.07 SURFACE MOUNTED DOOR CLOSERS

A. All closers for this project shall be the products of a single manufacturer for continuity of design and consideration of warranty. All door closers shall be mounted as to achieve the maximum degree of opening (trim permitting).

B. All closers to be heavy duty, surface-mounted, fully hydraulic, rack and pinion action with high strength case iron cylinder to provide control throughout the entire door opening and closing cycle.

C. Size all closers in accordance with the manufacturer’s recommendations at the factory.

D. D. All closers to have adjustable spring power sizes 1 or 2 through 4 or 6 and non-critical regulating screw valves for closing speed, latching speed and back-check control as a standard feature unless specified otherwise.

E. E. Provide closer covers only if provided as a standard part of the door closer package.

F. F. The hardware supplier shall provide all required brackets, spacers or filler plates as required by the manufacture for a proper and functional installation as part of their base bid.

G. G. Supply appropriate arm assembly for each closer so that closer body and arm are mounted on non-public side of door opening and on the interior side of exterior openings, except where required otherwise in the hardware sets.

H. H. Provide drop plates and any additional mounting brackets required for the proper installation of the door closer shall be included in the hardware supplier’s base bid.

1. I. Finish: Baked on Powder Coated finish shall match other hardware.

I. J. Provide and mount all door closers with sex bolts as provided by the manufacturer.

1. K. Closers shall be LCN “4040XP” series as specified.

2.08 DOOR STOPS AND HOLDERS

A. A. Door stops are to be furnished for every door leaf. Every door is to have a floor, wall, or an overhead stop.

B. B. Place doorstops in such a position that they permit maximum door swing, but do not present a hazard of obstruction. Furnish floor strikes for floor holders of proper height to engage holders of doors.

C. C. Where overhead stops and holders are specified, or otherwise required for proper door operation, they are to be heavy duty and of extruded brass, bronze or stainless steel with no plastic parts as specified. The General Contractor shall provide wood blocking in all stud walls specified and scheduled to receive wall stops.

1. D. Finish: Shall match other hardware where available.
2. E. Acceptable Products
3. 1. Floor and wall stops as listed in hardware sets. Equivalent products as manufactured by Ives, ABH and Trimco are acceptable.

2.09 PUSH PLATES, DOOR PULLS, AND KICKPLATES

A. A. All push plates, door pull, kick plates and other miscellaneous hardware as listed in hardware sets. Equivalent products as manufactured by Ives, Hager and Trimco are acceptable.

B. B. Kick plates to be 10 inches high and Mop plates to be 6 inches high, both by 1-½ inches or 1 inch less than door width (LDW) as specified. They are to be of 16-gauge thick base metal. For door with louvers or narrow bottom rails, kick plate height to be 1 inch less dimension shown from the bottom of the door to the bottom of the louver or glass.

C. C. Where required armor plates, edge guards and other protective hardware shall be supplied in sizes as scheduled in the hardware sets.

D. FINISH: SAME AS OTHER HARDWARE WHERE AVAILABLE.

2.10 FLUSH BOLTS AND COORDINATORS

A. A. Provide Flush bolts with Dust Proof Strikes as indicated in the individual hardware sets by Ives, Hager and Trimco are acceptable. Finish shall match the adjacent hardware.

2.11 THRESHOLDS AND SEALS

A. A. Provide materials and finishes as listed in hardware sets. Zero products have been specified to set a high level of quality, equivalent product by manufactured by National Guard Products and Pemko shall be acceptable. All thresholds must be in accordance with the requirements of the ADA and ANSI A117.1.

B. B. Provide thresholds with Zero 226 stainless steel sleeve anchoring application. Supply all necessary anchoring devices as supplied by the product manufacturer for the installation of weather strip and sound seal.

C. Seals shall comply with requirements of UL 10C. All thresholds, door bottoms and weather strip inserts shall be a silicone based product as specified in 3.02 Hardware Sets. Other materials used shall be rejected, unless originally specified.

D. Seals shall comply with the requirements of the Wood Door Manufacturer’s certification requirements.

E. Install all Threshold in a full bed of sealant as to prevent water & insect penetration inside of the building.

2.12 FINISHES

A. A. Finishes for all hardware as required in this specification are to be Dark Bronze – 313, 613, 695, D as needed.

B. B. Special care is to be taken to make uniform the finish of all various manufactured items.

2.13 DOOR SILENCERS

A. Provide door silencers at all openings without gasket. Provide two- (2) each at pair of doors and three- (3) or four- (4) each for each single door (coordinate with the frame manufacturer).

2.14 PROPRIETARY PRODUCTS

A. A. References to specific products are used to establish quality standards of utility and performance. Unless otherwise approved provide only the specified product.

B. All other materials, not specifically described, but required for a complete and proper finish hardware installation, are to be selected by the Contractor, subject to the approval of the Architect and the Owners Representative.

C. Architect and the Owners Representative reserve the right to approve all the substitutions proposed for this specification. All requests for substitution to be made prior to bid in accordance with Division 1, General Requirements, and are to be in writing, hand delivered to the Architect. Two (2) copies of the manufacturer's brochures and a physical sample of each item in the appropriate design and finish shall accompany requests for substitution.

PART 3 - EXECUTION

43.01 3.01 INSTALLATION AND SERVICE ITEMS OF FINISH HARDWARE

A. A. All finish hardware shall be installed by an experienced finish hardware installer with at least ten (10) years of experience after a pre-installation meeting between the contractor, hardware Manufacturers representative, the hardware supplier, the hollow metal supplier and the wood door supplier. The finish hardware installer shall be responsible for the proper installation and function of all doors and hardware.

B. B. The hardware supplier's office and/or warehouse shall be located within a one seventy-five (75) mile radius of the project site as to better service the general contractor and the Owners Representative during this project.

C. C. Check hardware against the reviewed hardware schedule upon delivery. Store the hardware in a dry and secure location to protect against loss and damage.

D. D. Install finish hardware in accordance with approved hardware schedule and manufacturers' printed instructions. Pre-fit hardware before finish is applied to door; remove and reinstall after finish is complete and dry. Install and adjust hardware so that parts operate smoothly, close tightly, and do not rattle.

E. E. Mortise and cutting to be done neatly, and evidence of cutting to be concealed in the finished work. Protect all Finish hardware from scratching or other damage.

3.02 HARDWARE SETS

143196 OPT0460815 VERSION 1

HARDWARE GROUP NO. 001

FOR USE ON DOOR #(S):

003-2					

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1		NOTE	HARDWARE BY DOOR MANUFACTURER	UNK

HARDWARE GROUP NO. 002

FOR USE ON DOOR #(S):

104					

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	NOTE	CASED OPENING - NO HARDWARE REQUIRED	

HARDWARE GROUP NO. 003

FOR USE ON DOOR #(S):

311-A	311-B	312			

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	NOTE	EXISTING HARDWARE TO REMAIN	

HARDWARE GROUP NO. 101C

FOR USE ON DOOR #(S):

001-2	003-1				

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	IVE
1	EA	OFFICE/ENTRY LOCK	L9050T ASTA L583-363	SCH
1	EA	PERMANENT CORE	23-030 CKC EV29 T	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
3	EA	SILENCER	SR64	IVE

HARDWARE GROUP NO. 103

FOR USE ON DOOR #(S):

108-C1	108-D1	200-H1	202-B2	204-A1	206-B1
206-B2	206-C1	303-B			

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	IVE
1	EA	OFFICE/ENTRY LOCK	L9050T ASTA L583-363	SCH
1	EA	PERMANENT CORE	23-030 CKC EV29 T	SCH
1	EA	WALL STOP	WS406/407CCV	IVE
3	EA	SILENCER	SR64	IVE

HARDWARE GROUP NO. 103S

FOR USE ON DOOR #(S):

108-B1	205	302-B			

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	IVE
1	EA	OFFICE/ENTRY LOCK	L9050T ASTA L583-363	SCH
1	EA	PERMANENT CORE	23-030 CKC EV29 T	SCH
1	EA	OH STOP	100S ADJ	GLY
3	EA	SILENCER	SR64	IVE

HARDWARE GROUP NO. 107

FOR USE ON DOOR #(S):

101	102-D1	102-D2			

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	IVE
1	EA	OFFICE/ENTRY LOCK	L9050T ASTA L583-363	SCH
1	EA	PERMANENT CORE	23-030 CKC EV29 T	SCH
1	EA	OH STOP	100S ADJ	GLY
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
3	EA	SILENCER	SR64	IVE

HARDWARE GROUP NO. 201

FOR USE ON DOOR #(S):

001-1	002-2	200-E1			

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	IVE
1	EA	STOREROOM LOCK	L9080T ASTA	SCH
1	EA	PERMANENT CORE	23-030 CKC EV29 T	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE
3	EA	SILENCER	SR64	IVE

HARDWARE GROUP NO. 201C

FOR USE ON DOOR #(S):

100-D1	100-E1	103-D2	103-D3	105-B1	105-C1

200-F1	200-I1	201-B1			

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	IVE
1	EA	STOREROOM LOCK	L9080T ASTA	SCH
1	EA	PERMANENT CORE	23-030 CKC EV29 T	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
3	EA	SILENCER	SR64	IVE

HARDWARE GROUP NO. 203

FOR USE ON DOOR #(S):

102-B1	102-C1	102-E1	108-E1	202-C1	202-D1
304-B					

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	IVE
1	EA	STOREROOM LOCK	L9080T ASTA	SCH
1	EA	PERMANENT CORE	23-030 CKC EV29 T	SCH
1	EA	WALL STOP	WS406/407CCV	IVE
3	EA	SILENCER	SR64	IVE

HARDWARE GROUP NO. 203S

FOR USE ON DOOR #(S):

200-D1	205-B1				

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	IVE
1	EA	STOREROOM LOCK	L9080T ASTA	SCH
1	EA	PERMANENT CORE	23-030 CKC EV29 T	SCH
1	EA	OH STOP	100S ADJ	GLY
3	EA	SILENCER	SR64	IVE

HARDWARE GROUP NO. 207

FOR USE ON DOOR #(S):

002-1					

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	IVE

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	STOREROOM LOCK	L9080T ASTA	SCH
1	EA	PERMANENT CORE	23-030 CKC EV29 T	SCH
1	EA	OH STOP	100S ADJ	GLY
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
3	EA	SILENCER	SR64	IVE

HARDWARE GROUP NO. 341

FOR USE ON DOOR #(S):

300-B	300-C				

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	L9040 ASTA L583-363 OS-OCC	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE
3	EA	SILENCER	SR64	IVE

HARDWARE GROUP NO. 341C

FOR USE ON DOOR #(S):

204-B1					

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	L9040 ASTA L583-363 OS-OCC	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
3	EA	SILENCER	SR64	IVE

HARDWARE GROUP NO. 401C

FOR USE ON DOOR #(S):

200-G1					

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	IVE
1	EA	PASSAGE SET	L9010 ASTA	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
3	EA	SILENCER	SR64	IVE

HARDWARE GROUP NO. 501C

FOR USE ON DOOR #(S):

104-B1	106-A1				

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	IVE
1	EA	CLASSROOM LOCK	L9070T ASTA	SCH
1	EA	PERMANENT CORE	23-030 CKC EV29 T	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
3	EA	SILENCER	SR64	IVE

HARDWARE GROUP NO. 700C

FOR USE ON DOOR #(S):

206-A1					

PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5	IVE
2	EA	PANIC HARDWARE	5547WDC-L-AST-SNB-#10WDA	VON
2	EA	MORTISE CYLINDER	20-059 X CAM AS REQ W/ KEYED CONSTRUCTION CORE	SCH
2	EA	PERMANENT CORE	23-030 CKC EV29 T	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	LCN
2	EA	SILENCER	SR64	IVE

HARDWARE GROUP NO. 701

FOR USE ON DOOR #(S):

206-A2	206-A3				

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	IVE
1	EA	PANIC HARDWARE	55-L-AST-SNB	VON
1	EA	MORTISE CYLINDER	20-059 X CAM AS REQ W/ KEYED CONSTRUCTION CORE	SCH
1	EA	PERMANENT CORE	23-030 CKC EV29 T	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE
3	EA	SILENCER	SR64	IVE

HARDWARE GROUP NO. 701C

FOR USE ON DOOR #(S):

206-A4					

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	IVE
1	EA	PANIC HARDWARE	55-L-AST-SNB	VON
1	EA	MORTISE CYLINDER	20-059 X CAM AS REQ W/ KEYED CONSTRUCTION CORE	SCH
1	EA	PERMANENT CORE	23-030 CKC EV29 T	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
3	EA	SILENCER	SR64	IVE

HARDWARE GROUP NO. 714

FOR USE ON DOOR #(S):

100-A2	100-A3	100-A4			

PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5	IVE
2	EA	PANIC HARDWARE	5547WDC-L-AST-SNB-#10WDA	VON
2	EA	MORTISE CYLINDER	20-059 X CAM AS REQ W/ KEYED CONSTRUCTION CORE	SCH
2	EA	PERMANENT CORE	23-030 CKC EV29 T	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH ST-1595 SPEC	LCN
1	EA	RAIN DRIP	142A DW + 4"	ZER
2	SET	MEETING STILE	328AA-S	ZER
1	EA	JAMB GASKETING	328AA-S	ZER
1	EA	HEADER SEAL	429AA-1PC HEADER WIDTH	ZER
2	EA	DOOR SWEEP	39A	ZER
1	EA	THRESHOLD	65A-V3-226	ZER
1	EA	POWER SUPPLY	POWER SUPPLY BY SECURITY CONTRACTOR	UNK

HARDWARE GROUP NO. 731R

FOR USE ON DOOR #(S):

004					

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112XY	IVE
1	EA	PANIC HARDWARE	55-L-BE-AST-SNB	VON
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	GASKETING	188FSBK PSA	ZER

HARDWARE GROUP NO. 801

FOR USE ON DOOR #(S):

100-B1	100-C1	200-B1	200-C1		

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	IVE
1	EA	PUSH PLATE	8200 8" x 16"	IVE

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	PULL PLATE	8302 10" 4" X 16"	IVE
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE
3	EA	SILENCER	SR64	IVE

HARDWARE GROUP NO. A714

FOR USE ON DOOR #(S):

100-A1					

PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5	IVE
1	EA	PANIC HARDWARE	5547WDC-EO-SNB	VON
1	EA	PANIC HARDWARE	5547WDC-NL-OP-556CA-SNB	VON
1	EA	MORTISE CYLINDER	20-059 X CAM AS REQ W/ KEYED CONSTRUCTION CORE	SCH
1	EA	RIM HOUSING	20-079 W/ KEYED CONSTRUCTION CORE	SCH
2	EA	PERMANENT CORE	23-030 CKC EV29 T	SCH
2	EA	LONG DOOR PULL	9264 72" 56" STD	IVE
1	EA	SURF. AUTO OPERATOR	9550 SERIES (PUSH SIDE MOUNTED)	LCN
1	EA	ACTUATOR PKG	RE-USE EXISTING ACTUATORS	LCN
2	SET	MEETING STILE	328AA-S	ZER
1	EA	JAMB GASKETING	328AA-S	ZER
1	EA	HEADER SEAL	429AA-1PC HEADER WIDTH	ZER
2	EA	DOOR SWEEP	39A	ZER
1	EA	THRESHOLD	65A-V3-226	ZER
1	EA	KEY SWITCH	653-1414 L2	SCE
1	EA	POWER SUPPLY	POWER SUPPLY BY SECURITY CONTRACTOR	UNK

HARDWARE GROUP NO. C201

FOR USE ON DOOR #(S):

201-A1	201-A2	202-A1	301	302-A	303-A
304-A	311-C				

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	EU MORTISE LOCK	L9092TEU ASTA RX CON 12/24 VDC	SCH
1	EA	PERMANENT CORE	23-030 CKC EV29 T	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE
3	EA	SILENCER	SR64	IVE
1	EA	MULTITECH KEYPAD/READER	MTK15 - OR TYPE SUPPLIED BY SECURITY CONTRACTOR	SCE
1	EA	DOOR CONTACT	679-05 (OR TYPE SUPPLIED BY SECURITY CONTRACTOR)	SCE
1	EA	POWER SUPPLY	POWER SUPPLY BY SECURITY CONTRACTOR	UNK
1	EA	POWER SUPPLY	POWER SUPPLY FOR CARD READER BY SECURITY CONTRACTOR	UNK

HARDWARE GROUP NO. C201C

FOR USE ON DOOR #(S):

102	103	105	106	107	108
306					

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	EU MORTISE LOCK	L9092TEU ASTA RX CON 12/24	SCH

QTY		DESCRIPTION	CATALOG NUMBER	MFR
			VDC	
1	EA	PERMANENT CORE	23-030 CKC EV29 T	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
3	EA	SILENCER	SR64	IVE
1	EA	MULTITECH KEYPAD/READER	MTK15 - OR TYPE SUPPLIED BY SECURITY CONTRACTOR	SCE
1	EA	DOOR CONTACT	679-05 (OR TYPE SUPPLIED BY SECURITY CONTRACTOR)	SCE
1	EA	POWER SUPPLY	POWER SUPPLY BY SECURITY CONTRACTOR	UNK
1	EA	POWER SUPPLY	POWER SUPPLY FOR CARD READER BY SECURITY CONTRACTOR	UNK

HARDWARE GROUP NO. C207

FOR USE ON DOOR #(S):

104-C1	202-B1	203	310-A		

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	EU MORTISE LOCK	L9092TEU ASTA RX CON 12/24 VDC	SCH
1	EA	PERMANENT CORE	23-030 CKC EV29 T	SCH
1	EA	OH STOP	100S ADJ	GLY
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
3	EA	SILENCER	SR64	IVE
1	EA	MULTITECH KEYPAD/READER	MTK15 - OR TYPE SUPPLIED BY SECURITY CONTRACTOR	SCE

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	DOOR CONTACT	679-05 (OR TYPE SUPPLIED BY SECURITY CONTRACTOR)	SCE
1	EA	POWER SUPPLY	POWER SUPPLY BY SECURITY CONTRACTOR	UNK
1	EA	POWER SUPPLY	POWER SUPPLY FOR CARD READER BY SECURITY CONTRACTOR	UNK

END OF SECTION 087100

SECTION 087163
– HISTORIC DOOR AND WINDOW HARDWARE RESTORATION AND COMPATIBLE NEW HARDWARE

PART 1 – GENERAL

1.01 REFERENCE STANDARDS

A. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.02 1.1 SUMMARY

A. WORK INCLUDES RESTORATION, REPAIR, CONSERVATION, REPLICATION, AND REINSTALLATION OF HISTORIC DOOR AND WINDOW HARDWARE IN COMPLIANCE WITH THE U.S. SECRETARY OF THE INTERIOR'S STANDARDS FOR REHABILITATION.

B. THE INTENT IS TO RETAIN, REPAIR, AND REUSE ORIGINAL HARDWARE WHEREVER POSSIBLE. WHERE ORIGINAL HARDWARE IS MISSING, DETERIORATED BEYOND REPAIR, OR INSUFFICIENT FOR CODE REQUIREMENTS, NEW HARDWARE SHALL BE PROVIDED THAT MATCHES THE ORIGINAL IN MATERIAL, PROFILE, GEOMETRY, FUNCTION, AND FINISH WHILE REMAINING DISTINGUISHABLE UPON CLOSE INSPECTION AS REQUIRED BY THE U.S. SECRETARY OF THE INTERIOR'S STANDARDS FOR REHABILITATION.

C. WORK INCLUDES:

1. HINGES, LOCKSETS, LATCHES

2. DOOR CLOSERS (HISTORIC WHERE APPLICABLE)

3. KNOBS, LEVERS, ESCUTCHEONS, PLATES

4. WINDOW SASH LIFTS, LOCKS, PULLEYS, AND WEIGHTS

5. BOLTS, CATCHES, HOOKS, AND OTHER COMPONENTS

6. NEW COMPATIBLE HARDWARE AS REQUIRED

1.2 REFERENCES

A. TEXAS HISTORICAL COMMISSION: HISTORIC BUILDINGS AND STRUCTURES REVIEW REQUIREMENTS

B. SECRETARY OF THE INTERIOR'S STANDARDS FOR REHABILITATION

C. NPS PRESERVATION BRIEFS 9, 10, 33

D. ANSI/BHMA A156 HARDWARE STANDARDS

E. NFPA 101 AND IBC LIFE-SAFETY COMPLIANCE

1.3 SUBMITTALS

A. HISTORIC HARDWARE INVENTORY

B. TREATMENT MOCK-UP

C. NEW HARDWARE COMPATIBILITY SUBMITTAL

D. RESTORATION PROCEDURES

1.4 QUALITY ASSURANCE

A. HISTORIC HARDWARE SPECIALIST: 5 YEARS EXPERIENCE MINIMUM.

B. MOCK-UP

C. COORDINATION

1.5 DELIVERY, STORAGE, AND HANDLING

A. LABEL AND STORE HARDWARE INDIVIDUALLY.

1.6 PROJECT CONDITIONS

A. COORDINATE REMOVAL WITH DOOR AND WINDOW RESTORATION.

PART 2 – PRODUCTS

30.01 2.1 ORIGINAL HISTORIC HARDWARE

A. EXISTING HARDWARE SHALL BE RETAINED AND RESTORED UNLESS MISSING, UNSOUND, OR NOT REPAIRABLE.

B. ORIGINAL MATERIALS MAY INCLUDE BRASS, BRONZE, IRON, STEEL, OR HISTORIC PLATED FINISHES.

2.2 NEW HARDWARE MATCHING EXISTING

A. MATCHING REQUIREMENTS:

1. MATERIAL

2. ALLOY COLOR AND TONE

3. PROFILE AND PROPORTIONS

4. MOUNTING GEOMETRY

5. SURFACE TEXTURE

6. FINISH SHEEN AND PATINA

B. DIFFERENTIATION: CONCEALED DATE STAMP OR SUBTLE MARK.

C. ACCEPTABLE SOURCES: CUSTOM FABRICATORS, REPRODUCTION MANUFACTURERS, SALVAGED HISTORIC PIECES.

2.3 CLEANING MATERIALS

A. NEUTRAL CLEANERS, MINERAL SPIRITS, NON-ABRASIVE POLISHES.

B. PROHIBITED: ACIDS, SANDBLASTING, GRINDING.

2.4 REPAIR MATERIALS

A. BRAZING/SOLDERING ALLOYS COMPATIBLE WITH ORIGINAL METAL.

B. IN-KIND FABRICATED COMPONENTS.

C. EPOXY ONLY WHERE TRADITIONAL REPAIR IS NOT POSSIBLE.

2.5 FINISHES

A. MATCH ORIGINAL PATINA AND FINISH.

B. PROTECTIVE COATINGS: MICROCRYSTALLINE WAX (PREFERRED), REVERSIBLE LACQUER.

PART 3 – EXECUTION

53.01 3.1 EXAMINATION

A. DOCUMENT CONDITIONS PRIOR TO REMOVAL.

3.2 REMOVAL AND DOCUMENTATION

A. CAREFULLY REMOVE AND TAG EACH COMPONENT.

B. PROVIDE ARCHITECT WITH UPDATED INVENTORY IF DISCREPANCIES APPEAR.

3.3 CLEANING AND RESTORATION PROCEDURES

A. CLEANING:

1. USE THE LEAST ABRASIVE METHOD APPROPRIATE TO EACH COMPONENT.

2. BEGIN WITH DRY BRUSHING AND PROGRESS TO MILD DETERGENTS OR MINERAL SPIRITS ONLY IF REQUIRED.

3. ABRASIVE PADS, WIRE WHEELS, OR ROTARY TOOLS ARE PROHIBITED UNLESS SPECIFICALLY APPROVED BY THE ARCHITECT.

4. ULTRASONIC CLEANING MAY BE USED ONLY FOR NON-FERROUS COMPONENTS AND ONLY WITH ARCHITECT'S APPROVAL.

5. PRESERVE HISTORIC COATINGS OR PATINA; AVOID REMOVING OXIDATION THAT CONTRIBUTES TO THE HISTORIC CHARACTER.

B. RESTORATION:

1. STRAIGHTEN BENT COMPONENTS USING COLD MECHANICAL METHODS UNLESS HEAT IS REQUIRED TO AVOID FRACTURE.

2. BRAZING, SOLDERING, AND MECHANICAL PINNING REPAIRS SHALL MATCH THE PARENT METAL AND SHALL NOT BE VISUALLY OBTRUSIVE.

3. REPLACE MISSING OR SEVERELY DETERIORATED PARTS IN-KIND USING PATTERNS TAKEN FROM EXISTING HARDWARE OR ADJACENT DOORS/WINDOWS.

4. WHERE MULTIPLE LAYERS OF PAINT EXIST, ASSESS WHETHER EARLY PAINT LAYERS CONSTITUTE HISTORIC FINISHES. REMOVE ONLY NON-HISTORIC ACCRETIONS UNLESS OTHERWISE APPROVED.

5. OVERPAINTING OF OPERABLE HARDWARE IS PROHIBITED; REMOVE PAINT FROM MOVING COMPONENTS CAREFULLY WITHOUT DAMAGING METAL OR FINISHES.

6. LUBRICATE PIVOTS, SPINDLES, AND INTERNAL LOCK MECHANISMS WITH A CONSERVATION-GRADE LUBRICANT AFTER CLEANING.

7. TEST RESTORED COMPONENTS FOR SMOOTH AND PROPER OPERATION PRIOR TO REINSTALLATION.

C. RESTRICTIONS:

1. DO NOT STRIP PATINA, PLATE OVER ORIGINAL FINISHES, OR POLISH TO A MIRROR SHINE UNLESS EVIDENCE CONFIRMS THIS WAS HISTORICALLY ACCURATE.

2. DO NOT ALTER SCREW-HOLE LOCATIONS, HARDWARE BACKSET, OR GEOMETRY WITHOUT ARCHITECT'S APPROVAL.

3. REVERSIBLE METHODS ARE REQUIRED WHEREVER POSSIBLE.

3.4 NEW COMPATIBLE HARDWARE INSTALLATION

A. INSTALL NEW HARDWARE MATCHING EXISTING.

B. AVOID ALTERING HISTORIC FABRIC AND ENSURE REVERSIBILITY.

3.5 REINSTALLATION

A. REINSTALL IN ORIGINAL LOCATIONS AND ADJUST FOR SMOOTH OPERATION.

3.6 FINAL PROTECTION

A. PROTECT HARDWARE AND APPLY FINAL WAX COATING.

END OF SECTION 087163

SECTION 090561
COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:

B. Removal of existing floor coverings.

C. Preparation of new and existing concrete floor slabs for installation of floor coverings.

D. Testing of concrete floor slabs for moisture and alkalinity (pH).

E. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
   1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.

F. Patching compound.

G. Remedial floor coatings.

1.02 REFERENCE STANDARDS

A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens); 2021.

B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete; 2020.

C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2021.

D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2016a.

E. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; 2018.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Visual Observation Report: For existing floor coverings to be removed.

C. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
   1. Moisture and alkalinity (pH) limits and test methods.
   2. Manufacturer's required bond/compatibility test procedure.

D. Testing Agency's Report:
   1. Description of areas tested; include floor plans and photographs if helpful.
   2. Summary of conditions encountered.
   3. Moisture and alkalinity (pH) test reports.
   4. Copies of specified test methods.
   5. Recommendations for remediation of unsatisfactory surfaces.
   6. Product data for recommended remedial coating.
   7. Certificate: Include certification of accuracy by authorized official of testing agency.
   8. Submit report to Architect.
   9. Submit report not more than two business days after conclusion of testing.

E. Adhesive Bond and Compatibility Test Report.

F. Copy of RFCI (RWP).

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
   1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.

B. Contractor's Responsibility Relating to Independent Agency Testing:
   1. Provide access for and cooperate with testing agency.
   2. Confirm date of start of testing at least 10 days prior to actual start.
   3. Allow at least 4 business days on site for testing agency activities.
   4. Achieve and maintain specified ambient conditions.
   5. Notify Owner when specified ambient conditions have been achieved and when testing will start.

C. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, handle, and protect products in accordance with manufacturer’s instructions and recommendations.

B. Deliver materials in manufacturer’s packaging; include installation instructions.

C. Keep materials from freezing.

1.07 FIELD CONDITIONS

A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.

B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.01 MATERIALS

A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
   1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
   2. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
   3. Products:
      a. ARDEX Engineered Cements; ARDEX Feather Finish: www.ardexamericas.com/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.

B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.

C. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring

manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.

1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
2. Use product recommended by testing agency.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

A. Perform following operations in the order indicated:
   1. Preliminary cleaning.
   2. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
   3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
   4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
   5. Specified remediation, if required.
   6. Patching, smoothing, and leveling, as required.
   7. Other preparation specified.
   8. Adhesive bond and compatibility test.
   9. Protection.

B. Remediations:
   1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
   2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
   3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.02 REMOVAL OF EXISTING FLOOR COVERINGS

A. Comply with local, State, and federal regulations and recommendations of RFCI (RWP), as applicable to floor covering being removed.

B. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

3.03 PRELIMINARY CLEANING

A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.

B. Do not use solvents or other chemicals for cleaning.

3.04 MOISTURE VAPOR EMISSION TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.

C. Test in accordance with ASTM F1869 and as follows.

D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.

E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.

F. Report: Report the information required by the test method.

3.05 ALKALINITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
   1. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
   2. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
   3. Use of a digital pH meter with probe is acceptable; follow meter manufacturer's instructions.

C. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.06 PREPARATION

A. See individual floor covering section(s) for additional requirements.

B. Comply with requirements and recommendations of floor covering manufacturer.

C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.

D. Do not fill expansion joints, isolation joints, or other moving joints.

3.07 ADHESIVE BOND AND COMPATIBILITY TESTING

A. Comply with requirements and recommendations of floor covering manufacturer.

3.08 APPLICATION OF REMEDIAL FLOOR COATING

A. Comply with requirements and recommendations of coating manufacturer.

3.09 PROTECTION

A. Cover prepared floors with building paper or other durable covering.

END OF SECTION 090561

SECTION 092116
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.

B. Metal stud wall framing.

C. Metal channel ceiling framing.

D. Acoustic insulation.

E. Gypsum sheathing.

F. Gypsum wallboard.

G. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Wood blocking product and execution requirements.

B. Section 078400 - Firestopping: Top-of-wall assemblies at fire-resistance-rated walls.

C. Section 079200 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

1.03 REFERENCE STANDARDS

A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2016, with Supplement (2020).

B. AISI S201 - North American Standard for Cold-Formed Steel Framing - Product Data; 2017.

C. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.

D. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).

E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.

F. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.

G. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.

H. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).

I. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.

J. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.

K. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2020.

L. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2022.

M. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.

N. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.

O. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.

P. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).

Q. ASTM E413 - Classification for Rating Sound Insulation; 2016.

R. GA-216 - Application and Finishing of Gypsum Panel Products; 2021.

S. GA-224 - Installation of Predecorated Gypsum Board; Gypsum Association; 2008.

T. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data:
   1. Provide data on metal framing, gypsum board, accessories, and joint finishing system.
   2. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.

B. Interior Partitions: Provide completed assemblies with the following characteristics:
   1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

2.02 METAL FRAMING MATERIALS

A. Material and Product Requirements Criteria: AISI S201.

B. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.

C. Manufacturers - Metal Framing, Connectors, and Accessories:
   1. ClarkDietrich; ____: www.clarkdietrich.com/#sle.
   2. MarinoWARE; ____: www.marinoware.com/#sle.
   3. Phillips Manufacturing Co; ____: www.phillipsmfg.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

D. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
   1. Studs: C-shaped with knurled or embossed faces.
   2. Runners: U shaped, sized to match studs.
   3. Ceiling Channels: C-shaped.
   4. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch.

E. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection and prevent rotation of studs while maintaining structural performance of partition.
   1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100.
   2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot-dipped galvanized coating.
   3. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 12 feet.

2.03 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
   1. American Gypsum Company; ____: www.americangypsum.com/#sle.
   2. CertainTeed Corporation; ____: www.certainteed.com/#sle.
   3. Georgia-Pacific Gypsum; ____: www.gpgypsum.com/#sle.

4. Substitutions: See Section 016000 - Product Requirements.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. Thickness:
      a. Vertical Surfaces: 5/8 inch.
      b. Ceilings: 5/8 inch.
      c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.

2.04 GYPSUM BOARD ACCESSORIES

A. Acoustic Insulation: ASTM C665; preformed mineral-fiber, friction fit type, unfaced; thickness as required for STC.

B. Finishing Accessories: ASTM C1047, extruded aluminum alloy (6063 T5) or galvanized steel sheet ASTM A924/A924M G90, unless noted otherwise.
   1. Types: As detailed or required for finished appearance.
   2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.
   3. Products:
      a. Same manufacturer as framing materials.

C. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic, galvanized steel, or rolled zinc, unless noted otherwise.
   1. Architectural Reveal Beads:
      a. Reveal Depth: 1/4 inch.
      b. Reveal Width: 1/4 inch.
   2. Wall Mounted Deflection Beads: Flexible gasket and bead with 1-1/8 inch flange.

D. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.

E. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

F. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion-resistant.

G. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C1007AISI S220 and manufacturer's instructions.

B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
   1. Level ceiling system to a tolerance of 1/1200.
   2. Laterally brace entire suspension system.

C. Studs: Space studs at 16 inches on center.
   1. Extend partition framing to structure where indicated and to ceiling in other locations.
   2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
   3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of

stud connections; do not leave studs unattached to track.

D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

E. Standard Wall Furring: Install at concrete walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
   1. Orientation: Horizontal.
   2. Spacing: At 16 inches on center.

F. Blocking: Install wood blocking for support of:
   1. Framed openings.
   2. Wall-mounted cabinets.
   3. Plumbing fixtures.
   4. Wall-mounted door hardware.

3.03 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Acoustic Sealant: Install in accordance with manufacturer's instructions.

3.04 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
   1. Exception: Tapered edges to receive joint treatment at right angles to framing.

C. Double-Layer, Nonrated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.

D. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

E. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.

F. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.

3.05 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.06 JOINT TREATMENT

A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.

B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.

C. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

3.07 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

3.08 CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

B. Clean _____.

3.09 PROTECTION

A. Protect installed gypsum board assemblies from subsequent construction operations.

END OF SECTION 092116

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SECTION 095100
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

C. Supplementary insulation above ceiling.

1.02 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.

B. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.

C. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019 (Reapproved 2025).

D. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2022.

E. CHPS (HPPD) - High Performance Products Database; Current Edition.

F. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.

G. UL (FRD) - Fire Resistance Directory; Current Edition.

H. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Do not install acoustical units until after interior wet work is dry.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on suspension system components and acoustical units.

C. Samples: Submit two samples 8x8 inch in size illustrating material and finish of acoustical units.

D. Samples: Submit two samples each, 12 inches long, of suspension system main runner, cross runner, and perimeter molding.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.05 QUALITY ASSURANCE

A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acoustic Tiles/Panels:

1. Armstrong World Industries, Inc; ____: www.armstrongceilings.com/#sle.
2. Certainteed Architectural; ____: www.certainteed.com/ceilings-and-walls/#sle.
3. USG Corporation; ____: www.usg.com/ceilings/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. Suspension Systems:
1. Same as for acoustical units.
2. Substitutions: See Section 016000 - Product Requirements.

2.02 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Class A.
1. VOC Content: Certified as Low Emission by one of the following:
a. Product listing in UL (GGG).
b. Product listing in CHPS (HPPD).

B. Acoustical Tiles: Painted mineral fiber, with the following characteristics:
1. Classification: ASTM E1264 Type III.
2. Size: 24 by 24 inches.
3. Thickness: 5/8 inch.
4. Tile Edge: Tegular.
a. Joint: Kerfed and rabbeted.
5. Color: White.
6. Suspension System: Exposed grid.
7. Suspension System: Concealed.

2.03 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
1. Materials:
a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.

2.04 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

B. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.

C. Perimeter Moldings: Same metal and finish as grid.
1. Angle Molding: L-shaped, for mounting at same elevation as face of grid.

D. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM

A. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

B. Locate system on room axis according to reflected plan.

C. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
1. Use longest practical lengths.

D. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of

face plane of adjacent members.

E. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

F. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

G. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

H. Do not eccentrically load system or induce rotation of runners.

3.03 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

E. Cutting Acoustical Units:
   1. Make field cut edges of same profile as factory edges.

F. Where round obstructions occur, provide preformed closures to match perimeter molding.

G. Install hold-down clips on panels within 20 ft of an exterior door.

3.04 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.05 CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

B. Clean surfaces.

C. Replace damaged or abraded components.

END OF SECTION 095100

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SECTION 096623
RESINOUS MATRIX TERRAZZO FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Epoxy matrix terrazzo with ground and polished finish.

B. Divider strips.

1.02 RELATED REQUIREMENTS

A. Section 090561 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.

1.03 REFERENCE STANDARDS

A. NTMA (GRAD) - Aggregate Gradation Standards; Current Edition.

B. NTMA (EPOXY) - Epoxy Terrazzo Specifications; Current Edition.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for divider strips, control joint strips, expansion joints, and sealer; include printed copy of current NTMA recommendations for type of terrazzo specified.

C. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.

D. Cleaning and Maintenance Data: Include procedures for stain removal, stripping, and sealing.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with NTMA recommendations as posted at their web site at www.ntma.com.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section.
   1. Minimum five years of documented experience.

C. Installer Qualifications: Company specializing in performing the type of work specified in this section.
   1. Minimum five years of documented experience.
   2. Approved by matrix manufacturer.

1.06 MOCK-UP

A. Construct mock-up of terrazzo illustrating appearance of finished work in each configuration required. Size mock-up to be not less than 3 by 3 feet.

B. Mock-up may remain as part of the work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store terrazzo materials in a dry, secure area.

B. Maintain minimum temperature of 60 degrees F.

C. Keep products away from fire or open flame.

1.08 FIELD CONDITIONS

A. Do not install terrazzo when temperature is below 50 degrees F or above 90 degrees F.

B. Maintain temperature within specified range 24 hours before, during, and 72 hours after installation of flooring.

C. Provide ambient lighting level of 50 ft candles, measured at floor surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design - Resinous Matrix Terrazzo Flooring: Key Resin; Key Epoxy Terrazzo System: www.keyresin.com/#sle.

B. Other Acceptable Manufacturers - Resinous Matrix Terrazzo Flooring:
   1. Key Resin Company; Key Epoxy Terrazzo System: www.keyresin.com/#sle.
   2. Sika Corporation; Sikafloor Terrazzo: www.sikafloorusa.com/#sle.
   3. Substitutions: See Section 016000 - Product Requirements.

2.02 EPOXY MATRIX TERRAZZO APPLICATIONS

A. Floors:
   1. Thickness: 1/4 inch, nominal.
   2. Color(s): To be selected by Architect.
   3. Aggregate Type: Granite chips.
   4. Aggregate Size: No. 0-1.

2.03 MATERIALS

A. Epoxy Matrix Terrazzo: Aggregate and matrix mix applied to substrate, troweled flat, and ground smooth.

B. Matrix: Two component resin and epoxy hardener with mineral filler and color pigment, non-volatile, thermo-setting.

C. Aggregate: Type as indicated; sized in accordance with NTMA aggregate gradation standards; color(s) as indicated, uniform in color.

D. Finishing Grout: Epoxy, color to match terrazzo matrix.

2.04 ACCESSORIES

A. Divider Strips: 1/8 inch thick zinc exposed top strip, zinc coated steel concealed bottom strip, with anchoring features.

B. Divider and Control Joint Strip Height: To suit thickness of terrazzo topping, with allowance for grinding.

C. Sealer: Colorless, non-yellowing, penetrating liquid type to completely seal matrix surface; not detrimental to terrazzo components.

D. Primer: _____.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive terrazzo.

B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of materials to subfloor surfaces.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for terrazzo flooring installation by testing for moisture and alkalinity (pH).
   1. Obtain instructions if test results are not within limits recommended by terrazzo flooring manufacturer.
   2. Follow moisture and alkalinity remediation procedures in Section 090561.

D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Clean substrate of foreign matter.

B. Prepare concrete subfloor by mechanically abrading surface in accordance with manufacturer's instructions.

C. Apply primer in accordance with manufacturer's instructions.

3.03 INSTALLATION

A. Saw cut substrate to install divider and control joint strips.

B. Install divider strips according to pattern approved on shop drawings.

C. Place terrazzo mix over substrate to thickness indicated.

3.04 FINISHING

A. Finish terrazzo to NTMA requirements.

B. Grind terrazzo surfaces with power disc machine; sequence with coarse to fine grit abrasive, using a wet method or using a dry grinder with vacuum to control dust.

C. Apply grout to fill voids exposed from grinding.

D. Remove grout coat by grinding, using a fine grit abrasive.

3.05 TOLERANCES

A. Maximum Variation from Flat Surface: 1/4 inch in 10 feet.

3.06 CLEANING

A. Scrub and clean terrazzo surfaces with neutral pH cleaner in accordance with manufacturer's instructions. Let dry.

B. Immediately after terrazzo has dried, apply sealer in accordance with manufacturer's instructions.

C. Polish surfaces in accordance with manufacturer's instructions.

3.07 PROTECTION

A. Protect finished terrazzo from damage due to subsequent construction until Date of Substantial Completion.

END OF SECTION 096623

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SECTION 099010
SILICATE PAINTS AND COATINGS

PART 1 – GENERAL

1.01 SUMMARY OF WORK

A. For coating stucco and plaster surfaces.

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide a complete list of all products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category

C. Maintenance Materials: Furnish the following for the Texas Historical Commission's use in the maintenance of the project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Paint and Coatings: 1 gallon (4 L) of each color; store where directed.
   3. Label each container with color in addition to the manufacturer's label.

D. Samples shall be submitted for color matching to the same address.

E. Material Safety Data Sheets (MSDS) as appropriate.
   1. Apply coating samples on masonry—preferably on the building. Do not apply samples to plywood or other non-masonry surfaces.
   2. Written verification from the Contractor that all specified items will be used. Provide purchase orders, shipping tickets, receipts, etc. to prove that the specified materials were ordered and received.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in commercial painting and finishing with three years documented experience and approved by the coating manufacturer.

B. Coating Samples: Prepare a sample of each type of repair listed below. Prepare, install, and finish each sample according to the specifications.

1.04 MOCK-UP

A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.

B. Provide panel, 6 feet (1.83 m) long by 6 feet (1.83 m) wide, illustrating special coating color, texture, and finish.

C. Prepare samples in an area where they will be exposed to the same conditions as will be present on the building during curing. Allow samples to cure for at least three days (or longer, if possible) before obtaining Owner’s approval for color match. Samples should be viewed from a minimum distance of 12 feet.

D. Locate where directed.

E. Mock-up may remain as part of the work.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Materials are to be delivered, stored, and handled to protect them from damage, extreme temperature, and moisture in accordance with Manufacturer’s written instructions.

B. Deliver and store material in Manufacturer’s original, unopened containers with the production date shown on the container or packaging.

C. Comply with the Manufacturer’s written specifications and recommendations for mixing, application, and curing coatings.

1.06 PROTECTION/ SITE CONDITIONS

A. Cold Weather Requirements: Do not work in temperatures below 45° F, when the substrate is

colder than 45° F, or when the temperature is expected to fall below 45° F for 48 hours after installation of the coating.

B. Hot Weather Requirements: Protect coating from direct sunlight and wind during application. Do not use or prepare coating when ambient air temperature is above 95° F.

C. Foul weather requirements: Do not work when precipitation is expected within 48 hours of installation. The coating needs adequate time to bond to the substrate. Moisture disrupts the curing process.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.

B. Paint System: Keim Mineral Coatings of America: www.kiem.com.
   1. Products:
      a. 2 coat system: Soldalit Paint.
      b. Color: Custom to match existing paint colors.

C. Substitutions: See 01 6000 Product Requirements.

PART 3 – EXECUTION

3.01 PREPARATION

A. Do not start work until surfaces to be coated are in proper condition to produce finished surfaces of uniform, satisfactory appearance.

B. Mildew, algae and fungus should be removed by methods recommended by the coating manufacturer.

C. Remove dust and loose particulate matter from surfaces to receive coatings immediately prior to coating application.

D. Protect all non-masonry surfaces such as: glass, wood, metal, etc.

E. Cracks and spalls must be repaired and cured prior to coating application.

F. To ensure even penetration of the coating, make sure any masonry repairs have been made with repair materials that are compatible to the substrate.

G. Remove any previous or existing coatings before application of new mineral coating.

H. Substrate must be completely dry before coating. Do not work when precipitation is expected within 48 hours of installation. The coating needs adequate time to bond to the substrate. Moisture disrupts the curing process.

3.02 MIXING COATING SYSTEM

A. It is recommended that proper eye protection be worn during mixing in case of accidental splashing.

B. Both the base and finish coats require diluting prior to application.

C. Mix the paint coatings using silicate paint thinner in the desired proportions, before applying to surface.

D. Allow for drying time as recommended by manufacturer before adding successive coats.

E. Approximate mixing ratio is 2 quarts of silicate paint thinner for every 5 1/2 gallons for both the base coat and finish coat. Depending on the desired coating consistency and the substrate surface, may slightly vary.

3.03 APPLICATION OF SILICATE COATING

A. Apply each coat by brush or 1 ¼” lambs-wool roller, making sure to work the material into the pores of the plaster surface. The coating is designed to be absorbed into the surface so it should not be applied in thick layers. Brush application increases the absorption of the coating

into the masonry. This feature results in a longer lasting, more durable coating.

B. Allow manufacturer's specified drying time, and ensure correct coating adhesion, for each coat before applying the next coat.

C. Apply succeeding coat until it matches the approved mock-up.

D. Where coating application abuts other materials or other coating color, terminate coating, making clean sharp termination line without coating overlap.

E. Where color changes occur between adjoining spaces, through framed openings that are of same color as adjoining surfaces, change color at outside stop corner nearest to face of closed door.

3.04 CLEAN UP

A. Place tools immediately in clean water when pausing work (15-30 minutes or more). Clean tools with clean water immediately after finishing work. Mineral Life Silicate Paint can be removed from non-porous surfaces with clean water while still wet.

END OF SECTION 099010

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SECTION 099113
EXTERIOR PAINTING

PART 2 PRODUCTS

1.01 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless required to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Supply each paint material in quantity required to complete entire project's work from a single production run.
   3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is described explicitly in manufacturer's product instructions.

PART 3 EXECUTION

2.01 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

2.02 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance.

D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

END OF SECTION 099113

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SECTION 099123
INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Materials for backpriming woodwork.

D. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.

E. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
   5. Floors, unless specifically indicated.
   6. Glass.
   7. Concealed pipes, ducts, and conduits.

1.02 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.

B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2024.

C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.

D. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2020.

E. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

F. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).

G. SSPC V1 (PM1) - Good Painting Practice: Painting Manual Volume 1; 2024.

H. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

I. SSPC-SP 2 - Hand Tool Cleaning; 2024.

J. SSPC-SP 3 - Power Tool Cleaning; 2024.

K. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

L. SSPC-SP 13 - Surface Preparation of Concrete; 2018.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
   2. MPI product number (e.g., MPI #47).
   3. Cross-reference to specified paint system products to be used in project; include description of each system.

4. Manufacturer's installation instructions.
5. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions proposed.

C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
1. Where sheen is specified, submit samples in only that sheen.
2. Allow 30 days for approval process, after receipt of complete samples by Architect.
3. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as masonry, have been approved.

D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.

E. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements, for additional provisions.
2. Extra Paint and Finish Materials: 1 gal of each color; from the same product run, store where directed.
3. Label each container with color in addition to the manufacturer's label.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 5 years experience and approved by manufacturer.

1.05 MOCK-UP

A. See Section 014000 - Quality Requirements, for general requirements for mock-up.

B. Mock-up may remain as part of the work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.

D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 fc measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.

1. If a single manufacturer cannot provide specified products; minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.

B. Paints:
   1. Behr Paint Company: www.behr.com/#sle.
   2. Pittsburgh Paints: www.ppgpaints.com/#sle.
   3. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

C. Primer Sealers: Same manufacturer as top coats.

D. Substitutions: See Section 016000 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Supply each paint material in quantity required to complete entire project's work from a single production run.
   3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content:
   1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
      a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
      b. SCAQMD 1113 Rule.
      c. CARB (SCM).
   2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

2.03 PAINT SYSTEMS - INTERIOR

A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, concrete masonry units, brick, wood, plaster, uncoated steel, shop primed steel, galvanized steel, aluminum, and acoustical ceilings.
   1. Two top coats and one coat primer.
   2. Top Coat(s): High Performance Architectural Interior Latex; MPI #138, 139, 140, 141, or 142.
      a. Products:
         1) Behr Marquee Interior Satin Enamel [No.7450]. (MPI #140)
         2) Pittsburgh Paints Prominence Interior Latex, 84-3410 Series, Satin. (MPI #139)
         3) Sherwin-Williams Scuff Tuff Interior Waterbased Enamel, Eg-Shel, S24-50 Series.
         4) Substitutions: See Section 016000 - Product Requirements

2.04 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
   1. Gypsum Wallboard: 12 percent.
   2. Plaster and Stucco: 12 percent.
   3. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
   4. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Concrete:

F. Masonry:

G. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

H. Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high-alkali surfaces.

I. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

J. Galvanized Surfaces:

K. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
   3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 Commercial Blast Cleaning. Protect from corrosion until coated.

L. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

D. Sand wood and metal surfaces lightly between coats to achieve required finish.

E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for general requirements for field inspection.

B. Owner will provide field inspection.

3.05 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION 099123

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SECTION 099300
STAINING AND TRANSPARENT FINISHING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Field application of stains.

1.02 REFERENCE STANDARDS

A. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and catalog number, and general product category.
   2. MPI product number (e.g. MPI #33).

C. Samples: Two samples on actual wood substrate to be finished, 8 by 8 inch in size, indicating selected colors and sheens for each system, with specified coats cascaded.

D. Manufacturer's Instructions: Indicate special surface preparation procedures.

E. Maintenance Data: Submit data including finish schedule showing where each product, color, and finish was used, product technical data sheets, safety data sheets (SDS), care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements for additional provisions.
   2. Extra Stock Materials: Stain and transparent finish materials, 1 gal of each color and type; store where directed.
      a. Label each container with color and type in addition to the manufacturer's label.

1.04 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of stain or transparent finish, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Stain and Transparent Finish Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.06 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by manufacturer of stains and transparent finishes.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.

D. Minimum Application Temperature: 50 degrees F unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 fc measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide finishes from the same manufacturer to the greatest extent possible.
   1. In the event that a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.

B. Stains:
   1. Behr Process Corporation; ____: www.behr.com/#sle.
   2. Pittsburgh Paints; _____: www.ppgpaints.com/#sle.
   3. Sherwin-Williams Company; ____: www.sherwin-williams.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

2.02 STAINS AND TRANSPARENT FINISHES - GENERAL

A. Finishes:
   1. Provide finishes capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Provide materials compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
   3. Supply each finish material in quantity required to complete entire project's work from a single production run.
   4. Do not reduce, thin, or dilute finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Flammability: Comply with applicable code for surface burning characteristics.

C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

D. Colors: To be selected from manufacturer's full range of available colors.
   1. Selection to be made by Architect after award of contract.

2.03 INTERIOR STAIN AND TRANSPARENT FINISH SYSTEMS

A. Finish on Wood - Vertical Surfaces:
   1. Stain: Semi-transparent stain for wood, solvent based.
      a. Products:
         1) Behr Advanced Formula Oil-Based Wood Stain [B3500].
         2) Behr Premium Semi-Transparent Waterproofing Penetrating Oil Stain and Sealer [4600].
         3) Substitutions: Section 016000 - Product Requirements.
   2. Sealer: Water based, sanding sealer, clear.
      a. Products:
         1) Behr Water-Based Pre-Stain Wood Conditioner [No.B2080].
         2) Substitutions: Section 016000 - Product Requirements.
   3. Top Coat: Clear water-based varnish; MPI #128, 129, or 130.
      a. Products:
         1) Behr Fast Drying Water-Based Polyurethane [B8100].
         2) Substitutions: Section 016000 - Product Requirements.
   4. Top Coat Sheen:
      a. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.

2.04 ACCESSORY MATERIALS

A. Accessory Materials: Cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of finished surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of stains and finishes until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

D. Reinstall items removed prior to finishing.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for general requirements for field inspection.

B. Owner will provide field inspection.

3.05 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION 099300

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SECTION 122113
HORIZONTAL LOUVER BLINDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Horizontal slat louver blinds.

B. Operating hardware.

1.02 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the placement of concealed blocking to support blinds. See Section 061000.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating physical and dimensional characteristics.

C. Shop Drawings: Indicate opening sizes, tolerances required, method of attachment, clearances, and operation.

D. Samples: Submit two samples, 12 inch long illustrating slat materials and finish, cord type and color.

E. Manufacturer's Installation Instructions: Indicate special procedures.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 BLINDS WITHOUT SIDE GUIDES

A. Description: Horizontal slat louvers hung from full-width headrail with full-width bottom rail.

B. Wood Slats: Walnut species, square slat corners.
   1. Width: 2 inch.
   2. Pre-finished, color as selected by Architect.

C. Slat Support: Woven polypropylene cord, ladder configuration.

D. Head Rail: Pre-finished, formed aluminum box, with end caps; internally fitted with hardware, pulleys, and bearings for operation; same depth as width of slats.
   1. Color: Same as slats.

E. Control Wand: Extruded solid plastic; hexagonal shape.
   1. Length of window opening height less 3 inch.
   2. Color: Match color of slats.

F. Headrail Attachment: Wall brackets.

G. Accessory Hardware: Type recommended by blind manufacturer.

2.03 FABRICATION

A. Determine sizes by field measurement.

B. Fabricate blinds to fit within openings with uniform edge clearance of 1 inch.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that openings are ready to receive the work.

B. Ensure structural blocking and supports are correctly placed. See Section 061000.

3.02 INSTALLATION

A. Install blinds in accordance with manufacturer's instructions.

B. Secure in place with flush countersunk fasteners.

3.03 TOLERANCES

A. Maximum Variation of Gap at Window Opening Perimeter: 1/4 inch.

B. Maximum Offset From Level: 1/8 inch.

3.04 ADJUSTING

A. Adjust blinds for smooth operation.

3.05 CLEANING

A. Clean blind surfaces just prior to occupancy.

B. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.

END OF SECTION 122113

SECTION 126100
WOOD COURTROOM PEW SEATING

NOTE TO SPECIFIER: THIS SECTION IS INTENDED FOR USE IN HISTORIC CIVIC BUILDINGS AND COURTROOMS WHERE NEW FIXED WOOD PEW SEATING IS INSTALLED TO REPLACE NON-ORIGINAL SEATING. EDIT SELECTIONS IN BRACKETS AND COORDINATE DIMENSIONS, ACCESSIBILITY, AND CODE REQUIREMENTS WITH DRAWINGS AND AUTHORITIES HAVING JURISDICTION. REMOVE ALL NOTES PRIOR TO ISSUING PROJECT MANUAL.

1.01 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.

C. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

PART 1 – GENERAL

2.01 1.1 SUMMARY

A. SECTION INCLUDES:

A. Custom-fabricated, solid wood courtroom pew seating.

B. Anchoring, leveling, and installation of pews.

C. Factory finishing and field touch-up.

B. RELATED SECTIONS:

A. Section 06 20 00 – Finish Carpentry.

B. Section 09 90 00 – Painting and Coating.

C. Section 01 33 00 – Submittal Procedures.

D. Section 01 81 13 – Sustainable Design Requirements if applicable.

1.2 REFERENCES

A. ARCHITECTURAL WOODWORK INSTITUTE (AWI):

A. AWI Quality Standards Illustrated, latest edition.

B. ASTM INTERNATIONAL:

A. ASTM D4442 – Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials.

C. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA):

A. NFPA 101 – Life Safety Code.

D. AMERICANS WITH DISABILITIES ACT (ADA):

A. 2010 ADA Standards for Accessible Design.

1.3 ADMINISTRATIVE REQUIREMENTS

A. PREINSTALLATION CONFERENCE: CONDUCT CONFERENCE AT PROJECT SITE TO REVIEW LAYOUT, ANCHORAGE, COORDINATION WITH FINISHED FLOORING, PROTECTION OF HISTORIC MATERIALS, AND SEQUENCING.

1.4 SUBMITTALS

A. PRODUCT DATA: MANUFACTURER'S LITERATURE DESCRIBING PEW CONSTRUCTION, MATERIALS, FINISHES, AND ANCHORAGE SYSTEMS.

B. SHOP DRAWINGS:

A. Plans, elevations, and sections indicating pew profiles, end details, seat and back dimensions, anchorage locations, and overall layout.

B. Coordination drawings reflecting aisle widths, egress paths, and accessible seating locations.

C. SAMPLES:

A. Wood species samples showing grain and color.

B. Finish samples, minimum 6 by 6 inches, showing stain and final sheen.

D. MOCKUPS:

A. Provide one full-size pew section with end panel for review of proportions, craftsmanship, and finish.

B. Approved mockup may remain as part of the Work.

1.5 QUALITY ASSURANCE

A. MANUFACTURER QUALIFICATIONS: FIRM SPECIALIZING IN CUSTOM WOOD PEWS WITH MINIMUM 5 YEARS DOCUMENTED EXPERIENCE IN CIVIC, COURTROOM, OR INSTITUTIONAL PROJECTS.

B. INSTALLER QUALIFICATIONS: EXPERIENCED MILLWORK INSTALLER WITH DEMONSTRATED EXPERIENCE IN OCCUPIED OR HISTORIC BUILDINGS.

C. REGULATORY REQUIREMENTS:

A. Comply with applicable building codes, fire codes, and accessibility requirements.

B. Where subject to preservation review, fabricate and install pews in a manner consistent with the Secretary of the Interior’s Standards for Rehabilitation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. DELIVER MATERIALS WRAPPED AND PROTECTED FROM MOISTURE AND PHYSICAL DAMAGE.
B. STORE IN CONDITIONED SPACE, ELEVATED ABOVE FLOOR, AND PROTECTED FROM TEMPERATURE AND HUMIDITY EXTREMES.

1.7 PROJECT CONDITIONS

A. FIELD MEASUREMENTS: VERIFY COURTROOM DIMENSIONS, FLOOR SLOPES, AND OBSTRUCTIONS PRIOR TO FABRICATION.

B. ENVIRONMENTAL CONDITIONS: DO NOT INSTALL PEWS UNTIL BUILDING IS ENCLOSED AND HVAC SYSTEMS ARE OPERATING TO MAINTAIN OCCUPANCY-LEVEL CONDITIONS.

1.8 WARRANTY

A. MANUFACTURER’S WARRANTY: MINIMUM ONE-YEAR WARRANTY FROM DATE OF SUBSTANTIAL COMPLETION COVERING DEFECTS IN MATERIALS AND WORKMANSHIP.

PART 2 – PRODUCTS

28.01 2.1 MANUFACTURERS

A. BASIS-OF-DESIGN MANUFACTURER: CUSTOM MANUFACTURER SPECIALIZING IN SOLID WOOD INSTITUTIONAL OR COURTROOM SEATING.

B. SUBSTITUTIONS: IN ACCORDANCE WITH DIVISION 01 REQUIREMENTS.

2.2 MATERIALS

A. WOOD:

A. Species: Oak.

B. Moisture Content: 6 to 8 percent at time of fabrication.

C. Grade: Clear or Select, free of visible defects on exposed surfaces.

B. ADHESIVES: WATERPROOF STRUCTURAL WOOD ADHESIVE COMPLYING WITH ANSI/HPVA REQUIREMENTS.

C. FASTENERS:

A. Concealed screws or bolts, stainless steel or corrosion-resistant steel.

B. Exposed fasteners not permitted on visible surfaces.

D. ANCHORS: CONCEALED FLOOR ANCHORS SUITABLE FOR SUBSTRATE CONDITIONS.

2.3 PEW CONSTRUCTION

A. GENERAL:

A. Fabricate pews as rigid assemblies designed for heavy public use.

B. Appearance to reflect traditional courtroom seating proportions.

B. DIMENSIONS:

A. Seat Height: 17 to 18 inches above finished floor.

B. Seat Depth: 15 to 16 inches.

C. Back Height and Angle: As indicated on Drawings and approved Shop Drawings.

C. COMPONENTS:

A. Seat and Back: Solid wood panels or framed assemblies.

B. End Panels: Solid wood with traditional profiles; edges eased.

C. Intermediate Supports: As required for structural integrity.

D. JOINERY:

A. Mortise-and-tenon, dowel, or equivalent concealed joinery.

B. Tight-fitting, glued joints; mechanical fasteners concealed.

2.4 FINISHES

A. FINISH: SATIN OR LOW-SHEEN VARNISH OR POLYURETHANE FORMULATED FOR INSTITUTIONAL USE. APPLY UNDER CONTROLLED CONDITIONS. SELECTED STAIN FINISH TO MATCH WINDOWS AND DOORS.

B. FIRE PERFORMANCE: WHERE REQUIRED, PROVIDE FIRE-RETARDANT TREATMENT OR FINISH MEETING APPLICABLE FLAME-SPREAD REQUIREMENTS WITHOUT ALTERING APPEARANCE.

PART 3 – EXECUTION

44.01 3.1 EXAMINATION

A. VERIFY SUBSTRATES ARE LEVEL, SECURE, AND SUITABLE FOR ANCHORAGE.
B. VERIFY FLOOR FINISHES ARE COMPLETE AND PROTECTED.

3.2 INSTALLATION

A. INSTALL PEWS PLUMB, LEVEL, AND ALIGNED IN STRAIGHT ROWS WITH UNIFORM SPACING.

B. ANCHOR PEWS TO FLOOR SUBSTRATES IN ACCORDANCE WITH APPROVED SHOP DRAWINGS.

C. COORDINATE LAYOUT WITH AISLES, EGRESS PATHS, AND DESIGNATED ACCESSIBLE SEATING LOCATIONS.

D. FIELD MODIFICATIONS: DO NOT MODIFY PEWS WITHOUT ARCHITECT'S APPROVAL.

3.3 ADJUSTING AND CLEANING

A. ADJUST PEWS TO ELIMINATE ROCKING AND ENSURE STABILITY.
B. TOUCH UP MINOR FINISH DEFECTS USING APPROVED MATERIALS.
C. CLEAN EXPOSED SURFACES OF CONSTRUCTION DEBRIS.

3.4 PROTECTION

A. PROTECT INSTALLED PEWS FROM DAMAGE UNTIL SUBSTANTIAL COMPLETION.
B. REPAIR OR REPLACE DAMAGED WORK TO SATISFACTION OF ARCHITECT.

END OF SECTION 126100

SECTION 142400
MACHINE ROOM-LESS HYDRAULIC PASSENGER ELEVATORS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices; 2022.

B. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

C. ISO 9001 - Quality Management Systems — Requirements; 2015, with Amendment (2024).

D. ISO 14001 - Environmental Management Systems — Requirements with Guidance for Use; 2015, with Amendment (2024).

E. ISO 14044 - Environmental Management - Life Cycle Assessment - Requirements and Guidelines; 2006, with Amendment (2020).

F. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.

1.02 1.01 SUMMARY

A. Section includes: Machine room-less hydraulic passenger elevators as shown and specified. Elevator work includes:
   1. Standard pre-engineered hydraulic passenger elevators.
   2. Elevator car enclosures, hoistway entrances and signal equipment.
   3. Operation and control systems.
   4. Jack(s).
   5. Accessibility provisions for physically disabled persons.
   6. Equipment, machines, controls, systems and devices as required for safely operating the specified elevators at their rated speed and capacity.
   7. Materials and accessories as required to complete the elevator installation.

B. Related Sections:
   1. Division 1 General Requirements: Meet or exceed all referenced sustainability requirements.
   2. Division 3 Concrete: Installing inserts, sleeves and anchors in concrete.
   3. Division 4 Masonry: Installing inserts, sleeves and anchors in masonry.
   4. Division 5 Metals:
      a. Providing hoist beams, pit ladders, steel framing, auxiliary support steel and divider beams for supporting guide-rail brackets.
      b. Providing steel angle sill supports and grouting hoistway entrance sills and frames.
   5. Division 9 Finishes: Providing elevator car finish flooring and field painting unfinished and shop primed ferrous materials.
   6. Division 16 Sections:
      a. Providing electrical service to elevators, including fused disconnect switches where permitted. (note: fused disconnect switch to be provided as part of elevator manufacture product, see section 2.11 Miscellaneous elevator components for further details.)
      b. Emergency power supply, transfer switch and auxiliary contacts.
      c. Heat and smoke sensing devices.
      d. Convenience outlets and illumination in control room (if applicable), hoistway and pit.
   7. Division 22 Plumbing
      a. Sump pit and oil interceptor.

8. Division 23 Heating, Ventilation and Air Conditioning
    a. Heating and ventilating hoistways and/or control room.

C. Work Not Included: General contractor shall provide the following in accordance with the requirements of the Model Building Code and ANSI A17.1 Code. For specific rules, refer to ANSI A17.1, Part 3 for hydraulic elevators. State or local requirements must be used if more stringent. The cost of this work is not included in the TK Elevator's proposal, since it is a part of the building construction.
    1. Elevator hoist beam to be provided at top of elevator shaft. Beam must be able to accommodate proper loads and clearances for elevator installation and operation.
    2. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports and bracing including all setting templates and diagrams for placement.
    3. Hatch walls require a minimum two hours of fire rating. Hoistway should be clear and plumb with variations not to exceed 1/2" at any point.
    4. Elevator hoistways shall have barricades, as required.
    5. Install bevel guards at 75° on all recesses, projections or setbacks over 2" (4" for A17.1 2000 areas) except for loading or unloading.
    6. Provide rail bracket supports at pit, each floor and roof. For guide rail bracket supports, provide divider beams between hoistway at each floor and roof.
    7. Pit floor shall be level and free of debris. Reinforce dry pit to sustain normal vertical forces from rails and buffers.
    8. Where pit access is by means of the lowest hoistway entrance, a vertical ladder of non-combustible material extending 42" minimum, (48" minimum for A17.1-2000 areas) shall be provided at the same height, above sill of access door or handgrips.
    9. All wire and conduit should run remote from the hoistways.
    10. When heat, smoke or combustion sensing devices are required, connect to elevator control cabinet terminals. Contacts on the sensors should be sided for 12 volt D.C.
    11. Install and furnish finished flooring in elevator cab.
    12. Finished floors and entrance walls are not to be constructed until after sills and door frames are in place. Consult elevator contractor for rough opening size. The general contractor shall supply the drywall framing so that the wall fire resistance rating is maintained, when drywall construction is used.
    13. Where sheet rock or drywall construction is used for front walls, it shall be of sufficient strength to maintain the doors in true lateral alignment. Drywall contractor to coordinate with elevator contractor.
    14. Before erection of rough walls and doors; erect hoistway sills, headers, and frames. After rough walls are finished; erect fascias and toe guards. Set sill level and slightly above finished floor at landings.
    15. To maintain legal fire rating (masonry construction), door frames are to be anchored to walls and properly grouted in place.
    16. The elevator wall shall interface with the hoistway entrance assembly and be in strict compliance with the elevator contractor's requirements.
    17. General Contractor shall fill and grout around entrances, as required.
    18. All walls and sill supports must be plumb where openings occur.
    19. Locate a light fixture (200 lx / 19 fc) and convenience outlet in pit with switch located adjacent to the access door.
    20. Provide telephone line, light fixture (200 lx / 19 fc), and convenience outlet in the hoistway at the landing where the elevator controller is located. Typically this will be at the landing above the 1st floor. Final location must be coordinated with elevator contractor.
    21. As indicated by elevator contractor, provide a light outlet for each elevator, in center of hoistway.
    22. For signal systems and power operated door: provide ground and branch wiring circuits.
    23. For car light and fan: provide a feeder and branch wiring circuits to elevator control cabinet.
    24. Controller landing wall thickness must be a minimum of 8 1/2 inches thick. This is due to

the controller being mounted on the second floor landing in the door frame on the return side of the door. For center opening doors, the controller is located on the right hand frame (from inside the elevator cab looking out). These requirements must be coordinated between the general contractor and the elevator contractor.

25. Cutting, patching and recesses to accommodate hall button boxes, signal fixtures, etc..

1.02 SUBMITTALS

A. Product data: When requested, the elevator contractor shall provide standard cab, entrance and signal fixture data to describe product for approval.

B. Shop drawings:
   1. Show equipment arrangement in the corridor, pit, and hoistway and/or optional control room. Provide plans, elevations, sections and details of assembly, erection, anchorage, and equipment location.
   2. Indicate elevator system capacities, sizes, performances, safety features, finishes and other pertinent information.
   3. Show floors served, travel distances, maximum loads imposed on the building structure at points of support and all similar considerations of the elevator work.
   4. Indicate electrical power requirements and branch circuit protection device recommendations.

C. Powder Coat paint selection: Submit manufacturer's standard selection charts for exposed finishes and materials.

D. Plastic laminate selection: Submit manufacturer's standard selection charts for exposed finishes and materials.

E. Metal Finishes: Upon request, standard metal samples provided.

F. Operation and maintenance data. Include the following:
   1. Owner's manuals and wiring diagrams.
   2. Parts list, with recommended parts inventory.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: An approved manufacturer with minimum 15 years of experience in manufacturing, installing, and servicing elevators of the type required for the project.
   1. The manufacturer of machines, controllers, signal fixtures, door operators cabs, entrances, and all other major parts of elevator operating equipment.
      a. The major parts of the elevator equipment shall be manufactured by the installing company, and not be an assembled system.
   2. The manufacturer shall have a documented, on-going quality assurance program.
   3. ISO 9001:2000 Manufacturer Certified
   4. ISO 14001:2004 Environmental Management System Certified
   5. LEED Gold certified elevator manufacturing facility.

B. Installer Qualifications: The manufacturer or an authorized agent of the manufacturer with not less than 15 years of satisfactory experience installing elevators equal in character and performance to the project elevators.

C. Regulatory Requirements:
   1. ASME A17.1 Safety Code for Elevators and Escalators, latest edition or as required by the local building code.
   2. Building Code: National.
   3. NFPA 70 National Electrical Code.
   4. NFPA 80 Fire Doors and Windows.
   5. Americans with Disabilities Act - Accessibility Guidelines (ADAAG)
   6. Section 407 inch ICC A117.1, when required by local authorities
   7. CAN/CSA C22.1 Canadian Electrical Code
   8. CAN/CSA B44 Safety Code for Elevators and Escalators.

9. California Department of Public Health Standard Method V1.1–2010, CA Section 01350

D. Fire-rated entrance assemblies: Opening protective assemblies including frames, hardware, and operation shall comply with ASTM E2074, CAN4-S104 (ULC-S104), UL10(b), and NFPA Standard 80. Provide entrance assembly units bearing Class B or 1 1/2 hour label by a Nationally Recognized Testing Laboratory (2 hour label in Canada).

E. Inspection and testing:
   1. Elevator Installer shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.
   2. Arrange for inspections and make required tests.
   3. Deliver to the Owner upon completion and acceptance of elevator work.

F. Sustainable Product Qualifications:
   1. Environmental Product Declaration:
      a. GOOD: If Product Category Rules (PCR) are not available, produce a publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that has at least a cradle to gate se.
      b. BEST: If Product Category Rules (PCR) are available, produce and publish an Environmental Product Declaration (EPD) based on a critically reviewed life-cycle assessment conforming to ISO 14044, with external verification recognized by the EPD program operator.
   2. Material Transparency:
      a. GOOD: Provide Health Product Declaration at any level
      b. BETTER: Provide Health Product Declaration (HPD v2 or later). Complete, published declaration with full disclosure of known hazards, prepared using the Health Product Declaration Collaborative's "HPD builder" on-line tool.
      c. BEST: Cradle to Cradle Material Health Certificate v3, Bronze level or higher.
   3. LEED v4 – Provide documentation for all Building Product Disclosure AND Optimization credits in LEED v4 for product specified.
   4. Living Building Challenge Projects: Provide Declare label for products specified.

1.04 DELIVERY, STORAGE AND HANDLING

A. Manufacturing shall deliver elevator materials, components and equipment and the contractor is responsible to provide secure and safe storage on job site.
   1. PROJECT CONDITIONS

B. Temporary Use: Elevators shall not be used for temporary service or for any other purpose during the construction period before Substantial Completion and acceptance by the purchaser unless agreed upon by Elevator Contractor and General Contractor with signed temporary agreement.

1.06 WARRANTY

A. Warranty: Submit elevator manufacturer's standard written warranty agreeing to repair, restore or replace defects in elevator work materials and workmanship not due to ordinary wear and tear or improper use or care for 12 months after final acceptance.

1.07 MAINTENANCE

A. Furnish maintenance and call back service for a period of 12 months for each elevator after completion of installation or acceptance thereof by beneficial use, whichever is earlier, during normal working hours excluding callbacks.
   1. Service shall consist of periodic examination of the equipment, adjustment, lubrication, cleaning, supplies and parts to keep the elevators in proper operation. Maintenance work, including emergency call back repair service, shall be performed by trained employees of the elevator contractor during regular working hours.
   2. Submit parts catalog and show evidence of local parts inventory with complete list of recommended spare parts. Parts shall be produced by manufacturer of original equipment.

3. Manufacturer shall have a service office and full time service personnel within a 100 mile radius of the project site.

PART 2 PRODUCTS

7.01 2.01 MANUFACTURERS

A. Manufacturer: Design based around TK Elevator's endura Machine Room-Less hydraulic elevator.

2.02 MATERIALS, GENERAL

A. All Elevator Cab materials including frame, buttons, lighting, wall and ceiling assembly, laminates and carpet shall have an EPD and an HPD, and shall meet the California Department of Public Health Standard Method V1.1–2010, CA Section 01350 as mentioned in 1.03.9 of this specification.

B. Colors, patterns, and finishes: As selected by the Architect from manufacturer's full range of standard colors, patterns, and finishes.

C. Steel:
   1. Shapes and bars: Carbon.
   2. Sheet: Cold-rolled steel sheet, commercial quality, Class 1, matte finish.
   3. Finish: Factory-applied baked enamel for structural parts, powder coat for architectural parts. Color selection must be based on elevator manufacture's standard selections.

D. Plastic laminate: Decorative high-pressure type, complying with NEMA LD 3, Type GP-50 General Purpose Grade, nominal 0.050" thickness. Laminate selection must be based on elevator manufacture's standard selections.

E. Flooring by others.

2.03 HOISTWAY EQUIPMENT

A. Platform: Fabricated frame of formed or structural steel shapes, gusseted and rigidly welded with a wood sub-floor. Underside of the platform shall be fireproofed. The car platform shall be designed and fabricated to support one-piece loads weighing up to 25% of the rated capacity.

B. Sling: Steel stiles bolted or welded to a steel crosshead and bolstered with bracing members to remove strain from the car enclosure.

C. Guide Rails: Steel, omega shaped, fastened to the building structure with steel brackets.

D. Guides: Slide guides shall be mounted on top and bottom of the car.

E. Buffers: Provide substantial buffers in the elevator pit. Mount buffers on continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Provide extensions if required by project conditions.

F. Jack: A jack unit shall be of sufficient size to lift the gross load the height specified. Factory test jack to ensure adequate strength and freedom from leakage. Brittle material, such as gray cast iron, is prohibited in the jack construction. Provide the following jack type: Twin post holeless telesic 3-stage. Two jacks piped together, mounted one on each side of the car with each having three telesic sections designed to extend in a synchronized manner when oil is pumped into the Assembly. Each jack section will be guided from within the casing or the plunger assembly used to house the section. Each plunger shall have a high pressure sealing system which will not allow for seal movement or displacement during the course of operation. A follower guide shall be furnished for the top of the lower two plungers and be guided by rollers running inside a steel guide channel which is firmly attached to the guide rail system. This plunger guide system shall maintain a stabilized support for the plunger sections. Each Jack Assembly shall have check valves built into the assembly to allow for automatically re-syncing the three plunger sections by moving the jack to its fully contracted position..

G. Automatic Self-Leveling: Provide each elevator car with a self-leveling feature to automatically bring the car to the floor landings and correct for over travel or under travel. Self-leveling shall, within its zone, be automatic and independent of the operating device. The car shall be

maintained approximately level with the landing irrespective of its load.

H. Wiring, Piping, and Oil: Provide all necessary hoistway wiring in accordance with the National Electrical Code. All necessary code compliant pipe and fittings shall be provided to connect the power unit to the jack unit. Provide proper viscosity grade inherently biodegradable oil as specified by the manufacturer of the power unit (see Power Unit section 2.04.G for further details)

I. Pit moisture/water sensor located approximately 1 foot above the pit floor to be provided. Once activated, elevator will perform “flooded pit operation”, which will run the car up to the designated floor, cycle the doors and shut down and trip the circuit breaker shunt to remove 3 phase power from all equipment, including pit equipment.

J. Motorized oil line shut-off valve shall be provided that can be remotely operated from the controller landing service panel. Also a means for manual operation at the valve in the pit is required.

2.04 POWER UNIT

A. Power Unit (Oil Pumping and Control Mechanism): A self-contained unit located in the elevator pit consisting of the following items:
   1. NEMA 4/Sealed Oil reservoir with tank cover including vapor removing tank breather
   2. An oil hydraulic pump.
   3. An electric motor.
   4. Electronic oil control valve with the following components built into single housing; high pressure relief valve, check valve, automatic unloading up start valve, lowering and leveling valve, and electro-magnetic controlling solenoids.

B. Pump: Positive displacement type pump specifically manufactured for oil-hydraulic elevator service. Pump shall be designed for steady discharge with minimum pulsation to give smooth and quiet operation. Output of pump shall not vary more than 10 percent between no load and full load on the elevator car.

C. Motor: Standard manufacture motor specifically designed for oil-hydraulic elevator service. Duty rating – motors shall be capable of 80 starts per hour with a 30% motor run time during each start.

D. Oil Control Unit: The following components shall be built into a single housing. Welded manifolds with separate valves to accomplish each function are not acceptable. Adjustments shall be accessible and be made without removing the assembly from the oil line.
   1. Relief valve shall be adjustable and be capable of bypassing the total oil flow without increasing back pressure more than 10 percent above that required to barely open the valve.
   2. Up start and stop valve shall be adjustable and designed to bypass oil flow during start and stop of motor pump assembly. Valve shall close slowly, gradually diverting oil to or from the jack unit, ensuring smooth up starts and up stops.
   3. Check valve shall be designed to close quietly without permitting any perceptible reverse flow.
   4. Lowering valve and leveling valve shall be adjustable for down start speed, lowering speed, leveling speed and stopping speed to ensure smooth "down" starts and stops. The leveling valve shall be designed to level the car to the floor in the direction the car is traveling after slowdown is initiated.
   5. Provided with constant speed regulation in both up and down direction. Feature to compensate for load changes, oil temperature, and viscosity changes.
   6. Solid State Starting: Provide an electronic starter featuring adjustable starting currents.
   7. A secondary hydraulic power source (powered by 110VAC single phase) must be provided. This is required to be able to raise (reposition) the elevator in the event of a system component failure (i.e. pump motor, starter, etc.)
   8. Oil Type: Provide a zinc free, inherently biodegradable lubricant formulated with premium base stocks to provide outstanding protection for demanding hydraulic systems, especially

those operating in environmentally sensitive areas.

2.05 HOISTWAY ENTRANCES

A. Doors and Frames: Provide complete hollow metal type hoistway entrances at each hoistway opening bolted\knock down construction.
   1. Manufacturer's standard entrance design consisting of hangers, doors, hanger supports, hanger covers, fascia plates (where required), sight guards, and necessary hardware.
   2. Main landing door & frame finish: ASTM A1008 steel panels, factory applied powder coat finish with factory-applied powder coat finish entrance frame.
   3. Typical door & frame finish: ASTM A366 steel panels, factory applied powder coat enamel finish with factory-applied powder coat finish entrance frame.

B. Integrated Control System: the elevator controller to be mounted to hoistway entrance above 1st landing. The entrance at this level, shall be designed to accommodate the control system and provide a means of access to critical electrical components and troubleshooting features. See section 2.09 Control System for additional requirements.

C. At the controller landing, the hoistway entrance frame shall have space to accommodate and provide a lockable means of access (group 2 security) to a 3 phase circuit breaker. See section 2.11 Miscellaneous Elevator Components for further details

D. Interlocks: Equip each hoistway entrance with an approved type interlock tested as required by code. Provide door restriction devices as required by code.

E. Door Hanger and Tracks: Provide sheave type two point suspension hangers and tracks for each hoistway horizontal sliding door.
   1. Sheaves: Polyurethane tires with ball bearings properly sealed to retain grease.
   2. Hangers: Provide an adjustable device beneath the track to limit the up-thrust of the doors during operation.
   3. Tracks: Drawn steel shapes, smooth surface and shaped to conform to the hanger sheaves.

F. Hoistway Sills: Extruded metal, with groove(s) in top surface. Provide mill finish on aluminum.

2.06 PASSENGER ELEVATOR CAR ENCLOSURE

A. Car Enclosure:
   1. Walls: Cab type TKAP, reinforced cold-rolled steel with two coats factory applied baked enamel finish, with applied vertical wood core panels covered on both sides with high pressure plastic laminate.
   2. Reveals and frieze: a. Reveals and frieze: Powder Coated
   3. Canopy: Cold-rolled steel with hinged exit.
   4. Ceiling: Downlight type, metal pans with suspended LED downlights and dimmer switch. Number of downlights shall be dependent on platform size with a minimum of six. The metal pans shall be finished with a stainless steel, no. 4 brushed finish.
   5. Cab Fronts, Return, Transom, Soffit and Strike: Provide panels faced with brushed stainless steel
   6. Doors: Horizontal sliding car doors reinforced with steel for panel rigidity. Hang doors on sheave type hangers with polyurethane tires that roll on a polished steel track and are guided at the bottom by non-metallic sliding guides.
      a. Door Finish: Stainless steel panels: No. 4 brushed finish.
      b. Cab Sills: Extruded aluminum, mill finish.
   7. Handrail: Provide 1.5' diameter cylindrical metal on side and rear walls on front opening cars and side walls only on front and rear opening cars. Handrails shall have a stainless steel, no. 4 brushed finish.
   8. Ventilation: Manufacturer’s standard exhaust fan, mounted on the car top.
   9. Protection pads and buttons: Not required

B. Car Top Inspection: Provide a car top inspection station with an “Auto-Inspection” switch, an "emergency stop" switch, and constant pressure "up and down" direction and safety buttons to

make the normal operating devices inoperative. The station shall give the inspector complete control of the elevator. The car top inspection station shall be mounted in the door operator assembly.

2.07 DOOR OPERATION

A. Door Operation: Provide a direct or alternating current motor driven heavy duty operator designed to operate the car and hoistway doors simultaneously. The door control system shall be digital closed loop and the closed loop circuit shall give constant feedback on the position and velocity of the elevator door. The motor torque shall be constantly adjusted to maintain the correct door speed based on its position and load. All adjustments and setup shall be through the computer based service tool. Door movements shall follow a field programmable speed pattern with smooth acceleration and deceleration at the ends of travel. The mechanical door operating mechanism shall be arranged for manual operation in event of power failure. Doors shall automatically open when the car arrives at the landing and automatically close after an adjustable time interval or when the car is dispatched to another landing. AC controlled units with oil checks, or other deviations are not acceptable.

1. No Un-Necessary Door Operation: The car door shall open only if the car is stopping for a car or hall call, answering a car or hall call at the present position or selected as a dispatch car.
2. Door Open Time Saver: If a car is stopping in response to a car call assignment only (no coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.
3. Double Door Operation: When a car stops at a landing with concurrent up and down hall calls, no car calls, and no other hall call assignments, the car door opens to answer the hall call in the direction of the car's current travel. If an onward car call is not registered before the door closes to within 6 inches of fully closed, the travel shall reverse and the door shall reopen to answer the other call.
4. Nudging Operation: The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door closing is prevented for a field programmable time, a buzzer shall sound. When the obstruction is removed, the door shall begin to close at reduced speed. If the infra-red door protection system detects a person or object while closing on nudging, the doors shall stop and resume closing only after the obstruction has been removed.
5. Door Reversal: If the doors are closing and the infra-red beam(s) is interrupted, the doors shall reverse and reopen. After the obstruction is cleared, the doors shall begin to close.
6. Door Open Watchdog: If the doors are opening, but do not fully open after a field adjustable time, the doors shall recycle closed then attempt to open six times to try and correct the fault.
7. Door Close Watchdog: If the doors are closing, but do not fully close after a field adjustable time, the doors shall recycle open then attempt to close six times to try and correct the fault.
8. Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.

B. Door Protection Device: Provide a door protection system using microprocessor controlled infra-red light beams. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen.

2.08 CAR OPERATING STATION

A. Car Operating Station, General: The main car control in each car shall contain the devices required for specific operation mounted in an integral swing return panel requiring no applied faceplate. Wrap return shall have a brushed stainless steel finish. The main car operating panel shall be mounted in the return and comply with handicap requirements. Pushbuttons that illuminate using long lasting LED’s shall be included for each floor served, and emergency buttons and switches shall be provided per code. Switches for car light and accessories shall

be provided.

B. Emergency Communications System: Integral phone system provided.

C. Auxiliary Operating Panel:

D. Column Mounted Car Riding Lantern: A car riding lantern shall be installed in the elevator cab and located in the entrance. The lantern, when illuminated, will indicate the intended direction of travel. The lantern will illuminate and a signal will sound when the car arrives at a floor where it will stop. The lantern shall remain illuminated until the door(s) begin to close.

E. Special Equipment:

F. Limited Access Operation: Keyswitch and card reader space.(card reader by others)

G. Digital Services: Cloud-based IoT monitoring system comes standard with these options:
   1. Remote Monitoring with Application Programming Interface (API) Integration
   2. ADA Phone - Code Compliant Cellular Connectivity
   3. A17.1 2019 Code - Enhanced Communications
   4. Smart Device Elevator Calling with occupant app API integration

2.09 CONTROL SYSTEMS

A. Controller: Shall be integrated in a hoistway entrance jamb. Should be microprocessor based, software oriented and protected from environmental extremes and excessive vibrations in a NEMA 1 enclosure. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings.

B. Service Panel – to be located outside the hoistway in the controller entrance jamb and shall provide the following functionality/features:
   1. Access to main control board and CPU
   2. Main controller diagnostics
   3. Main controller fuses
   4. Universal Interface Tool (UIT)
   5. Remote valve adjustment
   6. Electronic motor starter adjustment and diagnostics
   7. Operation of pit motorized shut-off valve with LED feedback to the state of the valve in the pit
   8. Operation of auxiliary pump/motor (secondary hydraulic power source)
   9. Operation of electrical assisted manual lowering
   10. Provide male plug to supply 110VAC into the controller
   11. Run/Stop button

C. Automatic Light and Fan shut down: The control system shall evaluate the system activity and automatically turn off the cab lighting and ventilation fan during periods of inactivity. The settings shall be field programmable.

D. Emergency Power Operation: (Battery Lowering 10D-0C) When the loss of normal power is detected, a battery lowering feature is to be activated. The elevator will lower to a predetermined level and open the doors. After passengers have exited the car, the doors will close and the car will shutdown. When normal power becomes available, the elevator will automatically resume operation. The battery lowering feature is included in the elevator contract and does not utilize a building-supplied standby power source.

E. Special Operation: spe

F. Digital Services:
   1. Cloud-based IoT Monitoring System (standard): Contractor shall provide a cloud-based IoT (internet of things) monitoring system capable of tracking door movements and timing, trips, power cycles, car calls, out-of-service events and modes. This observation will continue 24/7 and it shall be capable of providing service technicians a minimum of three

recommended solutions for defined failure events and automatically dispatch service technicians in the event of failure(s) while sending notifications to end users of changes in their equipment's state via both email and mobile device. Access to IoT and related equipment data and status will be made available in both a web portal and mobile application secured by password and username with at least two-factor authentication. Finally, this system must be self-contained and not require internet provision by others.

2. Along with the monitoring system, options are available.
3. Remote Monitoring with Application Programming Interface (API) Integration: Contractor shall provide a portal and mobile device application (app) that communicates relevant service and operational information such as elevator operational status, open service call tickets, call ticket history and performance and service history. This system shall provide a REST application programming interface (API) capable of transmitting relevant information from the cloud-based IoT monitoring system. This data includes equipment operational status, door movements, service and maintenance history, traffic statistics and failure alerts.
4. ADA Phone – Code Compliant Cellular Connectivity: Contractor shall provide a phone service through a self-contained cellular based VoIP system. This system shall meet code, include a backup battery capable of powering the emergency communication equipment for 4+ hours in the event of a power outage. The solution shall have remote monitoring capability to ensure continuous connectivity with a means of remote troubleshooting. Remote monitoring capability shall include, at a minimum, the ability to monitor connectivity and power supply. Remote monitoring shall be capable of providing local alerts to response personnel when on-site intervention is required.
5. A17.1 2019 Code – Enhanced Communications: For jobs installed under enforcement of 2018 International Building Code or ASME A17.1-2019/CSA B44:19 Safety Code, contractor will provide a video camera necessary for viewing the elevator cab interior floor as well as a position indicator display in the cab operating panel capable of providing means of two-way, text-based communication when the emergency call button is engaged in the elevator car. These components, and associated cloud-based monitoring platform, will be non-proprietary in nature, allowing customization on where to direct emergency calls, while offering capability for any party to provide the emergency monitoring services.
6. Smart Device Elevator Calling with Occupant app API Integration: Contractor will provide an elevator calling application for smart devices (app) that can be accessed through Android and IOS smart device operating systems. This calling service shall be accomplished on both, Destination Dispatch and Traditional ETA elevator control system applications. Furthermore, a single, common and consistent app shall have the same user experience and user interface on both Destination Dispatch and Traditional ETA dispatching control systems. To enable mobile calling functionality without creating unnecessary wear on elevator components resulting from false calls, proximity detection beacons shall be installed in the elevator lobby at each floor. These beacons shall detect user smart devices and restrict calling of elevators when the user is not within a pre-configured range of elevator entrance. Beacon-based proximity detection distance must be configurable to accommodate various building and floor layouts. Once Bluetooth signal is detected, the user can place a floor call directly from their handheld or wearable device. The elevator calling app shall remove the need for interaction with hall fixtures, buttons or kiosks. This system shall be capable of placing an automatic call to a user-configured destination floor automatically based on both location in building (floor) and time of day. App users shall be able to configure their own source or starting floor, destination floor and schedule of automatic calling service, and be able to configure multiple automatic calling services and routines. System shall have reasonable ability to auto-provision users from access control system and not require duplicate entry of users for access control purposes. Finally, all services above shall be made available via an application programming interface (API) so that a 3rd party or tenant occupant app could be integrated with elevator smart device calling service so that users could receive multiple occupant experience-based services in a single, common, 3rd party mobile device application (app).

2.10 HALL STATIONS

A. Hall Stations, General: Buttons shall illuminate to indicate call has been registered at that floor for the indicated direction.
   1. Provide one pushbutton riser with faceplates having a brushed stainless steel finish.
      a. Phase 1 firefighter's service key switch, with instructions, shall be incorporated into the hall station at the designated level.

B. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements.

C. Hall Position Indicator: Not Applicable

D. Hall lanterns: Not Applicable

E. Special Equipment:

F. Limited access operation: Not Applicable

2.11 MISCELLANEOUS ELEVATOR COMPONENTS

A. Oil Hydraulic Silencer: Install multiple oil hydraulic silencers (muffler device) at the power unit location. The silencers shall contain pulsation absorbing material inserted in a blowout proof housing.

B. Lockable three phase circuit breaker with auxiliary contact with shunt trip capability to be provided. Circuit breaker to be located behind locked panel (Group 2 security access) at controller landing entrance jamb and should be sized according to the National Electrical Code.

C. Lockable single phase 110V circuit breaker for cab light and fan to be provided. Circuit breaker to be located behind locked panel (Group 2 security access) at controller landing entrance jamb should be sized according to the National Electrical Code

PART 3 EXECUTION

18.01 3.01 EXAMINATION

A. Before starting elevator installation, inspect hoistway, hoistway openings, pits and/or control room, as constructed, verify all critical dimensions, and examine supporting structures and all other conditions under which elevator work is to be installed. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 INSTALLATION

A. Install elevator systems components and coordinate installation of hoistway wall construction.
   1. Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturer's installation instructions and approved shop drawings.
   2. Comply with the National Electrical Code for electrical work required during installation.

B. Perform work with competent, skilled workmen under the direct control and supervision of the elevator manufacturer's experienced foreman.

C. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports, and bracing including all setting templates and diagrams for placement.

D. Welded construction: Provide welded connections for installation of 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 qualification of welding operators.

E. Coordination: Coordinate elevator work with the work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the Contractor, to ensure dimensional coordination of the work.

F. Install machinery, guides, controls, car and all equipment and accessories to provide a quiet,

smoothly operating installation, free from side sway, oscillation or vibration.

G. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.

H. Erect hoistway sills, headers, and frames before erection of rough walls and doors; erect fascia and toe guards after rough walls finished. Set sill units accurately aligned and slightly above finish floor at landings.

I. Lubricate operating parts of system, where recommended by manufacturer.

3.03 FIELD QUALITY CONTROL

A. Acceptance testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required and recommended by Code and governing regulations or agencies. Perform other tests, if any, as required by governing regulations or agencies.

B. Advise Owner, Contractor, Architect, and governing authorities in advance of dates and times tests are to be performed on the elevator.

3.04 ADJUSTING

A. Make necessary adjustments of operating devices and equipment to ensure elevator operates smoothly and accurately.

3.05 CLEANING

A. Before final acceptance, remove protection from finished surfaces and clean and polish surfaces in accordance with manufacturer's recommendations for type of material and finish provided. Stainless steel shall be cleaned with soap and water and dried with a non-abrasive surface; it shall not be cleaned with bleach-based cleansers.

B. At completion of elevator work, remove tools, equipment, and surplus materials from site. Clean equipment rooms and hoistway. Remove trash and debris.

1. Use environmentally preferable and low VOC emitting cleaners for each application type. Cleaners that contain solvents, pine and/or citrus oils are not permitted.

3.06 PROTECTION

A. At time of Substantial Completion of elevator work, or portion thereof, provide suitable protective coverings, barriers, devices, signs, or other such methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

3.07 DEMONSTRATION

A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.

B. Make a final check of each elevator operation, with Owner's personnel present, immediately before date of substantial completion. Determine that control systems and operating devices are functioning properly.

3.08 ELEVATOR SCHEDULE

A. Elevator Qty. 1

1. Elevator Model: endura MRL Twinpost above-ground 3-stage
2. Elevator Type: Hydraulic Machine Room-Less, Passenger
3. Rated Capacity: 5000H lbs.
4. Rated Speed: 80 feet/min.
5. Operation System: TAC32H
6. Travel: 36'-0"

7. Landings: 4 total
8. Openings:
    a. Front: 4
    b. Rear: 0
9. Clear Car Inside: 5'-8" wide x 9'-0" deep
10. Inside clear height: 7'-4" standard
11. Door clear height: 7'-0" standard
12. Hoistway Entrance Size: 4'-6" wide x 7'-0" high
13. Door Type: Two-speed | LH Side opening
14. Power Characteristics: 208 volts, 3 Phase, 60 Hz.
15. Seismic Requirements: None
16. Hoistway Dimensions: 7'-8" wide x 10'-9" deep
17. Pit Depth: 4'-0"
18. Button & Fixture Style: Traditional Signal Fixtures
19. Special Operations:
20. Limited Access with card readers by others for basement access
21. Digital Services:
22. Remote Monitoring with Application Programming Interface (API) Integration
23. ADA Phone - Code Compliant Cellular Connectivity
24. A17.1 2019 Code - Enhanced Communications
25. Smart Device Elevator Calling with occupant app API integration

3.09 SPECIAL CONDITIONS (NOTE: ADD SPECIAL CONDITIONS AS NEEDED)

END OF SECTION 142400

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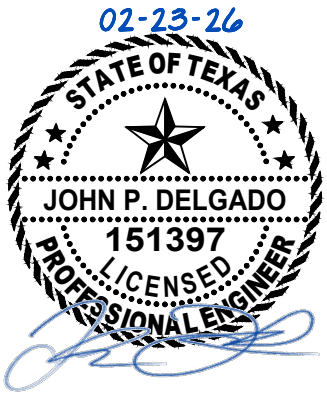

ELECTRICAL

PLUMBING

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Motors.
2. Packless expansion joints.
3. Grooved-joint expansion joints, lead free.
4. Alignment guides and anchors.
5. Sleeves without waterstop.
6. Sleeves with waterstop.
7. Stack-sleeve fittings.
8. Sleeve-seal systems.
9. Grout.
10. Silicone sealants.
11. Escutcheons.
12. Thermometers, liquid in glass, lead free.
13. Thermowells, lead free.
14. Pressure gauges, dial type, lead free.
15. Gauge attachments, lead free.
16. Test plugs, lead free.

B. Related Requirements:

1. Section 22 11 19 "Domestic Water Piping Specialties" for water meters.

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 plumbing equipment Sections.

   a. Include construction details, material descriptions, and dimensions of individual components, and finishes.
   b. Include operating characteristics and furnished accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of expansion joint, and gauge to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

1.7 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Domestic water expansion fittings and loops for plumbing piping intended to convey or dispense 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.

B. Compatibility: Provide products suitable for piping service fluids, materials, working pressures, and temperatures.

C. Capability: Provide products and installations to accommodate maximum axial movement as scheduled or indicated on Drawings.

2.2 MOTORS

A. Motor Requirements, General:

1. Content includes motors for use on alternating-current power systems of up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
2. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.
3. Comply with NEMA MG 1 unless otherwise indicated.
4. Comply with IEEE 841 for severe-duty motors.

B. Motor Characteristics:

1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 ft. above sea level.
2. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

C. Single-Phase Motors:

1. Motors larger than 1/20 hp must be one of the following, to suit starting torque and requirements of specific motor application:

    a. Permanent-split capacitor.
    b. Split phase.
    c. Capacitor start, inductor run.
    d. Capacitor start, capacitor run.

2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
4. Motors 1/20 HP and Smaller: Shaded-pole type.
5. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device will automatically reset when motor temperature returns to normal range.

D. Electronically Commutated Motors:

1. Microprocessor-Based Electronic Control Module: Converts 120 V single-phase AC power to three-phase DC power to operate the brushless DC motor.
2. Three-phase power motor module with permanent magnet rotor.
3. Circuit board or digital speed controller/LED display.
4. Building Automation System Interface: Coordinate with BAS requirements, if applicable to the project.

2.3 EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

A. Performance Requirements:

1. Compatibility: Provide products suitable for piping service fluids, materials, working pressures, and temperatures.
2. Capability: Provide products and installations that will accommodate maximum axial movement as scheduled or indicated on Drawings.

B. Packless Expansion Joints:

1. Rubber Union Connector Expansion Joints, Lead Free:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Amber/Booth Company, Inc.; a VMC Group Company.

b. Flex-Hose Co., Inc.
c. Flexicraft Industries.
d. General Rubber Corporation.
e. Mason Industries, Inc.
f. Proco Products, Inc.
g. Unaflex.
h. Unisource Manufacturing, Inc.
i. Source Limitations: Obtain rubber union connector expansion joints from single manufacturer.
j. Material: Twin reinforced EPDM rubber spheres with external restraining cables.
k. Minimum Pressure Rating: 150 psig at 170 deg F unless otherwise indicated.
l. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
m. End Connections for Greater than NPS 2 (DN 50): Flanged.
n. End Fittings: Stainless steel.

3. Flexible-Hose Packless Expansion Joints, Lead Free:

4. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Flex Pression Ltd.
b. Flex-Hose Co., Inc.
c. Flexicraft Industries.
d. Mason Industries, Inc.
e. Metraflex Company (The).
f. Unisource Manufacturing, Inc.
g. Source Limitations: Obtain flexible-hose packless expansion joints from single manufacturer.
h. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
i. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
j. Expansion Joints for Copper Tubing NPS 2 (DN 50) and Smaller: Copper-alloy fittings with solder-joint end connections.

1) Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.

k. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Copper-alloy fittings with threaded end connections.

1) Stainless steel hoses and single-braid, stainless steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.

l. Expansion Joints for Stainless Steel Piping NPS 2 (DN 50) and Smaller: Stainless steel fittings with threaded end connections.

1) Stainless steel hoses and single-braid, stainless steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.

m. Expansion Joints for Stainless Steel Piping NPS 2-1/2 to NPS 6 (DN 65 to DN 150): Stainless steel fittings with flanged end connections.

1) Stainless steel hoses and single-braid, stainless steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.

5. Metal-Bellows Packless Expansion Joints, Lead Free:

6. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Adsco Manufacturing LLC.
    b. American BOA, Inc.
    c. Badger Industries, Inc.
    d. Expansion Joint Systems, Inc.
    e. Flex Pression Ltd.
    f. Flex-Hose Co., Inc.
    g. Flexicraft Industries.
    h. Flex-Weld, Inc.
    i. Flo Fab Inc.
    j. Hyspan Precision Products, Inc.
    k. Mason Industries, Inc.
    l. Metraflex Company (The).
    m. Proco Products, Inc.
    n. Senior Flexonics Pathway.
    o. Tozen Corporation.
    p. U.S. Bellows, Inc.
    q. Unaflex.
    r. Unisource Manufacturing, Inc.
    s. Universal Metal Hose.
    t. WahlcoMetroflex.
    u. Source Limitations: Obtain metal-bellows packless expansion joints from single manufacturer.
    v. Standards: ASTM F1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
    w. Type: Circular, corrugated bellows with external tie rods.
    x. Minimum Pressure Rating: 150 psig unless otherwise indicated.
    y. Configuration: Single joint class(es) unless otherwise indicated.
    z. Expansion Joints for Copper Tubing: Single-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.

        1) End Connections for Copper Tubing NPS 2 (DN 50) and Smaller: threaded.
        2) End Connections for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Solder joint.
        3) End Connections for Copper Tubing NPS 5 (DN 125) and Larger: Flanged.

    aa. Expansion Joints for Stainless Steel Piping: Single-ply stainless steel bellows, stainless steel pipe ends, and carbon steel shroud.

        1) End Connections for Stainless Steel Pipe NPS 2 (DN 50) and Smaller: Threaded.
        2) End Connections for Stainless Steel Pipe NPS 2-1/2 (DN 65) and Larger: Flanged.

7. Externally Pressurized Metal-Bellows Packless Expansion Joints, Lead Free:

    a. Source Limitations: Obtain externally pressurized metal-bellows packless expansion joints from single manufacturer.

8. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adsco Manufacturing LLC.
b. American BOA, Inc.
c. Badger Industries, Inc.
d. Expansion Joint Systems, Inc.
e. Flex Pression Ltd.
f. Flex-Hose Co., Inc.
g. Flexicraft Industries.
h. Flex-Weld, Inc.
i. Flo Fab Inc.
j. Hyspan Precision Products, Inc.
k. Mason Industries, Inc.
l. Metraflex Company (The).
m. Proco Products, Inc.
n. Senior Flexonics Pathway.
o. Tozen Corporation.
p. U.S. Bellows, Inc.
q. Unaflex.
r. Unisource Manufacturing, Inc.
s. Universal Metal Hose.
t. WahlcoMetroflex.
u. Minimum Pressure Rating: 150 psig unless otherwise indicated.
v. Description:

1) Totally enclosed, externally pressurized, multi-ply, stainless steel bellows isolated from fluid flow by an internal pipe sleeve.
2) Carbon-steel housing.
3) Drain plugs and lifting lug for NPS 3 and larger.
4) Bellows: With operating clearance between the internal pipe sleeves and external shrouds.
5) Joints: Supplied with a built-in scale to confirm the starting position and operating movement.
6) Joint Axial Movement: 4 inches of compression and 3/4 inch of extension.

w. Permanent Locking Bolts: Set locking bolts to maintain joint lengths during installation. Temporary welding tabs that are removed after installation in lieu of locking bolts are unacceptable.
x. End Connection Configuration: Flanged; one raised, fixed and one floating flange.

9. Rubber Packless Expansion Joints, Lead Free:

10. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Amber/Booth Company, Inc.; a VMC Group Company.
b. Flex-Hose Co., Inc.
c. Flexicraft Industries.
d. Flex-Weld, Inc.
e. Garlock Sealing Technologies.
f. General Rubber Corporation.
g. Mason Industries, Inc.
h. Metraflex Company (The).
i. Proco Products, Inc.
j. Red Valve Company, Inc.
k. Tozen Corporation.
l. Unaflex.
m. Unisource Manufacturing, Inc.

n. Source Limitations: Obtain rubber packless expansion joints from single manufacturer.
o. Standards: ASTM F1123 and FSA's "Expansion Joints - Piping Technical Handbook."
p. Material: Fabric-reinforced rubber complying with FSA-PSJ-703.
q. Arch Type: Single arches with external control rods.
r. Spherical Type: Single spheres with external control rods.
s. Minimum Pressure Rating for NPS 1-1/2 to NPS 12 (DN 40 to DN 300): 225 psig at 170 deg F.

C. Grooved-Joint Expansion Joints, Lead Free:

D. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Anvil International.
2. Shurjoint-Apollo Piping Products USA Inc.
3. Victaulic Company.
4. Source Limitations: Obtain grooved-joint expansion joints from single manufacturer.
5. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.
6. Standard: AWWA C606, for grooved joints.
7. Material: ASTM A53/A53M, Schedule 40 stainless steel pipe with grooved ends.
8. Couplings: Five, ASTM A312/A312M ductile-iron flexible type for stainless steel pipe dimensions. Include ferrous housing sections, Grade E EPDM rubber gasket or Grade P fluoroelastomer blend gasket, and bolts and nuts.

E. Alignment Guides and Anchors:

1. Alignment Guides:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adsco Manufacturing LLC.
b. Advanced Thermal Systems, Inc.
c. Flex-Hose Co., Inc.
d. Flexicraft Industries.
e. Flex-Weld, Inc.
f. Hyspan Precision Products, Inc.
g. Mason Industries, Inc.
h. Metraflex Company (The).
i. Senior Flexonics Pathway.
j. U.S. Bellows, Inc.
k. Unisource Manufacturing, Inc.
l. Source Limitations: Obtain alignment guides from single manufacturer.
m. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe. Provide dielectric spacer for use with copper tubing/piping.

3. Anchor Materials:

a. Steel Shapes and Plates: ASTM A36/A36M.
b. Bolts and Nuts: ASME B18.10 or ASTM A183, steel hex head.
c. Washers: ASTM F844, steel, plain, flat washers.

d. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.

1) Stud: Threaded, zinc-coated carbon steel.
2) Expansion Plug: Zinc-coated carbon steel.
3) Washer and Nut: Zinc-coated carbon steel.

e. Chemical Fasteners: Insert-type stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.

1) Bonding Material: ASTM C881/C881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
2) Stud: ASTM A307, zinc-coated carbon **s**teel with continuous thread on stud unless otherwise indicated.
3) Washer and Nut: Zinc-coated carbon steel.

2.4 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:

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. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT; an EnPro Industries company.
4. Metraflex Company (The).
5. Proco Products, Inc.
6. Description: Manufactured PVC/HDPE, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

C. Stack-Sleeve Fittings:

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. Advance Products & Systems, Inc.
2. CALPICO, Inc.

3. GPT; an EnPro Industries company.
4. Metraflex Company (The).
5. Proco Products, Inc.
6. Zurn.
7. Jay R. Smith.
8. Description: Manufactured, dura-coated, duco-coated, or galvanized cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.

    a. Underdeck Clamp: Clamping ring with setscrews.

D. Sleeve-Seal Systems:

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. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT; an EnPro Industries company.
4. Metraflex Company (The).
5. Proco Products, Inc.
6. 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 of pipe.
    c. Pressure Plates: Carbon steel.
    d. Connecting Bolts and Nuts: Carbon steel, with zinc coating, ASTM B633 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.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Dow Corning Corporation.
    b. GE Construction Sealants; Momentive Performance Materials Inc.
    c. Polymeric Systems, Inc.
    d. Schnee-Morehead, Inc., an ITW company.
    e. Sherwin-Williams Company (The).

f. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.

3. Silicone Sealant, 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.
   a. Standard: ASTM C920, Type S, Grade P, Class 25, Uses T and NT.

4. Silicone Foam Sealant: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

5. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Dow Corning Corporation.
   b. GE Construction Sealants; Momentive Performance Materials Inc.
   c. Polymeric Systems, Inc.
   d. Schnee-Morehead, Inc., an ITW company.
   e. Sherwin-Williams Company (The).

2.5 ESCUTCHEONS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Brasscraft.
   b. McGuire Manufacturing.

B. 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, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
   4. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.
   5. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
   6. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

C. Floor Plates:

   1. Split Floor Plates: Cast brass with concealed hinge.

2.6 METERS AND GAUGES FOR PLUMBING PIPING

A. Thermometers, Liquid in Glass, Lead Free - Metal Case, Compact Style:

   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. Trerice, H. O. Co.

2. Source Limitations: Provide liquid-in-glass, lead-free, metal-case, compact-style thermometers by single manufacturer.
3. Standard: ASME B40.200.
4. Case: Cast aluminum; 6-inch nominal size.
5. Case Form: Straight 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 plastic.
9. Stem: Aluminum or lead-free brass and of length to suit installation.

    a. Design for Thermowell Installation: Bare stem.

10. Connector: 3/4 inch, 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.

B. Thermometers, Liquid in Glass, Lead Free - Metal Case, Industrial Style:

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. Trerice, H. O. Co.

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: Back 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.
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.

C. 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 center of pipe.
10. Lagging Extension: Include on thermowells for insulated piping and tubing. Extension is to be of sufficient length to extend beyond 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.

D. Pressure Gauges, Dial Type, Lead Free - Direct Mounted, Metal Case:

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. Stewart USA.
    b. AMETEK USG.
    c. Winters Instruments.

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; 4-1/2-inch nominal diameter.
5. Pressure-Element Assembly: Lead-free Bourdon tube.
6. Pressure Connection: Lead-free brass, with 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.
11. Ring: Metal.
12. Accuracy: Grade A, plus or minus 1 percent of middle half of span.

E. Gauge Attachments, Lead Free:

1. Snubbers: ASME B40.100, lead-free brass; with NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
2. Valves: Lead-free brass ball, with NPS 1/2, ASME B1.20.1 pipe threads.

F. Test Plugs, Lead Free:

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. Groebner.

2. Source Limitations: Provide lead-free test plugs from single manufacturer.
3. Description: Test-station fitting made for insertion into piping tee fitting.
4. 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.
5. Thread Size: NPS 1/2, ASME B1.20.1 pipe thread.
6. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
7. Core Inserts: EPDM self-sealing rubber.

PART 3 - EXECUTION

3.1 INSTALLATION OF EXPANSION JOINTS, GENERAL

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

3.2 INSTALLATION OF PACKLESS EXPANSION JOINTS

A. Install metal-bellows expansion joints in accordance with EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

B. Install rubber packless expansion joints in accordance with FSA-PSJ-703.

3.3 INSTALLATION OF GROOVED-JOINT EXPANSION JOINTS

A. Install grooved-joint expansion joints to grooved-end steel piping.

3.4 INSTALLATION OF ALIGNMENT GUIDES AND ANCHORS

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than **four** pipe diameters from expansion joint.

C. Attach guides to pipe, and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9.
2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-58, Type 24; U bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
3. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

3.5 INSTALLATION OF PIPE LOOP AND SWING CONNECTIONS

A. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

B. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.

C. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.6 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, seal the 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."

3.7 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 of concrete slab or wall.

C. Secure nailing flanges to wooden concrete forms.

D. Using grout, seal space around outside of sleeves. Select to maintain fire resistance of floor/slab/wall.

3.8 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 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using 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- and smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.9 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.

3.10 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 insulated piping and with OD that completely covers opening.

3.11 INSTALLATION OF METERS AND GAUGES

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 remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks.

H. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at most readable position.

I. Install remote-mounted pressure gauges on panel.

J. Install valve and snubber in piping for each pressure gauge for fluids.

K. Install test plugs in piping tees.

L. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.
2. Inlets and outlets of each domestic water heat exchanger.
3. Inlet and outlet of each domestic hot-water storage tank.
4. Outlet side of hot-water-balancing valve.
5. Each main hot-water-recirculating line return pipe.

M. Install pressure gauges in the following locations:

1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each domestic water pump.

3.12 CONNECTIONS

A. Install meters and gauges adjacent to machines and equipment to allow space for service and maintenance of meters, gauges, machines, and equipment.

3.13 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.

3.14 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.

3.15 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.

4. Interior Wall and Partitions:

a. Sleeves without waterstops.

3.16 ESCUTCHEONS APPLICATION

A. Escutcheons for New Piping and Relocated Existing Piping:

1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Chrome-Plated Piping: One piece, steel with polished, chrome-plated finish.
3. Insulated Piping:

a. One piece, steel 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.

5. Bare Piping at Ceiling Penetrations in Finished Spaces:

a. One piece, steel with polished, chrome-plated finish.

6. Bare Piping in Unfinished Service Spaces:

a. One piece, steel with polished, chrome-plated finish.

7. Bare Piping in Equipment Rooms:

a. One piece, steel with polished, chrome-plated finish.

B. Escutcheons for Existing Piping to Remain:

1. Chrome-Plated Piping: Split casting, 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.

3.17 THERMOMETER, LEAD FREE, APPLICATION

A. Thermometers at inlet and outlet of each domestic water heater are to be the following:

1. Metal case, compact-style or industrial, liquid-in-glass type.
2. Test plug with EPDM self-sealing rubber inserts.

B. Thermometers at inlet and outlet of each domestic hot-water storage tank are to be the following:

1. Metal case, compact or industrial-style, liquid-in-glass type.
2. Test plug with EPDM self-sealing rubber inserts.

C. Thermometer stems are to be of length to match thermowell insertion length.

3.18 THERMOMETER, LEAD FREE, SCALE-RANGE APPLICATION

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.

C. Scale Range for Domestic Cooled-Water Piping:

1. 0 to 100 deg F.

3.19 PRESSURE-GAUGE APPLICATION

A. Pressure gauges at discharge of each water service into building are to be the following:

1. Sealed, direct mounted, metal case.
2. Test plug with EPDM self-sealing rubber inserts.

B. Pressure gauges at inlet and outlet of each water pressure-reducing valve are to be the following:

1. Sealed, direct mounted, metal case.
2. Test plug with EPDM self-sealing rubber inserts.

C. Pressure gauges at suction and discharge of each domestic water pump are to be the following:

1. Sealed, direct mounted, metal case.
2. Test plug with EPDM self-sealing rubber inserts.

3.20 PRESSURE-GAUGE SCALE-RANGE APPLICATION

A. Scale Range for Water Service Piping:

1. 0 to 160 psi.

B. Scale Range for Domestic Water Piping:

1. 0 to 100 psi.

END OF SECTION 22 05 00

SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ball valves.
2. Check valves.

1.2 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene-diene terpolymer.

C. FKM: Fluoroelastomer.

D. NBR: Nitrile butadiene rubber (also known as Buna-N).

E. OS&Y: Outside screw and yoke.

F. PTFE: Polytetrafluoroethylene.

G. RPTFE: Reinforced polytetrafluoroethylene.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

a. Include material descriptions and dimensions of individual components.
b. Include operating characteristics and furnished accessories.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooved ends, press ends, solder ends, and weld ends.
3. Set ball valves open to minimize exposure of functional surfaces.
4. Set butterfly valves closed or slightly open.
5. Block check valves in either closed or open position.
6. Set gate valves closed to prevent rattling.

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 or other components as lifting or rigging points unless specifically indicated for this purpose in manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Standards:

1. Domestic-water piping valves intended to convey or dispense water for human consumption must comply with the U.S. Safe Drinking Water Act (SDWA), requirements of authorities having jurisdiction, and NSF 61/NSF 372; or to 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. ASME Compliance:

1. ASME B1.20.1 for threads for threaded-end valves.
2. ASME B16.5 for flanges on steel valves.
3. ASME B16.18 for cast-copper solder-joint connections.
4. ASME B16.22 for wrought-copper solder-joint connections.
5. ASME B16.34 for flanged- and threaded-end connections.
6. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are unacceptable.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Bypass and Drain Connections: MSS SP-45.

H. Valve Actuator Type:

1. Gear Actuator: For quarter-turn ball valves NPS 4 and larger.
2. Hand Lever: For quarter-turn ball valves smaller than NPS 4.

I. Valves in Insulated Piping:

1. Provide 2-inch extended neck stems.

2. Provide extended operating handles with nonthermal-conductive covering material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Provide memory stops that are fully adjustable after insulation is applied.

2.3 BALL VALVES, LEAD FREE

A. Ball Valves, Lead Free, Threaded Ends - Bronze, One Piece with Stainless Steel Trim:

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. NIBCO INC.
    b. WATTS; A Watts Water Technologies Company.

2. Standards: MSS SP-110 and MSS SP-145.
3. CWP Rating: 600 psig.
4. Body Design: One piece.
5. Body Material: Bronze.
6. Ends: Threaded.
7. Seats: PTFE.
8. Stem: Stainless steel.
9. Ball: Stainless steel, vented.
10. Port: Reduced.

B. Ball Valves, Lead Free, Threaded or Soldered Ends - Bronze, Two Piece with Full Port and Stainless Steel Trim:

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. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    b. Hammond Valve.
    c. Jenkins Valves; a Crane Co. brand.
    d. Milwaukee Valve Company.
    e. NIBCO INC.
    f. Red-White Valve Corp.
    g. Stockham; a Crane Co. brand.
    h. WATTS; A Watts Water Technologies Company.

2. Standards: MSS SP-110 and MSS SP-145.
3. CWP Rating: 600 psig.
4. Body Design: Two piece.
5. Body Material: Bronze.
6. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
7. Seats: PTFE.
8. Stem: Stainless steel.
9. Ball: Stainless steel, vented.
10. Port: Full.

2.4 CHECK VALVES, LEAD FREE

A. Check Valves, Lead Free, Swing Type, Threaded or Soldered Ends - Bronze, with Bronze Disc, Class 125:

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. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    b. Jenkins Valves; a Crane Co. brand.
    c. Milwaukee Valve Company.
    d. NIBCO INC.
    e. Red-White Valve Corp.
    f. Stockham; a Crane Co. brand.
    g. Val-Matic Valve & Manufacturing Corp.
    h. Victaulic Company.

2. Standard: MSS SP-80, Type 3.
3. CWP Rating: 200 psig.
4. Body Design: Horizontal flow.
5. Body Material: ASTM B62, bronze.
6. Ends: Threaded or soldered. See Part 3 check valve schedule articles.
7. Disc: Bronze.

B. Check Valves, Lead Free, Swing Type, Threaded or Soldered Ends - Bronze, with Nonmetallic Disc, Class 125:

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. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    b. Jenkins Valves; a Crane Co. brand.
    c. Milwaukee Valve Company.
    d. NIBCO INC.
    e. Red-White Valve Corp.
    f. Stockham; a Crane Co. brand.

2. Standard: MSS SP-80, Type 4.
3. CWP Rating: 200 psig.
4. Body Design: Horizontal flow.
5. Body Material: ASTM B62, bronze.
6. Ends: Threaded or soldered. See Part 3 check valve schedule articles.
7. Disc: PTFE.

C. Check Valves, Lead Free, Swing Type, Flanged or Threaded Ends - Iron, with Metal Seats, Class 125:

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. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    b. Hammond Valve.
    c. Jenkins Valves; a Crane Co. brand.

2. Standard: MSS SP-71, Type I.
3. CWP Rating: 200 psig.
4. Body Design: Clear or full waterway.
5. Body Material: ASTM A126, gray iron with bolted bonnet.
6. Ends: Flanged or threaded. See Part 3 check valve schedule articles.
7. Trim: Bronze.
8. Gasket: Asbestos free.

D. Check Valves, Swing Type, Flanged Ends - Iron, with Lever- and Spring-Closure Control, Class 125:

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. Apollo Valves; a part of Aalberts Integrated Piping Systems.
   b. Kennedy Valve.

2. Standard: MSS SP-71, Type I.
3. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 200 psig.
4. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): 150 psig.
5. Body Design: Clear or full waterway.
6. Body Material: ASTM A126, gray iron with bolted bonnet.
7. Ends: Flanged.
8. Trim: Bronze.
9. Gasket: Asbestos free.
10. Closure Control: Factory-installed, exterior lever and spring.

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. Examine press fittings to verify they have been properly pressed.

F. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

3.2 INSTALLATION OF VALVES

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Provide support of piping adjacent to valves such that no force is imposed upon valves.

C. Locate valves for easy access and where not blocked by equipment, other piping, or building components.

D. For valves in horizontal piping, install valves with stem at or above center of pipe.

E. Install valves in position that does not project into aisles or block access to other equipment.

F. Install valves in position to allow full stem and actuator or manual operator movement.

G. Verify that joints of each valve have been properly installed and sealed to assure there is no leakage or damage.

H. Install check valves for proper direction of flow and as follows:

1. Check Valves: Center-guided type and plate type, in horizontal or vertical position, between flanges.
2. Check Valves, Swing Type: In horizontal position with hinge pin level.

I. Valve Tags: Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

J. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's written recommended maximum.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 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.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. Wafer-Type Valves: Flanged connections.

3.5 DOMESTIC HOT- AND COLD-WATER BALL VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Ball valves, lead free, threaded or soldered ends - bronze, two piece with full port and stainless steel trim; threaded ends.

B. Pipe NPS 2-1/2 and Larger:
   1. Ball valves, lead free, flanged or threaded ends - bronze, with full port, Class 150; flanged ends.

3.6 DOMESTIC HOT- AND COLD-WATER CHECK VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

   1. Check valves, lead free, swing type, threaded or soldered ends - bronze, with bronze disc, Class 125; threaded ends.

B. Pipe NPS 2-1/2 and Larger:

   1. Check valves, lead free, swing type, flanged or threaded ends - iron, with metal seats, Class 125; threaded ends.

3.7 PUMP-DISCHARGE CHECK VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

   1. Check valves, lead free, swing type, threaded or soldered ends - bronze, with bronze disc, Class 125; threaded ends.

B. Pipe NPS 2-1/2 and Larger for Domestic Water Pumps:

   1. Check valves, lead free, swing type, flanged or threaded ends - iron, with lever- and spring-closure control, Class 125; threaded ends.

END OF SECTION 22 05 23

SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal hanger-shield inserts.
4. Fastener systems.
5. Pipe-positioning systems.
6. Equipment supports.

B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 22 05 00 "Common Work Results for Plumbing."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Pipe stands.
3. Equipment supports.

C. Delegated Design Submittals: 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.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

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: Pre-galvanized, 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 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 THERMAL HANGER-SHIELD INSERTS

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. National Pipe Hanger Corporation.
    b. Hayward Pipe and Supply Co., Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: ASTM C552, Type II cellular glass with 100-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 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.
   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. Hilti, Inc.
      b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
      c. MKT Fastening, LLC.
      d. Simpson Strong-Tie Co., Inc

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. 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. B-line, an Eaton business.
      b. Empire Tool and Manufacturing Co., Inc.
      c. Hilti, Inc.
      d. ITW Ramset/Red Head; Illinois Tool Works, Inc.
      e. MKT Fastening, LLC.

   2. Indoor Applications: Zinc-coated steel.
   3. Outdoor Applications: Stainless steel.

2.6 PIPE-POSITIONING SYSTEMS

A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.7 EQUIPMENT SUPPORTS

A. Description: 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 MSS SP-58. 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. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.

D. 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.

E. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

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. MSS SP-58, Type 39: Install 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. MSS SP-58, Type 40: Install 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 (DN 8 to DN 90): 12 inches long and 0.048 inch thick.
   b. NPS 4 (DN 100): 12 inches long and 0.06 inch thick.

5. 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.", and 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 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, and metal trapeze pipe hangers and attachments for general service applications.

F. Use stainless steel pipe hangers and stainless-steel attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal hanger-shield inserts for insulated piping and tubing.

J. 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 occurs.
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 occurs.
19. 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.
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 occurs 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, in addition to expansion and contraction, is required.

K. 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.

L. 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.

M. 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-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. 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.

O. 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.

P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

S. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 22 05 29

SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING 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. Stencils.
6. Valve tags.
7. Warning tags.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve-numbering scheme.

E. 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. 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. Brady Corporation.
b. Carlton Industries, LP.
c. Champion America.
d. Craftmark Pipe Markers.
e. Kolbi Pipe Marker Co.
f. LEM Products Inc.
g. Marking Services Inc.
h. Pipemarker.com; Brimar Industries, Inc.
i. Seton Identification Products; a Brady Corporation company.
j. emedco.

2. Material and Thickness: stainless steel, 0.025-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
3. Letter and Background Color: As indicated for specific application under Part 3.
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.

B. Plastic Labels for Equipment:

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. Brady Corporation.
    b. Carlton Industries, LP.
    c. Champion America.
    d. Craftmark Pipe Markers.
    e. Kolbi Pipe Marker Co.
    f. LEM Products Inc.
    g. Marking Services Inc.
    h. Pipemarker.com; Brimar Industries, Inc.
    i. Seton Identification Products; a Brady Corporation company.
    j. emedco.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
3. Letter and Background Color: As indicated for specific application under Part 3.
4. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. 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.
7. Fasteners: Stainless steel rivets or self-tapping screws.
8. 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. 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. Brady Corporation.
2. Carlton Industries, LP.
3. Champion America.

4. Craftmark Pipe Markers.
5. LEM Products Inc.
6. Marking Services Inc.
7. National Marker Company.
8. Pipemarker.com; Brimar Industries, Inc.
9. Seton Identification Products; a Brady Corporation company.
10. Stranco, Inc.
11. emedco.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. 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.

G. Fasteners: Stainless steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. 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.

J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 WARNING TAPE

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. Brady Corporation.
2. Craftmark Pipe Markers.
3. National Marker Company.
4. Pipemarker.com; Brimar Industries, Inc.
5. Seton Identification Products; a Brady Corporation company.

B. Material: Vinyl.

C. Minimum Thickness: 0.005 inch.

D. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.

E. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.

F. Maximum Temperature: 160 deg F.

G. Minimum Width: 4 inches.

2.4 PIPE LABELS

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. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
2. Brady Corporation.
3. Carlton Industries, LP.
4. Champion America.
5. Craftmark Pipe Markers.
6. Kolbi Pipe Marker Co.
7. LEM Products Inc.
8. Marking Services Inc.
9. Pipemarker.com; Brimar Industries, Inc.
10. Seton Identification Products; a Brady Corporation company.
11. emedco.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

F. 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: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

2.5 VALVE TAGS

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. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
2. Brady Corporation.
3. Carlton Industries, LP.
4. Champion America.
5. Craftmark Pipe Markers.
6. Kolbi Pipe Marker Co.
7. LEM Products Inc.
8. Marking Services Inc.
9. Pipemarker.com; Brimar Industries, Inc.
10. Seton Identification Products; a Brady Corporation company.

11. emedco.

B. 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 minimum thickness, with predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass link chain.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. 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. 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. Brady Corporation.
2. Champion America.
3. Craftmark Pipe Markers.
4. Kolbi Pipe Marker Co.
5. LEM Products Inc.
6. Marking Services Inc.
7. Pipemarker.com; Brimar Industries, Inc.
8. Seton Identification Products; a Brady Corporation company.
9. emedco.

B. Description: Preprinted accident-prevention tags of plasticized card stock.

1. Size: Approximately 4 by 7 inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. 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 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.

D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where are-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 09 91 23 "Interior Painting."

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 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. 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.

E. 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.

F. Pipe-Label Color Schedule:
1. Domestic Cold-Water Piping: White letters on an ANSI Z535.1 safety-green background.
2. Domestic Hot-Water Piping: White letters on an ANSI Z535.1 safety-green background
3. Domestic Hot-Water Return Piping White letters on an ANSI Z535.1 safety-green background.
4. Sanitary Waste and Storm Drainage Piping: White letters on a black background.
5. Deionized Water Piping: White letters on an ANSI Z535.1 safety-blue background.
6. Distilled Water Piping: White letters on an ANSI Z535.1 safety-blue background.
7. Reverse Osmosis Water Piping: White letters on an ANSI Z535.1 safety-blue background.

3.6 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. Domestic Hot-Water Return: 1-1/2 inches, round.
d. Deionized Water Piping: 1-1/2 inches, round.
e. Distilled Water Piping: 1-1/2 inches, round.
f. Reverse Osmosis Water Piping: 1-1/2 inches, round.

2. Valve-Tag Colors:

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.

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 indicated on Drawings and scheduled.

END OF SECTION 22 05 53

SECTION 22 05 93 - TESTING, ADJUSTING, AND BALANCING FOR PLUMBING

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. TAB of domestic water system.
2. TAB of plumbing equipment:

    a. Domestic hot-water in-line circulation pumps.

3. Pipe-leakage test verification.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

F. TDH: Total dynamic head.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.

D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Specialists Qualifications, Certified by NEBB or TABB:

1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE 111 Compliance: Requirements in ASHRAE 111 applicable to analogous domestic water system and plumbing equipment balancing.

D. ASHRAE 188 Compliance: Comply with balancing and report requirements, Section 8.3 "Balancing."

E. Code and Authorities Having Jurisdiction Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.6 FIELD CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

A. Subject to compliance with requirements, available TAB specialists that may be engaged include, but are not limited to, the following:
1. PHI Service.
2. Engineered Air Balance.

3. Testing Specialties Incorporated.

3.2 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, and balancing valves and fittings. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine approved submittals for plumbing systems and equipment.

D. Examine design data, including plumbing system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about plumbing system and equipment controls.

E. Examine equipment performance data, including pump curves.

1. Relate performance data to Project conditions and requirements, including pump system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate pump system-effect factors to reduce performance ratings of plumbing equipment when installed under conditions different from the conditions used to rate equipment performance. Compare results with the design data and installed conditions.

F. Examine system and equipment installations, and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine plumbing equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

I. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainers are installed and clean.

J. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.

K. Examine system pumps to ensure absence of entrained air in the suction piping.

L. Examine operating safety interlocks and controls on plumbing equipment.

M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of plumbing systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Domestic Water System:

a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed in accordance with applicable code and authority having jurisdiction.
b. Water heaters are installed and functioning.
c. Piping is complete and all points of outlet are installed.
d. Water treatment is complete.
e. Systems are flushed, filled, and air purged.
f. Strainers are clean.
g. Control valves are functioning in accordance with the sequence of operation.
h. Shutoff and balance valves are 100 percent open.
i. Hot-water circulating pumps are operational and proper rotation is verified.
j. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
k. Variable-frequency controllers' startup is complete and safeties are verified.
l. Suitable access to balancing devices and equipment is provided.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system in accordance with the procedures contained in ASHRAE 111 and NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

B. Cut insulation, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.

1. Where holes for probes are required in piping or equipment, install pressure and temperature test plugs to seal systems.
2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 220716 "Plumbing Equipment Insulation" and Section 22 07 19 "Plumbing Piping Insulation."

C. Mark equipment and balancing devices, including valve position indicators and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 GENERAL PROCEDURES FOR PLUMBING EQUIPMENT

A. Test, adjust, and balance plumbing equipment indicated on Drawings, including, but not limited to, the following:

1. Motors.
2. Domestic water in-line pumps.

3. Domestic water heaters.

3.6 PROCEDURES FOR DOMESTIC WATER SYSTEMS

A. Prepare test reports for pumps and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.

B. Prepare schematic diagrams of systems' Record drawings piping layouts.

C. In addition to requirements in "Preparation" Article, prepare domestic water systems for testing and balancing as follows:

1. Check expansion tank for proper setting.
2. Check water heater for proper discharge temperature setting.
3. Check remotest point of outlet for adequate pressure.
4. Check flow-control valves for proper position.
5. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
6. Verify that motor controllers are equipped with properly sized thermal protection.
7. Check that air has been purged from the system.

D. Measure and record upstream and downstream pressure of each piece of equipment.

E. Measure and record upstream and downstream pressure of pressure-reducing valves.

F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.

G. Check settings and operation of each safety valve. Record settings.

3.7 PROCEDURES FOR DOMESTIC HOT-WATER CIRCULATING INLINE PUMP

A. Balance system with manual or automatic balancing valves by setting at design flow.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

B. Adjust pump to deliver total design flow.

1. Measure pump TDH as follows:

a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
c. Convert pressure to head and correct for differences in gauge heights.
d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.

2. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.

3. Mark final settings and verify that all memory stops have been set.
4. Verify final system conditions as follows:

    a. Re-measure and confirm that total flow is within design.
    b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
    c. Mark final settings.

3.8 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.9 PROCEDURES FOR WATER HEATERS

A. Electric Water Heaters:

1. Measure and record entering- and leaving-water temperatures.
2. Measure and record water flow.
3. Measure and record pressure drop.
4. Measure and record relief valve(s) pressure setting.
5. Capacity: Calculate in Btu/h of heating output.
6. Efficiency: Calculate operating efficiency for comparison to submitted equipment.

3.10 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record flows, temperatures, and pressures of each piece of equipment. Compare the values to design or nameplate information, where information is available.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the condition of filters.
4. Check bearings and other lubricated parts for proper lubrication.
5. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. TAB After Construction: Before performing testing and balancing of renovated existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished in accordance with renovation scope indicated by Contract Documents. Verify the following:

1. New filters are installed.
2. Bearings and other parts are properly lubricated.
3. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated system flows of the renovated work to the measured flows, and determine the new pump speed.
2. Verify that the indicated system flows of the renovated work result in velocities and pump speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the system flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.

3.11 TOLERANCES

A. Set plumbing system's flow rates within the following tolerances:

1. Domestic Water Flow Rate: Plus or minus 5 percent. If design value is less than 10 gpm, within 10 percent.
2. Compressed-Air Flow Rate: Plus or minus 5 percent. If design value is less than 10 gpm, within 10 percent.

3.12 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to plumbing systems and general construction to allow access for performance-measuring and -balancing devices.

B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.13 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Manufacturers' test data.

3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents, including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Notes to explain why certain final data in the body of reports vary from indicated values.
14. Test conditions for pump performance forms, including the following:

    a. Variable-frequency controller settings for variable-flow hydronic systems.
    b. Settings for pressure controller(s).
    c. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of distribution systems. Present each system with single-line diagram and include the following:

1. Flow rates.
2. Pipe and valve sizes and locations.
3. Balancing stations.
4. Position of balancing devices.

E. Electric Water Heater Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

    a. System identification.
    b. Location.
    c. Model number and unit size.
    d. Manufacturer's serial number.
    e. Output capacity in Btu/h.
    f. Number of stages.
    g. Connected volts, phase, and hertz.
    h. Rated amperage.

2. Test Data (Indicated and Actual Values):

a. Heat output in Btu/h.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. High-temperature-limit setting in deg F.
e. Operating set point in deg F.
f. Voltage at each connection.
g. Amperage for each phase.

F. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves, and include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model number and serial number.
f. Water flow rate in gpm.
g. Water-pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump speed.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

G. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.14 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager.

B. Construction Manager shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.

E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to previous report.
2. If the second final inspection also fails, Owner may pursue other Contract options to complete TAB work.

F. Prepare test and inspection reports.

3.15 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

END OF SECTION 22 05 93

SECTION 22 07 19 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 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. Sanitary waste piping exposed to freezing conditions.
5. Supplies and drains for handicap-accessible lavatories and sinks.

1.2 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).

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of the manufacturer, fabricator, type, description, and size, as well as ASTM standard designation and maximum use temperature.

1.6 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.

1.7 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 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 are applied.

B. Products do not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come into contact with stainless steel 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 are qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type I for tubular materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Aeroflex USA.
    b. Armacell LLC.
    c. K-Flex USA.

G. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. 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 with factory-applied ASJ+ jacket].
3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

H. Mineral Wool, Preformed Pipe: Mandrel-wound mineral wool fibers bonded with a thermosetting resin, unfaced; suitable for maximum use temperature up to 1200 deg F in accordance with ASTM C447. 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. Owens Corning.
    c. ROCKWOOL.

2. Preformed Pipe Insulation: Type II, Grade A with factory-applied ASJ-SSL with factory-applied ASJ+ jacket.
3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.

2.3 INSULATING CEMENTS

A. Glass-Fiber and Mineral Wool Insulating Cement: Comply with ASTM C195.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Ramco Insulation, Inc.

B. Glass-Fiber and Mineral Wool Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Ramco Insulation, Inc.

2.4 ADHESIVES

A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Aeroflex USA.
b. Armacell LLC.
c. Foster Brand; H. B. Fuller.
d. K-Flex USA.

2. Flame-spread index is 25 or less and smoke-developed index is 50 or less as tested in accordance with ASTM E84.
3. Wet Flash Point: Below 0 deg F.
4. Service Temperature Range: 40 to 200 deg F.
5. Color: Black.

C. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller.
c. Mon-Eco Industries, Inc.

D. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller.
c. Mon-Eco Industries, Inc.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.
b. P.I.C. Plastics, Inc.
c. Proto Corporation.
d. Speedline Corporation.
e. The Dow Chemical Company.

2.5 MASTICS AND COATINGS

A. Materials are compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller.
    c. Knauf Insulation.
    d. Mon-Eco Industries, Inc.
    e. Vimasco Corporation.

2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
5. Color: White.

C. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller.
    c. Mon-Eco Industries, Inc.

2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
3. Service Temperature Range: 0 to 180 deg F.
4. Color: White.

D. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller.

2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller.
    c. Knauf Insulation.

d. Mon-Eco Industries, Inc.
e. Vimasco Corporation.

2. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

2.6 LAGGING ADHESIVES

A. Adhesives comply with MIL-A-3316C, Class I, Grade A, and are compatible with insulation materials, jackets, and substrates.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller.
c. Vimasco Corporation.

2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

2.7 SEALANTS

A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller.
c. Mon-Eco Industries, Inc.
d. Owens Corning.

2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.

C. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller.
c. Mon-Eco Industries, Inc.

2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.

D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Childers Brand; H. B. Fuller Construction Products.
   b. Foster Brand; H. B. Fuller.

2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.8 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. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
3. ASJ+: Aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136 Types I, II, III, IV, and VII.

2.9 FIELD-APPLIED JACKETS

A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Airex Manufacturing Inc.
   b. Johns Manville; a Berkshire Hathaway company.
   c. P.I.C. Plastics, Inc.
   d. Proto Corporation.
   e. Speedline Corporation.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

D. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.
b. RPR Products, Inc.

2. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

a. Factory cut and rolled to size.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil-thick polysurlyn.
e. 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.

3. Stainless Steel Jacket: ASTM A240/A240M.

a. Factory cut and rolled to size.
b. Material, 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. Moisture Barrier for Outdoor Applications: 2.5-mil-thick polysurlyn.
e. 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.

E. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane, consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Owens Corning.
b. Polyguard Products, Inc.

F. Self-Adhesive Outdoor Jacket (Asphaltic): 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with white aluminum-foil facing.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. MFM Building Products Corp.
b. Polyguard Products, Inc.

G. Self-Adhesive Indoor/Outdoor Jacket (Non-Asphaltic): Vapor barrier and waterproofing jacket for installation over insulation located aboveground outdoors or indoors. Specialized jacket with five layers of laminated aluminum and polyester film with low-temperature acrylic pressure-sensitive adhesive. Outer aluminum surface is coated with UV-resistant coating for protection from environmental contaminants.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M.
b. Foster Brand; H. B. Fuller.
c. Ideal Tape Co., Inc., an American Biltrite Company.

2. Permeance: 0.00 perm as tested in accordance with ASTM F1249.
3. Flamespread/Smoke Developed: 25/50 as tested in accordance with ASTM E84.
4. Aluminum Finish: Smooth.

2.10 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Mesh: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Childers Brand; H. B. Fuller Construction Products.

B. Woven Polyester Mesh: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Foster Brand; H. B. Fuller.
b. Vimasco Corporation.

2.11 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Cloth: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Alpha Associates, Inc.

2.12 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Industrial Adhesives and Tapes Division.
b. Avery Dennison Corporation, Specialty Tapes Division.
c. Ideal Tape Co., Inc., an American Biltrite Company.
d. Knauf Insulation.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Industrial Adhesives and Tapes Division.
b. Avery Dennison Corporation, Specialty Tapes Division.
c. Ideal Tape Co., Inc., an American Biltrite Company.
d. Knauf Insulation.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. 3M Industrial Adhesives and Tapes Division.
    b. Ideal Tape Co., Inc., an American Biltrite Company.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. 3M Industrial Adhesives and Tapes Division.
    b. Avery Dennison Corporation, Specialty Tapes Division.
    c. Ideal Tape Co., Inc., an American Biltrite Company.
    d. Knauf Insulation.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.13 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Johns Manville; a Berkshire Hathaway company.
    b. RPR Products, Inc.

2. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal.
3. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. C & F Wire Products.
    b. Johns Manville; a Berkshire Hathaway company.
    c. RPR Products, Inc.

2.14 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Buckaroos, Inc.
b. MVG Molded Products.
c. McGuire Manufacturing.
d. Plumberex Specialty Products, Inc.
e. ProFlo; a Ferguson Enterprises, Inc. brand.
f. Truebro; IPS Corporation.
g. Zurn Industries, LLC.
h. Oatey Co.

2. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ProFlo; a Ferguson Enterprises, Inc. brand.
b. Truebro; IPS Corporation.
c. Zurn Industries, LLC.

2. 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. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL 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, compress, or otherwise damage insulation or jacket.

D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) 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 during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents.

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, but not to the extent of creating wrinkles or areas of compression in the insulation.
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.

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.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

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 below.

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 made from same material and density as that of adjacent pipe insulation. Each piece is 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 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 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 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 and polyolefin, 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.

D. Install removable insulation covers at locations indicated. Installation conforms to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC 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.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.

2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated valve covers manufactured of same material as that of pipe insulation when available.
2. When prefabricated valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL 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 jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with 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 prefabricated 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 glass-fiber or mineral-wool 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 prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated 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 prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated sections are not available, install fabricated 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.

3.8 INSTALLATION OF FIELD-APPLIED JACKETS

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

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.

3.9 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.

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections with the assistance of a factory-authorized service representative].

B. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.11 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.

3.12 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1 and Smaller: Insulation is one of the following:
   a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
   b. Mineral Wool, Preformed Pipe Insulation, Type II: 1/2 inch thick.

2. NPS 1-1/4 and Larger: Insulation is one of the following:
   a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
   b. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation is one of the following:
   a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
   b. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.

2. NPS 1-1/2 and Larger: Insulation is one of the following:
   a. Flexible Elastomeric: 1 inch thick.Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
   b. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.

C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation is by protective shielding pipe covers per section 2.14.

D. Hot Service Drains:

1. All Pipe Sizes: Insulation is one of the following:
   a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
   b. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.

E. Condensate Piping:

1. NPS 1 and Smaller: Insulation is one of the following:
   a. Flexible Elastomeric: 1/2 inch thick.

2. NPS 1-1/4 and Larger: Insulation is one of the following:
   a. Flexible Elastomeric: 1/2 inch thick.

3.13 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Water Piping:

1. All Pipe Sizes: Insulation is one of the following:
   a. Glass-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
   b. Mineral Wool, Preformed Pipe Insulation, Type II: 2 inches thick.

3.14 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. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:
1. None.

D. Piping, Exposed:
1. Aluminum, Smooth: 0.016 inch thick.

3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:
1. Aluminum, Smooth: 0.024 inch thick.

D. Piping, Exposed:
1. Aluminum, Smooth with Z-Shaped Locking Seam: 0.024 inch thick.

END OF SECTION 22 07 19

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings - domestic water.
2. Piping joining materials - domestic water.
3. Encasement for piping.
4. Transition fittings - domestic water.
5. Dielectric fittings - domestic water.

B. Related Requirements:

1. Section 33 14 15 "Site Water Distribution Piping" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 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.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Installers of pressure-sealed joints are to be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

1.5 WARRANTY

1. Warranty is to cover labor and material costs of repairing and/or replacing defective materials and repairing any incidental damage caused by failure of piping system due to defects in materials or manufacturing.
2. Warranty is to be in effect only upon submission by Contractor to manufacturer of valid pressure/leak documentation indicating that the system was tested and passed manufacturer's pressure/leak test.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Domestic water piping, tubing, fittings, joints, and appurtenances intended to convey or dispense 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 PIPING MATERIALS

A. Potable-water piping and components are to comply with NSF 14, NSF 61, and NSF 372.

2.3 COPPER TUBE AND FITTINGS - DOMESTIC WATER

A. Drawn-Temper Copper Tube: ASTM B88, Type L.

B. Annealed-Temper Copper Tube: ASTM B88, Type K.

C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.

D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Do not use solder joints on pipe sizes greater than NPS 4.

E. Wrought Copper Unions: ASME B16.22. Do not use solder joints on pipe sizes greater than NPS 4.

F. Option if Approved by Live Oak County: Pressure-Seal-Joint Fittings, Copper or Bronze - Domestic Water:

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. Conex Banninger - USA.
    c. Copper Press Brand; Merit Brass Company.
    d. Elkhart Brass Mfg. Co., Inc.
    e. FNW; Ferguson Enterprises, Inc.
    f. Mueller Streamline Co.; a company of Mueller Industries.
    g. NIBCO INC.
    h. Viega LLC.

2. Source Limitations: Obtain pressure-seal-joint fittings, copper or bronze, from single manufacturer.
3. Housing: Copper.
4. O-Rings and Pipe Stops: EPDM.
5. Tools: Manufacturer's special tools.
6. Minimum 200 psig working-pressure rating at 250 deg F.

2.4 PIPING JOINING MATERIALS - DOMESTIC WATER

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B32, lead-free alloys.

D. Flux: ASTM B813, water flushable.

E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 ENCASEMENT FOR PIPING

A. Standard: ASTM A674 or AWWA C105/A21.5.

B. Form: Sheet or tube.

C. Color: Black or natural.

2.6 TRANSITION FITTINGS - DOMESTIC WATER

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.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Couplings - Domestic Water: AWWA C219.

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. Cascade Waterworks Mfg. Co.
b. Dresser Pipeline Solutions.
c. Ford Meter Box Company, Inc. (The).
d. JCM Industries, Inc.
e. Jay R. Smith Mfg Co; a division of Morris Group International.
f. Romac Industries, Inc.
g. Smith-Blair, a Xylem brand.
h. Viking Johnson.

2. Source Limitations: Obtain sleeve-type transition couplings from single manufacturer.

2.7 DIELECTRIC FITTINGS - DOMESTIC WATER

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 - Domestic Water:

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. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    b. Jomar Valve.
    c. WATTS; A Watts Water Technologies Company.
    d. Zurn Industries, LLC.

2. Source Limitations: Obtain dielectric unions from single manufacturer.
3. Standard: ASSE 1079.
4. Pressure Rating: 125 psig minimum at 180 deg F.
5. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges - Domestic Water:

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. Capitol Manufacturing Company.
    b. Matco-Norca.
    c. WATTS; A Watts Water Technologies Company.
    d. Zurn Industries, LLC.

2. Source Limitations: Obtain dielectric flanges from single manufacturer.
3. Standard: ASSE 1079.
4. Factory-fabricated, bolted, companion-flange assembly.
5. Pressure Rating: 125 psig minimum at 180 deg F.
6. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits - Domestic Water:

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. Advance Products & Systems, LLC.
    b. CALPICO, Inc.

2. Source Limitations: Obtain dielectric-flange insulating kits from single manufacturer.
3. Nonconducting materials for field assembly of companion flanges.
4. Pressure Rating: 150 psig.
5. Gasket: Phenolic, Temperature Rating: 225 deg F.
6. Bolt Sleeves: Phenolic or polyethylene.
7. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples - Domestic Water:

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. Anvil; an ASC Engineered Solution.
    b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    c. Matco-Norca.
    d. Sioux Chief Manufacturing Company, Inc.
    e. Victaulic Company.

2. Source Limitations: Obtain dielectric nipples from single manufacturer.
3. Standard: IAPMO PS 66.
4. Electroplated steel nipple complying with ASTM F1545.
5. Pressure Rating and Temperature: 300 psig at 225 deg F.
6. End Connections: Male threaded or grooved.
7. 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 is to be the following:

1. Annealed-temper copper tube, ASTM B88, Type K; wrought-copper, solder-joint fittings; and brazed joints. No joints below slab.

D. Under-building-slab, domestic water piping, NPS 2 and smaller is to be the following:

1. Annealed-temper copper tube, ASTM B88, Type K; wrought-copper, solder-joint fittings; and brazed joints. No joints below slab.

E. Aboveground domestic water piping, NPS 2 and smaller is to be the following:
1. Drawn-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and soldered joints.
2. Drawn-temper copper tube, ASTM B88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

F. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 is to be the following:

1. Drawn-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and soldered joints.
2. Drawn-temper copper tube, ASTM B88, Type L; copper pressure-seal-joint fittings; and pressure-sealed 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 in accordance with CDA's "Copper Tube Handbook."

C. Install underground copper tube and ductile-iron pipe in PE encasement in accordance with ASTM A674 or AWWA C105/A21.5.

D. Install valves in accordance with Section 22 05 23 "General-Duty Valves for Plumbing Piping."

E. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 22 11 19 "Domestic Water Piping Specialties."

F. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

H. 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.

I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

J. Install piping to permit valve servicing.

K. 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.

L. Install piping free of sags and bends.

M. Install fittings for changes in direction and branch connections.

N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

O. Install pressure gauges on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gauges in Section 22 05 00 "Common Work Results for Plumbing."

P. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 22 11 23.21 "Inline, Domestic Water Pumps."

Q. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 22 05 00 "Common Work Results for Plumbing."

R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 00 "Common Work Results for Plumbing."

S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 00 "Common Work Results for Plumbing."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 00 "Common Work Results for Plumbing."

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 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.

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 in accordance with ASTM B828 or CDA's "Copper Tube Handbook."

F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.

G. 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 in accordance with ASME B31.9.

H. 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 (DN 50) and Smaller: Plastic-to-metal transition fittings.

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 seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for hangers, supports, and anchor devices in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

C. Install hangers for copper pipe, 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.

E. Support vertical runs of copper pipe to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.8 PIPING 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.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.9 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.10 CLEANING

A. 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 in accordance with 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. Repeat procedures if biological examination shows contamination.
    e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-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 procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 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. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.12 FIELD QUALITY CONTROL

A. 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 installation 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.

END OF SECTION 22 11 16

SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Automatic water shutoff valve systems.
5. Balancing valves.
6. Temperature-actuated, water mixing valves.
7. Strainers for domestic water piping.
8. Outlet boxes.
9. Hose bibbs.
10. Wall hydrants.
11. Drain valves.
12. Water-hammer arresters.
13. Trap-seal primer device.
14. Flexible connectors.

B. Related Requirements:

1. Section 220500 "Common Work Results for Plumbing."
2. Section 221116 "Domestic Water Piping" for water meters.
3. Section 224500 "Emergency Plumbing Fixtures" for water tempering equipment.
4. Section 224700 "Drinking Fountains and Water Coolers."
5. Section 230923.18 "Leak Detection Instruments" for leak detection devices related to HVAC applications.
6. Section 331415 "Site Water Distribution Piping" for fire water-service backflow prevention devices.

1.2 DEFINITIONS

A. FKM: A family of fluoroelastomer materials defined by ASTM D1418.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Test and inspection reports.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and 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.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

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. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    b. Cash Acme Plumbing Products; an RWC brand.
    c. FEBCO; A WATTS Brand.
    d. WATTS; A Watts Water Technologies Company.
    e. Zurn Industries, LLC.

2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers:

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. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    b. Cash Acme Plumbing Products; an RWC brand.

c. Champion-Arrowhead.
d. MIFAB, Inc.
e. WATTS; A Watts Water Technologies Company.
f. Woodford Manufacturing Company.
g. Zurn Industries, LLC.
h. Jay R. Smith Mfg Co; a division of Morris Group International.

2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

2.4 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principal Backflow Preventers:

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. Apollo Valves; a part of Aalberts Integrated Piping Systems.
b. WATTS; A Watts Water Technologies Company.
c. Zurn Industries, LLC.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle third of flow range.
5. Size: See plans.
6. Design Flow Rate: See plans.
7. Selected Unit Flow Range Limits: See plans.
8. Pressure Loss at Design Flow Rate: 12 psi for sizes NPS 2 and smaller; 12 psi for NPS 2-1/2 and larger.
9. Body: Bronze cast silicon copper alloy for NPS 2 and smaller; ductile or cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
11. Configuration: Designed for horizontal, straight-through flow.
12. Accessories:

a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Double-Check, Backflow-Prevention Assemblies:

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. Apollo Valves; a part of Aalberts Integrated Piping Systems.
b. WATTS; A Watts Water Technologies Company.
c. Zurn Industries, LLC.

2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Size: See plans.
6. Design Flow Rate: See plans.
7. Selected Unit Flow Range Limits: See plans.
8. Pressure Loss at Design Flow Rate: 5psi for sizes NPS 2 and smaller; 5 psi for NPS 2-1/2 and larger.
9. Body: Bronze for NPS 2 and smaller; ductile or cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
11. Configuration: Designed for horizontal, straight-through flow.
12. Accessories:

    a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

C. Dual-Check-Valve Backflow Preventers:

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. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    b. Cash Acme Plumbing Products; an RWC brand.
    c. WATTS; A Watts Water Technologies Company.
    d. Zurn Industries, LLC.

2. Standard: ASSE 1024.
3. Operation: Continuous-pressure applications.
4. Size: See plans .
5. Body: Bronze with union inlet.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

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. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    b. Cash Acme Plumbing Products; an RWC brand.
    c. WATTS; A Watts Water Technologies Company.
    d. Zurn Industries, LLC.

2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Size: See plans.
5. Design Flow Rate: See plans.
6. Design Inlet Pressure: See plans.
7. Design Outlet Pressure Setting: See plans.
8. Body: Bronze for NPS 2 and smaller; bronze for NPS 2-1/2 and NPS 3.

9. Valves for Booster Heater Water Supply: Include integral bypass.
10. End Connections: Threaded or solder for NPS 2 and smaller; flanged or solder for NPS 2-1/2 and NPS 3.

B. Water-Control Valves:

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. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    b. CLA-VAL.
    c. Flomatic Valves; Flomatic Corporation.
    d. OCV Control Valves.
    e. WATTS; A Watts Water Technologies Company.
    f. Zurn Industries, LLC.

2. Description: Pilot-operated, diaphragm-type, single-seated, main water-control valve.
3. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless steel body.

    a. Size: See plans.
    b. Pattern: Globe-valve design.
    c. Trim: Stainless steel.

5. Design Flow: See plans.
6. Design Inlet Pressure: See plans.
7. Design Outlet Pressure Setting: See plans.
8. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

2.6 AUTOMATIC WATER SHUTOFF VALVE SYSTEMS

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. FloLogic, Inc.
2. OnSite PRO Inc.
3. QMI Manufacturing Inc.
4. RectorSeal Plumbing; A CSW Industrials Company.
5. Reliance Detection Technologies.
6. WaterCop.

B. Shutoff Control Ball Valves and Actuators:

1. Size: See plans .
2. Design Flow Rate: See plans.
3. Design Inlet Pressure: See plans.
4. Control Valve: Two-piece, full-port brass ball valve, MSS SP-110.

    a. End Connections: Threaded, female.

b. Fittings: One 3/8-by-1/2-inch male compression and one 3/8-by-1/2-inch female compression.
c. Seats: PTFE.
d. O-Rings: FKM.
e. Stem: Low-lead brass. Blowout proof.
f. CWP Rating: 600 psig.

5. Manual-override control turn-knob for emergency operation of valve.
6. Valve Actuator: Motor operated, with or without gears, electric and electronic. Capable of closing valve against inlet pressure. Direct mount, fails closed.

a. Power Supply: 120 V ac step-down transformer with cord and plug.
b. Manual Intervention: Allowed.
c. Position Indicator: Standard.

7. Actuator Enclosure: Suitable for ambient conditions encountered by application.

C. Shutoff Control Butterfly Valve and Actuator:

1. Size: See plans.
2. Compliance: MSS SP-67.
3. Full-port, epoxy-coated, ductile-iron lug body.
4. Seat: EPDM, minus 30 deg F to plus 250 deg F.
5. Face-to-Face Flange: ASME B16.5 flanges.
6. Disc Design: Floating stainless steel dual shaft.
7. Disc Material: Coated ductile iron.
8. Locating Pin: Carbon steel.
9. Bushings: PTFE.
10. O-Rings: EPDM.
11. Ten-position stop.
12. Manual-override control turn-knob for emergency operation of valve.
13. Valve Actuator: Motor operated, with or without gears, electric and electronic. Capable of closing valve against inlet pressure. Direct mount, fails closed.

a. Power Supply: 120 V ac step-down transformer with cord and plug.
b. Manual Intervention: Allowed.
c. Position Indicator: Standard.

14. Actuator Enclosure: Suitable for ambient conditions encountered by application.

2.7 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

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. Bell & Gossett; a Xylem brand.
b. IMI Hydronic Engineering Inc.
c. NIBCO INC.
d. Nexus Valve, Inc.; Aalberts Hydronic Flow Control.
e. WATTS; A Watts Water Technologies Company.

2. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
3. Body: Brass or bronze.
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Memory-Stop Balancing Valves:

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. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    b. Crane Fluid Systems; Crane Co.
    c. Hammond Valve.
    d. Jenkins Valves; a Crane Co. brand.
    e. Milwaukee Valve Company.
    f. NIBCO INC.
    g. Red-White Valve Corp.
    h. Stockham; a Crane Co. brand.

2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass or stainless steel.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

C. Automatic Flow Control Balancing Valves:

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. Caleffi North America.
    b. IMI Hydronic Engineering Inc.
    c. ThermOmegaTech.
    d. Acorn Controls; a Division of Morris Group International.

2. Flow Regulation: Plus or minus 5 percent over 95 percent of the working range.
3. Pressure Rating: 200 psig.
4. Size: NPS 2 or smaller.
5. Body: Stainless steel or brass.
6. Flow Cartridge: Stainless steel or antiscale polymer.
7. End Connections: Threaded or solder joint.

2.8 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

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. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    b. Cash Acme Plumbing Products; an RWC brand.
    c. POWERS; A Watts Water Technologies Company.
    d. Symmons Industries, Inc.
    e. Taco Comfort Solutions.
    f. WATTS; A Watts Water Technologies Company.
    g. Zurn Industries, LLC.

2. Standard: ASSE 1070.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: See plans.
9. Tempered-Water Design Flow Rate: See plans.
10. Valve Finish: Rough bronze.
11. Mounting: Manufacturer's wall bracket.

B. Primary, Thermostatic, Water Mixing Valves:

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. Acorn Engineering Company; a Division of Morris Group International.
    b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    c. Cash Acme Plumbing Products; an RWC brand.
    d. Lawler Manufacturing Company, Inc.
    e. POWERS; A Watts Water Technologies Company.
    f. Symmons Industries, Inc.
    g. WATTS; A Watts Water Technologies Company.
    h. Zurn Industries, LLC.
    i. Acorn Controls; a Division of Morris Group International.

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: Exposed-mounted, thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: See plans.
9. Tempered-Water Design Flow Rate: See plans.
10. Selected Valve Flow Rate at 45-psig
11. Pressure Drop: See plans.
12. Pressure Drop at Design Flow Rate: See plans.
13. Valve Finish: Rough bronze.
14. Piping Finish: Copper.

C. Individual-Fixture, Water Tempering Valves:

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. Acorn Engineering Company; a Division of Morris Group International.
    b. Lawler Manufacturing Company, Inc.
    c. POWERS; A Watts Water Technologies Company.
    d. Zurn Industries, LLC.
    e. Acorn Controls; a Division of Morris Group International.

2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Material: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Connections: Threaded inlets and outlet.
7. Finish: Chrome plated.
8. Tempered-Water Setting: See plans.
9. Tempered-Water Design Flow Rate: See plans.
10. Mounting: Manufacturer's wall bracket.

D. Primary Water Tempering Valves:

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. WATTS; A Watts Water Technologies Company.
    b. Acorn Controls; a Division of Morris Group International.

2. Standard: ASSE 1017, thermostatically controlled, water tempering valve, listed as tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Material: Bronze body.
5. Temperature Control: Manual.
6. Connections: Threaded inlets and outlet.
7. Selected Primary Water Tempering Valve Size: See plans.
8. Tempered-Water Setting: See plans.
9. Tempered-Water Design Flow Rate: See plans.
10. Pressure Drop at Design Flow Rate: See plans.
11. Tempered-Water Outlet Size: See plans for end connection.
12. Cold-Water Inlet Size: See plans for end connection.
13. Hot-Water Inlet Size: See plans for end connection.
14. Valve Finish: Rough bronze.

2.9 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

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. Keckley Company.
    b. Titan Flow Control, Inc.

c. WATTS; A Watts Water Technologies Company.
d. Zurn Industries, LLC.
e. Caleffi North America.

2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
4. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
5. Screen: Stainless steel with round perforations unless otherwise indicated.
6. Perforation Size:

   a. Strainers NPS 2 and Smaller: 0.020 inch.
   b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.

7. Drain: Pipe plug.

2.10 OUTLET BOXES

A. Icemaker Outlet Boxes:

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. Guy Gray, IPS Corporation.
   b. Oatey Co.
   c. Sioux Chief Manufacturing Company, Inc.
   d. Water-Tite, IPS Corporation.

2. Mounting: Recessed.
3. Material and Finish: Plastic box and faceplate.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Accessory: Water hammer arrestor.
6. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.11 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

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. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. MIFAB, Inc.
   c. Prier Products, Inc.
   d. WATTS; A Watts Water Technologies Company.
   e. Woodford Manufacturing Company.
   f. Zurn Industries, LLC.
   g. Josam Company.

2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet, Concealed: With integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounted with cover.
9. Box and Cover Finish: See plans.
10. Operating Keys(s): One with each wall hydrant.

2.12 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4.
4. Body: ASTM B62 bronze.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.13 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

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. MIFAB, Inc.
    b. Precision Plumbing Products.
    c. Sioux Chief Manufacturing Company, Inc.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.14 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

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. Jay R. Smith Mfg Co; a division of Morris Group International.
    b. Josam Company.
    c. MIFAB, Inc.
    d. Precision Plumbing Products.
    e. Sioux Chief Manufacturing Company, Inc.
    f. WATTS; A Watts Water Technologies Company.
    g. Zurn Industries, LLC.

2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.15 FLEXIBLE CONNECTORS

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. Flex-Hose Co., Inc.
2. Mason Industries, Inc.
3. Metraflex Company (The).

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

C. Stainless Steel-Hose Flexible Connectors: Corrugated-stainless steel tubing with stainless steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

A. Backflow Preventers: Install in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
3. Do not install bypass piping around backflow preventers.

B. Water Regulators: Install with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gauges on inlet and outlet.

C. Water Control Valves: Install with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gauges on inlet and outlet.

D. Automatic Water Shutoff Valves: Test for signal strength before valve installation. Install automatic shutoff valve downstream from main domestic water shutoff valve. Install valve controller in an accessible location with sensors in areas where water is likely to accumulate.

E. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.

F. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.

G. Y-Pattern Strainers: For water, install on supply side of each control valve water pressure-reducing valve solenoid valve and pump.

H. Outlet Boxes: Install boxes recessed in wall or surface mounted on wall. Install 1-1/2-by-3-1/2-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."

I. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.

J. Supply-Type, Trap-Seal Primer Device: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

K. Trap-Seal Primer Systems: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 PIPING CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 26 05 26 "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.

3.4 CONTROL CONNECTIONS

A. Connect control wiring in accordance with Section 26 05 23 "Control-Voltage Electrical Power Cables."

3.5 IDENTIFICATION

A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
   1. Water pressure-reducing valves.
   2. Automatic water shutoff valve systems.
   3. Temperature-actuated, water mixing valves.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.6 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

D. Adjust each pressure vacuum breaker reduced-pressure-principle backflow preventer double-check, backflow-prevention assembly and double-check, detector-assembly backflow preventer in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections.

   1. Test each pressure vacuum breaker reduced-pressure-principle backflow preventer double-check, backflow-prevention assembly and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.

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 unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 22 11 19

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Hub and spigot, cast-iron soil pipe and fittings.
2. Hubless, cast-iron soil pipe and fittings.
3. Specialty pipe fittings.
4. Encasement for underground metal piping.

B. Related Requirements:
1. Section 22 13 13 "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and elevations, or Building Information Model (BIM) drawn to scale, showing items described in this Section and coordinated with all building trades.

B. Field quality-control reports.

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 are capable of withstanding the following minimum working pressure unless otherwise indicated:
1. Soil, Waste, and Vent Piping: 10 ft. head of water.

2.2 PIPING MATERIALS

A. Piping materials to 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. 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. AB & I Foundry; a part of the McWane family of companies.
2. Charlotte Pipe and Foundry Company.
3. Tyler Pipe; a part of McWane family of companies.

B. Pipe and Fittings:

1. Marked with CISPI collective trademark.
2. ASTM A74, service cast iron.

C. Gaskets: ASTM C564, rubber.

D. Caulking Materials: ASTM B29, pure lead and oakum or hemp fiber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

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. AB & I Foundry; a part of the McWane family of companies.
   2. Charlotte Pipe and Foundry Company.
   3. Tyler Pipe; a part of McWane family of companies.

B. Pipe and Fittings:
   1. Marked with CISPI collective trademark.
   2. ASTM A888 or CISPI 301.

C. CISPI, Hubless-Piping Couplings:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

      a. ANACO-Husky.
      b. Charlotte Pipe and Foundry Company.
      c. Dallas Specialty & Mfg. Co.
      d. MIFAB, Inc.
      e. Mission Rubber Company, LLC; a division of MCP Industries.
      f. Tyler Pipe; a subsidiary of McWane Inc.

   2. Standards: ASTM C1277 and CISPI 310.
   3. Description: Stainless steel corrugated shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:
   1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections of same size as and compatible with pipes to be joined.
   2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
   3. Unshielded, Nonpressure Transition Couplings:

      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) Dallas Specialty & Mfg. Co.
         2) Fernco Inc.
         3) Mission Rubber Company, LLC; a division of MCP Industries.
         4) Plastic Oddities.

      b. Standard: ASTM C1173.
      c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
      d. End Connections: Same size as and compatible with pipes to be joined.
      e. Sleeve Materials:

         1) For Cast-Iron Soil Pipes: ASTM C564, rubber.
         2) For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926 PVC.
         3) For Dissimilar Pipes: ASTM D5926 PVC or other material compatible with pipe materials being joined.

   4. Shielded, Nonpressure Transition Couplings:

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) Cascade Waterworks Mfg. Co.
2) Mission Rubber Company, LLC; a division of MCP Industries.

b. Standard: ASTM C1460.
c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
d. End Connections: Same size as and compatible with pipes to be joined.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating non-conductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:

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) A.Y. McDonald Mfg. Co.
2) Capitol Manufacturing Company.
3) HART Industrial Unions, LLC.
4) Jomar Valve.
5) WATTS; A Watts Water Technologies Company.
6) Wilkins.
7) Zurn Industries, LLC.

b. 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.

3. Dielectric Flanges:

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) Capitol Manufacturing Company.
2) Matco-Norca.
3) WATTS; A Watts Water Technologies Company.
4) Zurn Industries, LLC.

b. Description:

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.

4. Dielectric-Flange Insulating Kits:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Advance Products & Systems, LLC.
2) CALPICO, Inc.
3) GPT; a division of EnPRO Industries.

b. Description:

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.

5. Dielectric Nipples:

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) Anvil; an ASC Engineered Solution.
2) Elster Perfection; Honeywell.
3) Matco-Norca.
4) Precision Plumbing Products.
5) Victaulic Company.

b. 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.

2.6 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Standard: ASTM A674 or AWWA C105/A 21.5.
B. Material: Linear low-density polyethylene film of 0.008-inch or high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.
C. Form: Sheet.
D. Color: Black or natural.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 20 00 "Earth Moving."

3.2 INSTALLATION OF PIPING

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: Two percent downward in direction of flow for piping NPS 3 and smaller; 2 percent downward in direction of flow for piping NPS 4 and larger.
   2. Horizontal Sanitary Waste Piping: Two percent downward in direction of flow.
   3. Vent Piping: One percent down toward vertical fixture vent or toward vent stack.

M. Install cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
   1. Install encasement on underground piping in accordance with ASTM A674 or AWWA C105/A 21.5.

N. 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 22 13 19 "Sanitary Waste Piping Specialties."
   2. Install drains in sanitary waste gravity-flow piping.
      a. Comply with requirements for drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."

O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

P. Install sleeves for piping penetrations of walls, ceilings, and floors.
   1. Comply with requirements for sleeves specified in Section 22 05 00 "Common Work Results for Plumbing."

Q. Install sleeve seals for piping penetrations of concrete walls and slabs.
   1. Comply with requirements for sleeve seals specified in Section 22 05 00 "Common Work Results for Plumbing."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors.
   1. Comply with requirements for escutcheons specified in Section 22 05 00 "Common Work Results for Plumbing."

3.3 JOINT CONSTRUCTION

A. Hub- and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Hub-and-Spigot, Cast-Iron Soil Piping Caulked Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum caulked joints.

C. Hubless, Cast-Iron Soil Piping Coupled Joints:
   1. Join hubless, cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

D. Threaded Joints: Thread pipe with tapered pipe threads in accordance with 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.

E. Grooved Joints: Cut groove ends of pipe in accordance with AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

F. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

G. Joint Restraints and Sway Bracing:
   1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:

      a. Provide axial restraint for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
      b. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.
      c. Provide rigid sway bracing for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction and branch openings.

3.4 INSTALLATION OF SPECIALTY PIPE FITTINGS

A. Transition Couplings:
   1. Install transition couplings at joints of piping with small differences in ODs.
   2. In Waste Drainage Piping: Shielded, nonpressure 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.
   3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
   4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment" Section 22 05 48.13 "Vibration Controls 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 and crawlspaces.
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 and crawlspaces.
5. Vertical Piping: MSS Type 8 or Type 42 clamps.
6. Install individual, straight, horizontal piping runs:

    a. 100 Ft. and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Ft.: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Ft. if Indicated: MSS Type 49, spring cushion rolls.
7. Multiple, Straight, Horizontal Piping Runs 100 Ft. 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 cast-iron soil 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. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

D. Support vertical runs of cast-iron soil piping to comply with MSS SP-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 22 13 19 "Sanitary Waste Piping Specialties."
6. Equipment: Connect waste piping as indicated.

    a. Provide shutoff valve if indicated and union for each connection.
    b. 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 in accordance with 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. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 22 05 53 "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 in accordance with 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 ft. 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 (inside walls, chases, and above ceilings) soil and waste piping NPS 4 and smaller are to be the following:
   1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
   2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

C. Aboveground (inside walls, chases, and above ceilings) vent piping NPS 4 and smaller is to be the following:
   1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
   2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

D. Underground soil, waste, and vent piping NPS 4 and smaller are to be the following:
   1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
   2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

E. Crawlspace soil, waste, and vent piping NPS 4 and smaller are to be the following:
   1. Hub-and-Spigot, cast-iron soil pipe and fittings; CISPI hub-and-spigot gasketed or caulked joints.
   2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 221316

SECTION 22 13 19 - 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.

B. Related Requirements:
   1. Section 07 62 00 "Sheet Metal Flashing and Trim" for metal roof flashing assemblies.
   2. Section 07 72 00 "Roof Accessories" for preformed flashings.
   3. Section 07 84 13 "Penetration Firestopping" for through-penetration firestop assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

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 ASSEMBLY DESCRIPTIONS

A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.2 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. 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; A Watts Water Technologies Company.
      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 or hubless, cast-iron soil pipe test tee as required to match connected piping.
   5. Closure: Countersunk or raised-head, 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to 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; A Watts Water Technologies Company.
   f. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: As required.
7. Outlet Connection: Threaded.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: **Cast iron** with threads.
10. Frame and Cover Material and Finish: See plans.
11. Frame and Cover Shape: See plans.
12. Top-Loading Classification: See plans.
13. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Josam Company.
   c. MIFAB, Inc.
   d. WATTS; A Watts Water Technologies Company.
   e. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure Plug:
   a. Cast iron.
   b. Countersunk head.
   c. Drilled and threaded for cover attachment screw.
   d. Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access, Cover Plate: Round, flat, chrome-plated brass cover plate with screw.
7. Wall Access, Frame and Cover: Round, wall-installation frame and cover.

2.3 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 with increaser fitting of size indicated.

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, Trap-Seal Primer Fittings:
1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

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.

F. Stack Flashing Fittings:
1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

G. Vent Caps:
1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

H. Expansion Joints:
1. Standard: ASME A112.6.4.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent 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 floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
   1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
   2. Size: Same as floor drain inlet.

G. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

H. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.

I. Install vent caps on each vent pipe passing through roof.

J. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

K. Install wood-blocking reinforcement for wall-mounting-type specialties.

L. 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 22 13 16 "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 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
   1. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

A. Protect drains during the 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 22 13 19

SECTION 22 14 29 - SUMP PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Oil-sensing sump pumps and controllers.

1.2 ACTION SUBMITTALS

A. Product Data:
   1. Oil-sensing sump pumps and controllers.

B. Product Data Submittals: For each product.

   1. Construction details, material descriptions, dimensions of individual components and profiles.
   2. Rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps and controls.

   1. Indicate actual installed items by marking submittals with an arrow or box.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with manufacturer's written instructions for handling.

1.5 WARRANTY

A. Manufacturer Warranty: [**Manufacturer agrees**] [**Installer agrees**] [**Manufacturer and Installer agree**] to repair or replace sump pumps that fail in materials or workmanship within specified warranty period.

   1. Failures include, but are not limited to, the following:

      a. Faulty operation of motors, impellers, controller, wiring, and connectors.
      b. Deterioration of metals, metal finishes, and other materials beyond normal use.

   2. Warranty Period: 1 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of sump pump from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

2.3 OIL-SENSING SUMP PUMPS AND CONTROLLERS

A. Oil-Sensing Sump Pumps and Controllers:

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. Zoeller Pump Company.
2. Taco Pumps.

C. Description: Factory-assembled and -tested sump-pump unit. ASME A17.1 compliant.
1. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 14.1-14.2 and HI 14.3.
2. Pump Casing: Cast iron, with strainer inlet; legs that elevate pump to permit flow into impeller; and vertical discharge for piping connection.
3. Capacities and Characteristic:

a. Unit Capacity: 50 gpm.
b. Number of Pumps: One.
c. Each Pump:

1) Capacity: 50 gpm.
2) Total Dynamic Head: 38 feet.
3) Speed: 3450.
4) Discharge Size: 2” NPS.
5) Electrical Characteristics:

a) Motor Horsepower: 1/2 hp.
b) Volts: 115 V ac.
c) Phases: Single.
d) Hertz: 60.

d. Unit Electrical Characteristics:

1) Full-Load Amperes: 15 A.

4. Controls:

a. Industrial-grade switch(es) with internal 20 A relay and Type 304 stainless steel sensor probes.
b. Liquid/oil sensor that differentiates and indicates the presence of oil and/or water under high-water conditions.
c. Alarm Panel:

1) High-oil-level alarm.
2) High-water-level alarm.
3) Audible and visual alarms for each alarm condition.
4) Dry contacts for remote monitoring of oil, water, and high liquid conditions.

d. Control Panel:

1) Simplex.
2) Enclosure: NEMA 250, Type 4X.
3) HOA switch(es).
4) Green pump run light; power on light.
5) Pump circuit breaker(s).

2.4 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220500 "Common Work Results for Plumbing."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Motors for submersible pumps are to be hermetically sealed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of sanitary sewer piping connections before sump-pump installation.

3.2 INSTALLATION

A. Pump Installation Standards: Comply with HI 14.4 for installation of sump pumps.

B. Equipment Mounting:
1. Set pumps inside bottom of elevator pit, plumb and level.

C. Wiring Method: Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance.

3.4 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.

3.5 ADJUSTING

A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust control set points.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test, inspect, and adjust components, assemblies, and equipment installations, including connections.

B. Tests and inspections:

1. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Pumps and controls will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 22 14 29

SECTION 22 42 00 - COMMERCIAL PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Commercial lavatories.
2. Commercial urinals.
3. Commercial water closets.
4. Flushometer valves.
5. Toilet seats.
6. Fixture carriers.

1.2 DEFINITIONS

A. PMMA: Polymethyl methacrylate; also known as "acrylic."

B. High-Efficiency Flush Volume: 1.28 gal. or less per flush.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for plumbing fixtures.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories and/or counter-mounted sinks.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. For lavatories and faucets.
2. For flushometer valves to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. 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. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
3. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one of each type.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Lavatory faucets spray heads and 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.

2.2 COMMERCIAL LAVATORIES

A. Lavatories, Wall-Mounted:

1. Lavatories, Wall Mounted - Vitreous China, Rectangular with Back:
   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 Standard.
      2) Briggs Plumbing Products, Inc.
      3) Kohler Co.
      4) Zurn Industries, LLC.
   b. Fixture:
      1) Standard: ASME A112.19.2/CSA B45.1.
      2) Type: For wall hanging.
      3) Nominal Size: Rectangular, see plans for size.
      4) Faucet-Hole Punching: Three holes, 4-inch centers.
      5) Faucet-Hole Location: Top.
      6) Color: White.
      7) Mounting Material: Chair carrier.
   c. Support: Lavatory carrier, floor affixed with steel uprights, concealed arm.
   d. Lavatory Mounting Height: Accessible in accordance with ICC A117.1.

2. Lavatory Faucets, Manually Operated:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) American Standard.
      2) Kohler Co.
      3) T&S Brass.
      4) Delta Faucet Company.
      5) Chicago; Geberit Group.
   b. Standard: ASME A112.18.1/CSA B125.1.
   c. Operation Type: Two handle, mixing, Commercial.

1) General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
2) Body Type: Widespread.
3) Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.
4) Finish: Polished chrome plate.
5) Maximum Flow Rate: 0.5 gpm.
6) Mounting Type: Deck, exposed.
7) Valve Handle(s): Wrist blade, 4 inches.
8) Spout: Fixed neck type.
9) Spout Outlet: Aerator.
10) Operation: Compression, manual.
11) Drain: Not part of faucet.

3. Lavatory 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: Loose key.

4. Risers:

a. NPS 1/2.
b. ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel, flexible hose riser.

5. Lavatory Waste Fittings:

a. Standard: ASME A112.18.2/CSA B125.2.
b. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.

6. Trap:

a. Size: NPS 1-1/2 by NPS 1-1/4.
b. Material:

1) 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.

2.3 COMMERCIAL URINALS

A. Urinals, Stall:

1. Urinals, Wall Hung - Back Outlet, Siphon Jet:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    1) American Standard.
    2) Kohler Co.
    3) Zurn Industries, LLC.

b. Fixture:

    1) Standards:

        a) ASME A112.19.2/CSA B45.1.
        b) ASME A112.19.5/CSA B45.15.

    2) Material: Vitreous china.
    3) Type: Siphon jet.
    4) Strainer or Trapway: Manufacturer's standard strainer with integral trap.
    5) Water Consumption: 0.5 gpf.
    6) Spud Size and Location: NPS 3/4; top.
    7) Outlet Size and Location: NPS 2; back.
    8) Color: White.

c. Flushometer Valves, Manually Operated - Diaphragm, Lever Handle:

d. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    1) Sloan Valve Company.
    2) Zurn Industries, LLC.

e. Source Limitations: Obtain flushometer valve from single source from single manufacturer.
f. Standard: ASSE 1037/ASME 112.1037/CSA B125.37.
g. Minimum Pressure Rating: 125 psig.
h. Features: Include integral check stop and backflow-prevention device.
i. Material: Brass body with corrosion-resistant components.
j. Style: Exposed.
k. Flushometer-Valve Finish: Chrome-plated.
l. Handle Finish: Chrome plated.
m. Consumption: 0.5 gal. per flush.
n. Minimum Inlet: NPS 3/4.
o. Minimum Outlet: NPS 3/4.
p. Waste Fitting:

    1) Standard: ASME A112.18.2/CSA B125.2 for coupling.
    2) Size: NPS 2.

q. Support: Urinal carrier, floor affixed with steel uprights with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture.
r. Urinal Mounting Height: Standard or accessible in accordance with ICC A117.1. See plans.

2.4 COMMERCIAL WATER CLOSETS

A. Water Closets, Wall Mounted:

1. Water Closets, Wall Mounted - Top Spud:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) American Standard.
2) Kohler Co.
3) Zurn Industries, LLC.

b. Source Limitations: Obtain water closets from single source from single manufacturer.
c. Standard: ASME A112.19.2/CSA B45.1.
d. Bowl:

1) Material: Vitreous china.
2) Type: Siphon jet.
3) Style: Flushometer valve.
4) Mounting Height: Standard or accessible in accordance with ICC A117.1.
5) Rim Contour: Elongated.
6) Water Consumption: 1.28 gal. per flush.
7) Spud Size and Location: NPS 1-1/2; top.
8) Color: White.

e. Flushometer Valves, Manually Operated - Diaphragm, Lever Handle.
Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Sloan Valve Company.
2) Zurn Industries, LLC.

f. Source Limitations: Obtain flushometer valve from single source from single manufacturer.
g. Standard: ASSE 1037/ASME 112.1037/CSA B125.37.
h. Minimum Pressure Rating: 125 psig.
i. Features: Include integral check stop and backflow-prevention device.
j. Material: Brass body with corrosion-resistant components.
k. Style: Exposed.
l. Flushometer-Valve Finish: Chrome-plated.
m. Handle Finish: Chrome plated.
n. Consumption: 1.28 gal. per flush.
o. Minimum Inlet: NPS 1.0.
p. Minimum Outlet: NPS 1.5.
q. Waste Fitting:

1) Standard: ASME A112.18.2/CSA B125.2 for coupling.
2) Size: NPS 4.

r. Support: Water-closet carrier, floor affixed.

2.5 TOILET SEATS

A. Toilet Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Standard.
    b. Bemis Manufacturing Company.
    c. Church Seats; Bemis Manufacturing Company.
    d. Kohler Co.
    e. Zurn Industries, LLC.

2. Source Limitations: Obtain toilet seat from single source from single manufacturer.
3. Standard: IAPMO/ANSI Z124.5.
4. Material: Plastic.
5. Type: Commercial (Heavy duty).
6. Shape: Elongated rim, open front.
7. Hinge: Self-sustaining, check.
8. Hinge Material: Noncorroding metal.
9. Seat Cover: Not required.
10. Color: White.
11. Surface Treatment: Not required.

2.6 FIXTURE CARRIERS

A. Fixture Carriers - Urinal:

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. WATTS; A Watts Water Technologies Company.
    e. Wade; a subsidiary of McWane Inc.
    f. Zurn Industries, LLC.

2. Source Limitations: Obtain urinal carriers from single source from single manufacturer.
3. Standard: ASME A112.6.1M.
4. 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.

B. Fixture Carriers - Water Closet:

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. WATTS; A Watts Water Technologies Company.
    e. Wade; a subsidiary of McWane Inc.
    f. Zurn Industries, LLC.

2. Source Limitations: Obtain water closet carriers from single source from single manufacturer.
3. Standard: ASME A112.6.1M.
4. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine walls and floors for suitable conditions where plumbing fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF COMMERCIAL PLUMBING FIXTURES

A. Lavatory Installation:

1. Install lavatories level and plumb in accordance with roughing-in drawings.
2. Install supports, affixed to building substrate, for wall-mounted lavatories.
3. Install accessible, wall-mounted lavatories at mounting height in accordance with ICC A117.1.
4. Install water-supply piping with stop on each supply to each lavatory faucet. Install stops in locations that are accessible for ease of operation.
5. Install trap and waste piping on each drain outlet of each lavatory to be connected to sanitary drainage system.
6. 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 22 05 00 "Common Work Results for Plumbing."
7. 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 07 92 00 "Joint Sealants."
8. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

B. Urinal Installation:

1. Install urinals level and plumb in accordance with roughing-in drawings.
2. Install wall-hung, back-outlet urinals onto waste-fitting seals and attached to supports.
3. Install accessible, wall-mounted urinals at mounting height in accordance with ICC A117.1.
4. Install supports, affixed to building substrate, for wall-hung urinals.
5. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
6. Use chair-type carrier supports with rectangular steel uprights for urinals.
7. Measure support height installation from finished floor, not structural floor.

8. Install flushometer-valve, water-supply fitting on each supply to each urinal.
9. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
10. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.
11. Install actuators in locations easily reachable for people with disabilities.
12. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Install deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 00 "Common Work Results for Plumbing."
13. Seal joints between urinals, walls, and floors using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to urinal color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

C. Water Closet Installation:

1. Install water closets level and plumb in accordance with roughing-in drawings.
2. Install accessible, wall-mounted water closets at mounting height in accordance with ICC A117.1.
3. Use carrier supports with waste-fitting assembly and seal.
4. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals, and affix to building substrate.
5. Measure support height installation from finished floor, not structural floor.
6. Install flushometer-valve, water-supply fitting on each supply to each water closet.
7. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
8. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
9. Install actuators in locations easily reachable for people with disabilities.
10. Install toilet seats on water closets.
11. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Install deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 00 "Common Work Results for Plumbing."
12. Seal joints between water closets, walls, and floors using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to water-closet color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

3.3 INSTALLATION OF PIPING CONNECTIONS

A. Connect plumbing fixtures with water supplies and soil, waste, and vent piping. Use size fittings required to match plumbing fixtures.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Comply with soil, waste, and vent piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

D. Install protective-shielding pipe covers and enclosures on exposed supplies and waste piping of accessible plumbing fixtures. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

E. Where installing piping adjacent to water closets and urinals, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust plumbing fixtures and controls. Replace damaged and malfunctioning plumbing fixtures, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

C. Adjust water pressure at flushometer valves to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of plumbing fixtures, inspect and repair damages finishes. Replace any fixtures unable to be repaired to the satisfaction of the Architect.

B. Clean plumbing fixtures and associated faucets, valves, flushometer valves, and fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed plumbing fixtures and associated faucets, valves, flushometer valves, and fittings.

D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 42 00

SECTION 22 47 16 - PRESSURE WATER COOLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pressure water coolers.
2. 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.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include diagrams for power wiring.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For pressure water coolers to include in maintenance manuals.

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.

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, Vinyl-Covered Metal with Stainless Steel Top:

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. Elkay.
b. Murdock Manufacturing; A Division of Morris Group International.
c. Oasis International.
d. Halsey Taylor.

1. Source Limitations: Obtain surface wall-mounted, vinyl-covered metal with stainless steel top, pressure water coolers from single source from single manufacturer.
2. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
3. Control: Push bar.
4. Glass Filler.
5. Bottle Filler: Sensor activation. Fill rate 0.5 to 1.5 gpm.
6. Supply: NPS 3/8 with shutoff valve.
7. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
6. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
7. Support: Water-cooler carrier.
8. Water-Cooler Mounting Height: High/low-standard/accessible in accordance with ICC A117.1.
9. Capacities and Characteristics:

    a. Cooled Water: 8 gph.
    b. Ambient-Air Temperature: 90 deg F.
    c. Inlet-Water Temperature: 80 deg F.
    d. Cooled-Water Temperature: 50 deg F.
    e. Cooled-Water Storage: 1 gallon minimum.
    f. Electrical Characteristics:
        1) Volts: 120 V ac.
        2) Phase: Single.
        3) Hertz: 60 Hz.
        4) Full-Load Amperes: See electrical plans.
        5) Minimum Circuit Ampacity: See electrical plans.
        6) Maximum Overcurrent Protection: See electrical plans.

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; a subsidiary of McWane Inc.
    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. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

C. Install mounting frames, affixed to building construction, and attach recessed, pressure water coolers, and bottle filling stations to mounting frames.

D. 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 "General-Duty Valves for Plumbing Piping."

E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."

G. 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 "General-Duty 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.

C. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplates to be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplates to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

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 22 47 16

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.

B. Related Requirements:
1. Section 230500 "Common Work Results for HVAC" for pipe guides and anchors.
2. Section 233113 "Metal Ducts" for duct hangers and supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

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.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

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. Copper Pipe and Tube Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-plated steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-plated 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 MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 PLASTIC PIPE HANGERS

A. Description: Similar to MSS SP-58, Types 1 through 58, factory-fabricated steel pipe hanger except hanger is made of plastic.

B. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Flammability: ASTM D635, ASTM E84, and UL 94.

2.5 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. ABB, Electrification Business.
    b. Atkore Unistrut.
    c. B-Line; a division of Eaton, Electrical Sector.
    d. Flex-Strut Inc.
    e. G-Strut.
    f. Haydon Corporation.
    g. MIRO Industries Inc.
    h. Rooftop Support Systems; Eberl Iron Works, Inc.
    i. Wesanco/ZSi-Foster; an Ideal Tridon Group Company.

2. Description: Shop- or field-fabricated, pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
4. Channels: Continuous slotted carbon-steel channel with inturned lips.
5. Channel Width: Selected for applicable load criteria.
6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized steel.
8. Metallic Coating: Hot-dip galvanized.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Anvil; an ASC Engineered Solution.
    b. CADDY; brand of nVent Electrical plc.
    c. Carpenter & Paterson, Inc.
    d. Empire Industries, Inc.
    e. MIRO Industries Inc.
    f. PHD Manufacturing, Inc.

g. FNW; Ferguson Enterprises, Inc.

2. Description: Shop- or field-fabricated, pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
4. Channels: Continuous slotted carbon-steel channel with inturned lips.
5. Channel Width: Select for applicable load criteria.
6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized steel.
8. Metallic Coating: Hot-dip galvanized.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 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.

F. 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 MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the 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. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.

D. Framing System Installation: Metal. Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

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. 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.

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. 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. Thermal-hanger shield inserts may be used as an option. 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. Thermal-hanger shield inserts may be used as an option. 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 (DN 8 to DN 90): 12 inches long and 0.048 inch thick.
b. NPS 4 (DN 100): 12 inches long and 0.06 inch thick.
c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches long and 0.06 inch thick.
d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches long and 0.075 inch thick.
e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 (DN 200) 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 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 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.

    a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

2. Comply with requirements in Section 099113 "Exterior Painting," Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
3. 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, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.

F. Use fiberglass pipe hangers and fiberglass strut systems 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 padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. 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.

K. 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.

L. 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.

M. 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-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. 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.

O. 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.

P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION

SECTION 23 05 53 - IDENTIFICATION FOR HVAC 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. Duct labels.
6. Stencils.
7. Valve tags.
8. Warning tags.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve-numbering scheme.

E. Valve Schedules: Provide for each piping system. Included in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    1. Brady Corporation.
    2. Craftmark Pipe Markers.
    3. Kolbi Pipe Marker Co.
    4. Seton Identification Products; a Brady Corporation company.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
3. Letter and Background Color: As indicated for specific application under Part 3.
4. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

6. 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.
7. Fasteners: Stainless steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Craftmark Pipe Markers.
3. Seton Identification Products; a Brady Corporation company.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. 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.

G. Fasteners: Stainless steel rivets or self-taping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA70E and other applicable codes and standards.

J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 WARNING TAPE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Craftmark Pipe Markers.
3. Seton Identification Products; a Brady Corporation company.

B. Material: Vinyl.

C. Minimum Thickness: 0.005 inch.

D. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.

E. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.

F. Maximum Temperature: 160 deg F.

G. Minimum Width: 4 inches.

2.4 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Craftmark Pipe Markers.
3. Kolbi Pipe Marker Co.
4. Seton Identification Products; a Brady Corporation company.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

F. 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.

2.5 STENCILS – FOR DUCTWORK SERVING ENERGY RECOVERY UNIT ONLY

A. Stencils for Ducts: To be placed on each of the four duct systems at each energy recovery unit.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Craftmark Pipe Markers.
2. Kolbi Pipe Marker Co.
3. Pipemarker.com; Brimar Industries, Inc.

2. 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.

3. Stencil Material: Polyester or oil board.
4. Stencil Paint: Exterior, gloss, acrylic enamel. Paint may be in pressurized spray-can form.
5. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.
6. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    1. Craftmark Pipe Markers.
    2. Kolbi Pipe Marker Co.
    3. Pipemarker.com; Brimar Industries, Inc.

2. 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.
3. Stencil Material: Polyester or oil board.
4. Stencil Paint: Exterior, gloss, acrylic enamel. Paint may be in pressurized spray-can form.
5. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.
6. Letter and Background Color: As indicated for specific application under Part 3.

2.6 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Craftmark Pipe Markers.
3. Kolbi Pipe Marker Co.
4. Seton Identification Products; a Brady Corporation company.

B. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: aluminum, 0.031-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire link chain or beaded chain or S-hook.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. 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.

2.7 WARNING TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Craftmark Pipe Markers.
3. Kolbi Pipe Marker Co.
4. Seton Identification Products; a Brady Corporation company.

B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. 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.

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."

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 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, ductwork, and equipment.

D. 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.

E. Flow-Direction Arrows: Use arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

F. Pipe-Label Color Schedule:See discussion in "Colors for Pipe Identification Systems" Paragraph in the Evaluations. Background and lettering colors should comply with recommendations in ASME A13.1 where applicable. Note that all colors listed in ASME A13.1 preceded by the word "safety" are required to comply with ANSI Z535.1.

1. Refrigerant Piping: White letters on an ANSI Z535.1 safety-blue background.
2. Toxic and Corrosive Fluids: Black letters on an ANSI Z535.1 safety-orange background.
3. Flammable Fluids: Black letters on an ANSI Z535.1 safety-yellow background.
4. Combustible Fluids: White letters on an ANSI Z535.1 safety-brown background.
5. Potable and Other Water: White letters on an ANSI Z535.1 safety-green background.
6. Compressed Air: White letters on an ANSI Z535.1 safety-blue background.

3.6 INSTALLATION OF DUCT LABELS

A. Install self-adhesive duct labels showing service and flow direction with permanent adhesive on air ducts.

1. Provide labels in the following color codes:

    1. For air supply ducts: White letters on blue background.
    2. For air return ducts: White letters on blue background.
    3. 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 20 ft. where exposed or are concealed by removable ceiling system.

D. Stenciled Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:

1. Black letters on White background.

3.7 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, and HVAC terminal devices 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:

1. Refrigerant: 1-1/2 inches, round.

2. Valve-Tag Colors:

1. For each piping system, use the same lettering and background coloring system on valve tags as used for the Pipe Label Schedule text and background.

3.8 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 23 05 93 - TESTING, ADJUSTING, AND BALANCING 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. Testing, Adjusting, and Balancing of Air Systems:
      a. Constant-volume air systems.
      b. Energy Recovery air systems.
      c.
   2. Testing, adjusting, and balancing of equipment.
   3. Sound tests.
   4. Duct leakage tests verification.
   5. HVAC-control system verification.

B. Procurement of T&B Services shall be by the general contractor. The T&B agent shall submit their bid directly to the general contractor. Refer to Section 3 for approved balancing contractors.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

E. TDH: Total dynamic head.

F. UFAD: Underfloor air distribution.

1.4 PREINSTALLATION MEETINGS

A. TAB Conference: Conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan, to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.
   1. Minimum Agenda Items:
      a. The Contract Documents examination report.
      b. The TAB plan.

c. Needs for coordination and cooperation of trades and subcontractors.
d. Proposed procedures for documentation and communication flow.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.

D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. Instrument calibration reports, to include the following:
1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.6 QUALITY ASSURANCE

A. TAB Specialists Qualifications, Certified by AABC:
1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
2. TAB Technician: Employee of the TAB specialist and certified by AABC.

B. TAB Specialists Qualifications, Certified by NEBB:
1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB.
2. TAB Technician: Employee of the TAB specialist and certified by NEBB.

C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

E. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.7 FIELD CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

A. Subject to compliance with requirements, engage one of the following:
1. TSI Inc.
2. PHI Inc.
3. Reynolds Engineering.
4. PEBL.

3.2 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums used for HVAC to verify that they are properly separated from adjacent areas and sealed.

F. Examine equipment performance data, including fan curves.
1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

K. Examine operating safety interlocks and controls on HVAC equipment.

L. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.

M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

A. Prepare a TAB plan that includes the following:
   1. Equipment and systems to be tested.
   2. Strategies and step-by-step procedures for balancing the systems.
   3. Instrumentation to be used.
   4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
   1. Airside:
      a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
      b. Duct systems are complete.
      c. Volume, smoke, and fire dampers are open and functional.
      d. Clean filters are installed.
      e. Fans are operating, free of vibration, and rotating in correct direction.
      f. Variable-frequency controllers' startup is complete and safeties are verified.
      g. Automatic temperature-control systems are operational.
      h. Ceilings are installed.
      i. Windows and doors are installed.
      j. Suitable access to balancing devices and equipment is provided.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

B. Cut insulation, ducts, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
   1. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 23 33 00 "Air Duct Accessories."
   2. Where holes for probes are required in piping or hydronic equipment, install pressure and temperature test plugs to seal systems.
   3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 23 07 13 "Duct Insulation," Section 23 07 16 "HVAC Equipment Insulation," and Section 23 07 19 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:
   1. Motors.
   2. Fans and ventilators.
   3. Condensing units.
   4. Split-system air conditioners.
   5. Energy Recovery Units.

3.6 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' Record drawings duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

3.7 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
   1. Measure total airflow.
      a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.

b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

2. Measure fan static pressures as follows:
   a. Measure static pressure directly at the fan outlet or through the flexible connection.
   b. Measure static pressure directly at the fan inlet or through the flexible connection.
   c. Measure static pressure across each component that makes up the air-handling system.
   d. Report artificial loading of filters at the time static pressures are measured.
3. Review Contractor-prepared shop drawings and Record drawings to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
4. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.
1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.
1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.8 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.

8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.9 PROCEDURES FOR AIR-COOLED CONDENSING UNITS

A. Verify proper rotation of fan(s).

B. Measure and record entering- and leaving-air temperatures.

C. Measure and record entering and leaving refrigerant pressures.

D. Measure and record operating data of compressor(s), fan(s), and motors.

3.10 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each electric heating coil:
1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Air pressure drop.
5. Voltage and amperage input of each phase at full load.
6. Calculated kilowatt at full load.
7. Fuse or circuit-breaker rating for overload protection.

B. Measure, adjust, and record the following data for each refrigerant coil:
1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Entering and leaving refrigerant pressure and temperatures.

3.11 DUCT LEAKAGE TESTS

A. Witness the duct leakage testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified limits.

C. Report deficiencies observed.

3.12 HVAC CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:
1. Verify HVAC control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.

8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.13 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 10 percent or minus 5 percent. If design value is less than 100 cfm, within 10 cfm.
2. Air Outlets and Inlets: Plus 10 percent or minus 5 percent. If design value is less than 100 cfm, within 10 cfm.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.14 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance-measuring and -balancing devices.

B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.15 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:
1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
2. Name and address of the TAB specialist.

3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents, including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans performance forms, including the following:
    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Heating coil, dry-bulb conditions.
    e. Face and bypass damper settings at coils.
    f. Fan drive settings, including settings and percentage of maximum pitch diameter.
    g. Variable-frequency controller settings for variable-air-volume systems.
    h. Settings for pressure controller(s).
    i. Other system operating conditions that affect performance.
16. Test conditions for pump performance forms, including the following:
    a. Variable-frequency controller settings for variable-flow hydronic systems.
    b. Settings for pressure controller(s).
    c. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units, include the following:
1. Unit Data:
    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Center-to-center dimensions of sheave and amount of adjustments in inches.
    j. Number, make, and size of belts.
    k. Number, type, and size of filters.
2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and speed.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):
a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan speed.
d. Inlet and discharge static pressure in inches wg.
e. For each filter bank, filter static-pressure differential in inches wg.
f. Preheat-coil static-pressure differential in inches wg.
g. Cooling-coil static-pressure differential in inches wg.
h. Heating-coil static-pressure differential in inches wg.
i. List for each internal component with pressure-drop, static-pressure differential in inches wg.
j. Outdoor airflow in cfm.
k. Return airflow in cfm.
l. Outdoor-air damper position.
m. Return-air damper position.

F. Apparatus-Coil Test Reports:
1. Coil Data:
a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft..
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):
a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Refrigerant expansion valve and refrigerant types.
i. Refrigerant suction pressure in psig.
j. Refrigerant suction temperature in deg F.

G. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
1. Unit Data:
a. System identification.
b. Location.
c. Coil identification.
d. Capacity in Btu/h.
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.

h. Airflow rate in cfm.
i. Face area in sq. ft..
j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):
a. Heat output in Btu/h.
b. Airflow rate in cfm.
c. Air velocity in fpm.
d. Entering-air temperature in deg F.
e. Leaving-air temperature in deg F.
f. Voltage at each connection.
g. Amperage for each phase.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Motor Data:
a. Motor make, and frame type and size.
b. Horsepower and speed.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):
a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan speed.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
a. System fan and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

J. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
1. Unit Data:
a. System and air-handling-unit identification.
b. Location and zone.

c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):
a. Airflow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

K. Instrument Calibration Reports:
1. Report Data:
a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.16 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of the Commissioning Authority.

B. Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.

E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:
1. TAB specialists shall recheck all measurements and adjust. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to the previous report.
2. If the second final inspection also fails, Owner may pursue others Contract options to complete TAB work.

F. Prepare test and inspection reports.

3.17 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 07 13 - DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following duct services:
   1. Insulation for all supply, return, outside and exhaust duct systems.

B. Related Requirements:

   1. Section 23 07 19 "HVAC Piping Insulation."
   2. Section 23 31 13 "Metal Ducts" for duct liners.

1.2 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.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or craft training program, certified by the Department of Labor, Bureau of Apprenticeship and Training.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers are to be marked with the manufacturer's name, appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "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.

C. Coordinate installation and testing of heat tracing.

1.7 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

1. All Insulation Installed Indoors; Outdoors-Installed Insulation in Contact with Airstream: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 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 are to be applied.

B. Products do not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel 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 are qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.

F. Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 450 deg F in accordance with ASTM C411. Comply with ASTM C553, Type II, and ASTM C1290, 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; SAINT-GOBAIN.
b. Johns Manville; a Berkshire Hathaway company.
c. Knauf Insulation.
d. Manson Insulation Inc.
e. Owens Corning.

G. Glass-Fiber Board Insulation: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 250 deg F for jacketed and between 35 deg F and 450 deg F for unfaced in accordance with ASTM C411. Comply with ASTM C612, 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; SAINT-GOBAIN.
b. Johns Manville; a Berkshire Hathaway company.
c. Knauf Insulation.
d. Manson Insulation Inc.
e. Owens Corning.

H. Glass-Fiber, Pipe and Tank: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 850 deg F, in accordance with ASTM C411. Comply with ASTM C1393.

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. Knauf Insulation.
d. Manson Insulation Inc.
e. Owens Corning.

2. Semirigid board material with factory-applied ASJ jacket.
3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 ADHESIVES

A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Eagle Bridges - Marathon Industries.
c. Foster Brand; H. B. Fuller.
d. Mon-Eco Industries, Inc.

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Eagle Bridges - Marathon Industries.
c. Foster Brand; H. B. Fuller.
d. Mon-Eco Industries, Inc.

2.4 MASTICS AND COATINGS

A. Materials are compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic, Water Based, Interior Use: Suitable for indoor use on below ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller.
c. Knauf Insulation.
d. Vimasco Corporation.

2. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Color: White.

C. Vapor-Retarder Mastic, Solvent Based, Exterior Use: Suitable for outdoor use on below ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Eagle Bridges - Marathon Industries.
c. Foster Brand; H. B. Fuller.

2. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
3. Service Temperature Range: Minus 50 to plus 220 deg F.

4. Color: White.

2.5 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller.
   d. Mon-Eco Industries, Inc.

2. Materials are compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Childers Brand; H. B. Fuller Construction Products.
   b. Foster Brand; H. B. Fuller.

2. Materials are compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
4. ASJ+: All-service jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136, Types I, II, III, IV, and VII.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets comply with ASTM C921, Type I, unless otherwise indicated.

B. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Johns Manville; a Berkshire Hathaway company.
    b. RPR Products, Inc.

2. 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. Moisture Barrier for Outdoor Applications: 3-mil- thick polysurlyn.

C. Self-Adhesive Outdoor Jacket (Asphaltic): 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross laminated polyethylene film covered with white aluminum-foil facing.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Foster Brand; H. B. Fuller.
    b. MFM Building Products Corp.
    c. Polyguard Products, Inc.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Mesh: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering ducts.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller.

2.9 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Cloth: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

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. Alpha Associates, Inc.

2.10 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Industrial Adhesives and Tapes Division.
b. Avery Dennison Corporation, Specialty Tapes Division.
c. Ideal Tape Co., Inc., an American Biltrite Company.
d. Knauf Insulation.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Industrial Adhesives and Tapes Division.
b. Avery Dennison Corporation, Specialty Tapes Division.
c. Ideal Tape Co., Inc., an American Biltrite Company.
d. Knauf Insulation.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.11 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.
b. RPR Products, Inc.

2. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) AGM Industries, Inc.
        2) Gemco.
        3) Midwest Fasteners, Inc.
        4) Nelson Stud Welding.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) AGM Industries, Inc.
        2) CL WARD & Family Inc.
        3) Gemco.
        4) Midwest Fasteners, Inc.
        5) Nelson Stud Welding.

3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) AGM Industries, Inc.
        2) Gemco.
        3) Midwest Fasteners, Inc.
        4) Nelson Stud Welding.

    b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. C & F Wire Products.
    b. Johns Manville; a Berkshire Hathaway company.
    c. RPR Products, Inc.

2.12 CORNER ANGLES

A. Stainless Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel in accordance with ASTM A240/A240M, Type 304 or 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, compress, or otherwise damage insulation or jacket.

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. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents.

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, but not to the extent of creating wrinkles or areas of compression in the insulation.
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.

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 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.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.5 INSTALLATION OF GLASS-FIBER AND MINERAL-WOOL INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

B. Comply with manufacturer's written installation instructions.

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 over compress 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 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.

C. 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, 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, 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 over compress 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 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 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

3.7 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "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.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. 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 is limited to

five location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:
1. Fan Coil Unit Supply air and Return Air.
2. Energy Recovery Unit Outside Air, Return Air, Supply Air and Exhaust Air.
3. Supply air devices, insulate back pan.

B. Items Not Insulated:

1.
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.
8. Dedicated exhaust fan ductwork (excluding ERV units).

3.10 INDOOR DUCT INSULATION SCHEDULE

A. Concealed rectangular and round Supply Air from Fan Coil units, outside air from ERV, supply air from ERV, supply air devices - duct insulation is the following

1. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.

B. Concealed, rectangular and round return-air from fan coil unit and return/exhaust from ERV duct insulation is the following:
1. 1” thick duct liner, per section 23 31 13 – Metal Ducts.

END OF SECTION 23 07 13

SECTION 23 07 19 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulation for HVAC piping systems.

B. Related Requirements:

1. Section 23 07 13 "Duct Insulation" for duct insulation.

1.2 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).

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or craft training program, certified by the Department of Labor, Bureau of Apprenticeship and Training.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of manufacturer, fabricator, type, description, and size, as well as ASTM standard designation, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC 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.

1.7 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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 authority having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

1. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 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 are applied.

B. Products do not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come into contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.

E. Flexible Elastomeric: Closed-cell, or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type I, for tubular materials, Type II for sheet materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Aeroflex USA.
b. Armacell LLC.

2.3 ADHESIVES

A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Aeroflex USA.
b. Armacell LLC.

2. Flame-spread index is 25 or less and smoke-developed index is 50 or less as tested in accordance with ASTM E84.
3. Wet Flash Point: Below 0 deg F.
4. Service Temperature Range: 40 to 200 deg F.
5. Color: Black.

2.4 MASTICS AND COATINGS

A. Materials are compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Aeroflex USA.
b. Childers Brand; H. B. Fuller Construction Products.
c. Foster Brand; H. B. Fuller.

2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Color: White.

2.5 SEALANTS

A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller.

2. Permanently flexible, elastomeric sealant.

a. Service Temperature Range: Minus 100 to plus 300 deg F.
b. Color: White or gray.

C. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller.

2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.

2.6 FIELD-APPLIED JACKETS

A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.

B. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Johns Manville; a Berkshire Hathaway company.
    b. RPR Products, Inc.

2. 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 Outdoor Applications: 53-mil- thick polysurlyn.
    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.

2.7 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Johns Manville; a Berkshire Hathaway company.
    b. RPR Products, Inc.

2. Stainless Steel: ASTM A240/A240M, Type 316; 0.015 inch thick, 3/4 inch wide with wing seal.

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.

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, compress, or otherwise damage insulation or jacket.

D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) 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 during storage or in the installation process before being properly covered and sealed in accordance with the Contract Documents.

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. Cut insulation in a manner to avoid compressing insulation.

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 in similar fashion to butt joints.

O. 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.

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.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

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 below.

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 prefabricated fitting insulation or mitered or routed fittings made from same material and density as that of adjacent pipe insulation. Each piece is butted tightly against adjoining pieces 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 prefabricated 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 prefabricated 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 prefabricated 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. 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 to fit. 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 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 and polyolefin, 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.

D. Install removable insulation covers at locations indicated. Installation conforms to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install the same insulation jacket as that of adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC 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.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to the outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.

2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated valve covers manufactured of same material as that of pipe insulation when available.
2. When prefabricated valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF FIELD-APPLIED JACKETS

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with the same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated and for horizontal applications, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

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.

E. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap presized jackets around individual pipe insulation sections, with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.

3. Continuous jacket can be spiral-wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch- circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.8 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.9 PIPING INSULATION SCHEDULE, GENERAL

A. Insulation conductivity and thickness per pipe size comply with schedules in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.

B. 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.

3.10 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation is the following:
   a. Flexible Elastomeric: 1 inch thick.

B. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation is the following:
   a. Flexible Elastomeric: 1 inch thick.

C. Refrigerant Liquid Piping:

1. All Pipe Sizes: Insulation is the following:
   a. Flexible Elastomeric: 1 inch thick.

3.11 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation is the following:
   a. Flexible Elastomeric: 2 inches thick.

B. Refrigerant Liquid Piping:

1. All Pipe Sizes: Insulation is the following:

   a. Flexible Elastomeric: 2 inches thick.

3.12 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. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed:

1. None.

3.13 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed to Outdoor Weather Conditions:
1. Aluminum, Corrugated: 0.024 inch thick.

END OF SECTION 23 07 19

SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Valves and specialties.
3. Refrigerants.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Solenoid valves.
2. Thermostatic expansion valves.
3. Strainers.
4. Filter dryers.
5. Pressure-regulating valves.
6. Mufflers.

B. Product Data Submittals: For each product.

1. Submit data for each type of refrigerant piping, fitting, valve, piping specialty, and refrigerant.

C. Delegated Design Submittals: For refrigerant piping size and layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

D. Shop Drawings:

1. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
2. Show interface and spatial relationships between piping and equipment.
3. Shop Drawing Scale: 1/4 inch equals 1 foot.

1.3 INFORMATIONAL SUBMITTALS

A. Welding Certificates: For each welder performing shop or field welding on Project.

B. Field Quality-Control Reports: For each field quality control test and inspection.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with ASME Boiler and Pressure Vessel Code: Section IX, "Welding, Brazing, and Fusing Qualifications."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

B. Prepare valves and specialties for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads and other end connections.

C. Use the following precautions during storage:

1. Maintain valve and specialty end protection.
2. Store valves and specialties indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," for refrigerant piping size and layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

B. Comply with ASHRAE 15.

C. Comply with ASME B31.5.

D. Test Pressure for Refrigerant R-410A, R-32 and R-454.

1. Suction Tubing for Refrigeration and Air-Conditioning Applications Other than Heat Pumps: 300 psig.
2. Suction Tubing for Heat-Pump Applications: 535 psig.
3. Hot-Gas and Tubing Lines: 535 psig.

2.2 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B280, Type ACR.

B. Wrought-Copper Fittings, Brazed Joint: ASME B16.50.

C. Wrought-Copper Unions: ASME B16.22.

D. Brazing Filler Metals: AWS A5.8M/A5.8.

E. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
4. Working Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

2.3 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

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. Danfoss, Inc.
    b. Henry Technologies Inc.; The Henry Group.
    c. Parker (Parker Hannifin).

2. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
3. Diaphragm: Phosphor bronze and stainless steel with stainless steel spring.
4. Operator: Rising stem and hand wheel.
5. Seat: Nylon.
6. End Connections: Socket, union, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 240 deg F.

B. Check Valves:

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. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    b. Danfoss, Inc.
    c. Emerson Climate Technologies; Emerson Electric Co.
    d. Henry Technologies Inc.; The Henry Group.
    e. Parker (Parker Hannifin).

2. Body: Ductile iron, forged brass, or cast bronze; globe pattern.

3. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
4. Piston: Removable polytetrafluoroethylene seat.
5. Closing Spring: Stainless steel.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 deg F.

C. Service Valves:

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. Danfoss, Inc.
    b. Emerson Climate Technologies; Emerson Electric Co.
    c. Henry Technologies Inc.; The Henry Group.
    d. JB Industries.
    e. Parker (Parker Hannifin).
    f. RectorSeal HVAC; a CSW Industrials Company.
    g. Refrigeration Sales, Inc.

2. Body: Forged brass with brass cap, including key end to remove core.
3. Core: Removable ball-type check valve with stainless steel spring.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Copper spring.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

D. Refrigerant Locking Caps:

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. C & D Valve, LLC.
    b. JB Industries.
    c. RectorSeal HVAC; a CSW Industrials Company.
    d. Refrigeration Sales, Inc.

2. Description: Locking-type, tamper-resistant, threaded caps to protect refrigerant-charging ports from unauthorized refrigerant access and leakage.
3. Material: Brass, with protective shroud or sleeve.
4. Refrigerant Identification: Color-coded, refrigerant specific based on AHRI Guideline N design.
5. Special Tool: For installing and unlocking.

E. Solenoid Valves: Comply with AHRI 760 I-P and UL 429; listed and labeled by an NRTL.

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. Danfoss, Inc.
    b. Emerson Climate Technologies; Emerson Electric Co.

c. Henry Technologies Inc.; The Henry Group.
d. Parker (Parker Hannifin).

2. Body and Bonnet: Plated steel.
3. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Threaded.
6. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 115 V ac coil.
7. Working Pressure Rating: 400 psig.
8. Maximum Operating Temperature: 240 deg F.

F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

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. Danfoss, Inc.
b. Henry Technologies Inc.; The Henry Group.
c. Parker (Parker Hannifin).

2. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
3. Piston, Closing Spring, and Seat Insert: Stainless steel.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Threaded.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.

G. Thermostatic Expansion Valves: Comply with AHRI 750 I-P.

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. Danfoss, Inc.
b. Emerson Climate Technologies; Emerson Electric Co.
c. Henry Technologies Inc.; The Henry Group.
d. Parker Hannifin; Sporlan Division (Zoomlock).

2. Body, Bonnet, and Seal Cap: Forged brass or steel.
3. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
4. Packing and Gaskets: Non-asbestos.
5. Capillary and Bulb: Copper tubing filled with refrigerant charge.
6. Suction Temperature: 40 deg F.
7. Superheat: Adjustable.
8. Reverse-flow option (for heat-pump applications).
9. End Connections: Socket, flare, or threaded union.
10. Working Pressure Rating: 700 psig.

H. Straight-Type Strainers:

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. Danfoss, Inc.
    b. Henry Technologies Inc.; The Henry Group.
    c. Parker (Parker Hannifin).

2. Body: Welded steel with corrosion-resistant coating.
3. Screen: 100-mesh stainless steel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

I. Angle-Type Strainers:

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. Danfoss, Inc.
    b. Henry Technologies Inc.; The Henry Group.
    c. Parker (Parker Hannifin).

2. Body: Forged brass or cast bronze.
3. Drain Plug: Brass hex plug.
4. Screen: 100-mesh monel.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

J. Moisture/Liquid Indicators:

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. Danfoss, Inc.
    b. Emerson Climate Technologies; Emerson Electric Co.
    c. Henry Technologies Inc.; The Henry Group.
    d. Parker (Parker Hannifin).
    e. RLS LLC.

2. Body: Forged brass.
3. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
4. Indicator: Color-coded to show moisture content in parts per million (ppm).
5. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
6. End Connections: Socket or flare.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 240 deg F.

K. Replaceable-Core Filter Dryers: Comply with AHRI 730 I-P.

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. Danfoss, Inc.
    b. Emerson Climate Technologies; Emerson Electric Co.
    c. Henry Technologies Inc.; The Henry Group.
    d. Parker (Parker Hannifin).

2. Body and Cover: Painted-steel shell with ductile-iron cover, stainless steel screws, and neoprene gaskets.
3. Filter Media: 10 micron, pleated with integral end rings; stainless steel support.
4. Desiccant Media: Activated alumina.
5. Design: Reverse flow (for heat-pump applications).
6. End Connections: Socket.
7. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
8. Maximum Pressure Loss: 2 psig.
9. Rated Flow: Per manufacturer..
10. Working Pressure Rating: 500 psig.
11. Maximum Operating Temperature: 240 deg F.

L. Permanent Filter Dryers: Comply with AHRI 730 I-P.

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. Danfoss, Inc.
    b. Emerson Climate Technologies; Emerson Electric Co.
    c. Henry Technologies Inc.; The Henry Group.
    d. Parker (Parker Hannifin).
    e. RLS LLC.

2. Body and Cover: Painted-steel shell.
3. Filter Media: 10 micron, pleated with integral end rings; stainless steel support.
4. Desiccant Media: Activated alumina.
5. Design: Reverse flow (for heat-pump applications).
6. End Connections: Socket.
7. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
8. Maximum Pressure Loss: 2 psig.
9. Rated Flow: Per manufacturer.
10. Working Pressure Rating: 500 psig.
11. Maximum Operating Temperature: 240 deg F.

M. Mufflers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Danfoss, Inc.
    b. Emerson Climate Technologies; Emerson Electric Co.
    c. Henry Technologies Inc.; The Henry Group.
    d. Parker Hannifin; Sporlan Division (Zoomlock).

2. Body: Welded steel with corrosion-resistant coating.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

N. Receivers: Comply with AHRI 495.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Henry Technologies Inc.; The Henry Group.
   b. Parker Hannifin; Sporlan Division (Zoomlock).

2. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
3. Comply with UL 207; listed and labeled by an NRTL.
4. Body: Welded steel with corrosion-resistant coating.
5. Tappings: Inlet, outlet, liquid-level indicator, and safety-relief valve.
6. End Connections: Socket or threaded.
7. Working Pressure Rating: 450 psig.
8. Maximum Operating Temperature: 250 deg F.

O. Liquid Accumulators: Comply with AHRI 495.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Emerson Climate Technologies; Emerson Electric Co.
   b. Henry Technologies Inc.; The Henry Group.
   c. Parker (Parker Hannifin).

2. Body: Welded steel with corrosion-resistant coating.
3. End Connections: Socket or threaded.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

2.4 REFRIGERANTS

A. R-410A, ASHRAE 34: Pentafluoroethane/Difluoromethane.

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. DuPont Fluorochemicals Div.

PART 3 - EXECUTION

3.1 PIPING APPLICATION SCHEDULES

A. Refrigerant: R-410A, R-32, R-454.

B. Suction, Hot-Gas, and Liquid Tubing for Conventional Air-Conditioning (Cooling-Only) Applications, NPS 4 (DN 100) and Smaller: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

C. Safety-Relief-Valve Discharge Tubing for Conventional Air-Conditioning (Cooling-Only) Applications, Copper: Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

D. Suction, Hot-Gas, and Liquid Tubing for Heat-Pump Applications, NPS 4 (DN 100) and Smaller: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

E. Safety-Relief-Valve Discharge Tubing for Heat-Pump Applications, Copper: Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install diaphragm packless valves in suction and discharge lines of compressor.

B. Install service valves for gauge taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.

E. Install thermostatic expansion valves as close as possible to distributors on evaporators.

1. Install valve so diaphragm case is warmer than bulb.
2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

F. Install safety-relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside in accordance with ASHRAE 15.

G. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

H. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:

1. Solenoid valves.
2. Thermostatic expansion valves.
3. Compressor.

I. Install filter dryers in liquid line between compressor and thermostatic expansion valve.

J. Install receivers sized to accommodate pump-down charge.

K. Install flexible connectors at compressors.

L. Provide refrigerant locking caps on refrigerant charging ports that are located outdoors unless otherwise protected from unauthorized access by a means acceptable to authority having jurisdiction.

3.3 INSTALLATION OF PIPING, GENERAL

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping in accordance with ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 08 31 13 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

L. Install refrigerant piping in protective conduit where installed belowground.

M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

N. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

P. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

Q. Identify refrigerant piping and valves in accordance with Section 23 05 53 "Identification for HVAC Piping and Equipment."

R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 23 05 00 "Common Work Results for HVAC."

S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 23 05 00 "Common Work Results for HVAC."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 23 05 00 "Common Work Results for HVAC."

3.4 PIPE 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. Brazed Joints: Construct joints in accordance with AWS BRH, "Brazing Handbook," Ch. 35, "Pipe and Tubing."

1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 ft. long.
2. Roller hangers and spring hangers for individual horizontal runs 20 ft. or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 ft. or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing, 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.

E. Support vertical runs of copper tubing to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.

    a. Fill system with nitrogen to the required test pressure.
    b. System must maintain test pressure at the manifold gauge throughout duration of test.
    c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

C. Prepare test and inspection reports.

3.7 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, in accordance with manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.

4. Open refrigerant valves but not bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 23 23 00

SECTION 23 31 13 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

B. Related Requirements:

1. Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 23 33 00 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 DEFINITIONS

A. OSHPD: Office of Statewide Health Planning and Development (State of California).

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

B. Shop Drawings:

1. Not Required.

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 are to 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 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 304 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 are to 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." All longitudinal seams are to be Pittsburgh lock seams unless otherwise specified for specific application.

1. Where specified for specific applications, all joints are to 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 AND FLAT-OVAL 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. For ducts exposed to weather, construct of Type 304 stainless steel indicated by manufacturer to be suitable for outdoor installation.

3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Elgen Manufacturing.
    b. GreenSeam.
    c. Linx Industries; a DMI company (formerly Lindab).
    d. MKT Metal Manufacturing.
    e. McGill AirFlow LLC.
    f. Nordfab Ducting.
    g. SEMCO, LLC; part of FlaktGroup.
    h. SHAPE Manufacturing Inc.
    i. Set Duct Manufacturing.
    j. Sheet Metal Connectors, Inc.
    k. Spiral Manufacturing Co., Inc.
    l. Ductmate Industries, Inc; a DMI company.

B. Source Limitations: Obtain single-wall round and flat oval ducts and fittings from single manufacturer.

C. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

D. 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.

E. 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.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

F. 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 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 are to be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A1008/A1008M, with oiled, matte finish for exposed ducts.

D. Reinforcement Shapes and Plates: ASTM A36/A36M, 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.

E. 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.

2.5 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C1071, 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; SAINT-GOBAIN.
b. Johns Manville; a Berkshire Hathaway company.
c. Knauf Insulation.

d. Owens Corning.
e. Sekisui Voltek, LLC.

2. Source Limitations: Obtain fibrous-glass duct liner from single manufacturer.
3. 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.

4. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound is to be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
5. Solvent-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916.

B. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-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. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm or greater.
7. 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.
8. 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.

9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.

10. 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.

2.6 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets are to 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: 3 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 C920.

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 is to provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and is to be rated for10-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.

2.7 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 A603.

E. Steel Cables for Stainless Steel Ducts: Stainless steel complying with ASTM A492.

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 23 33 00 "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. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

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 ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports." **DO NOT WRAP INSULATION AROUND DUCT SUPPORTS. SUPPORTS SHALL BE INDEPENDENTLY PLACED AFTER DUCT INSULATION HAS BEEN INSTALLED.**

B. Building Attachments: Secure supports to building wood structural framing with approved fasteners.

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.

3.5 DUCTWORK CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 23 33 00 "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 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Visually / Audible check all duct systems for leakage, prior to insulation.

2. Formal leakage testing is not required unless the Testing and Balancing agent cannot achieve proper airflow due to duct leakage in the system.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness in accordance with "Description of Method 3 - NADCA Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

    a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media is to not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.7 STARTUP

A. Air Balance: Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC."

3.8 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.
2. Underground Ducts: Concrete-encased, galvanized sheet steel.

B. Supply Ducts:

1. Ducts Connected to ERV and Fan Coil Units:

a. Pressure Class: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 4.
d. SMACNA Leakage Class for Round and Flat Oval: 2.

C. Return Ducts:

1. Ducts Connected to ERV and Fan Coil Units:

a. Pressure Class: Positive or negative 1-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 4.
d. SMACNA Leakage Class for Round and Flat Oval: 2.

D. Exhaust Ducts:

1. Ducts Connected to ERV and dedicated Exhaust Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Class: Negative 2-inch wg.
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 4.
d. SMACNA Leakage Class for Round and Flat Oval: 2.

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

F. Liner:
1. Fan Coil and ERV Return-Air Ducts: Fibrous glass, Type I, 1 inch thick.
2. ERV Exhaust-Air Ducts: Fibrous glass, Type I, 1 inch thick.
3. Transfer Ducts: Fibrous glass, Type I, 1 inch thick.

G. Elbow Configuration:

1. Rectangular Duct - Requirements for Different Velocities: 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.

   b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
   c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

H. 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: 45-degree boot tap.

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."

a. Velocity 1000 fpm or Higher: 45-degree lateral.

END OF SECTION 23 31 13

SECTION 23 33 00 - 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. Flange connectors.
4. Turning vanes.
5. Remote damper operators.
6. Duct-mounted access doors.
7. Flexible connectors.
8. Duct accessory hardware.

B. Related Requirements:

1. Section 23 33 46 "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.
e. Include diagrams for power, signal, and control wiring.

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.

B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

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 BAROMETRIC RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Greenheck Fan Corporation.
   b. Nailor Industries Inc.
   c. Pottorff.
   d. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.

B. General Requirements:

   1. Suitable for horizontal or vertical mounting.
   2. Maximum Air Velocity: 1250 fpm.
   3. Maximum System Pressure: 2 inches wg.

C. Construction:

   1. Frame: 16-gauge- thick, galvanized sheet steel with welded corners or mechanically attached.
   2. Blades:

      a. 16-gauge- thick, galvanized sheet steel.
      b. Maximum Width: 6 inches.
      c. Action: Parallel.
      d. Balance: Gravity.

3. Blade Seals: Neoprene.
4. Blade Axles: Galvanized steel.
5. Tie Bars and Brackets:

    a. Material: Galvanized steel.
    b. Rattle free with 90-degree stop.

6. Bearings: Synthetic

D. Pressure Adjustment: Return spring or counter weight with adjustable tension.

E. Accessories:

1. Flange on intake.
2. Adjustment device to permit setting for varying differential static pressures.

2.3 MANUAL VOLUME DAMPERS

A. Low-Leakage, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Greenheck Fan Corporation.
    b. Nailor Industries Inc.
    c. Pottorff.
    d. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.

2. Performance:

    a. AMCA Certification: Test and rate in accordance with AMCA 511.
    b. Leakage:

        1) Class II: Leakage shall not exceed 10 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, U, or angle shaped.
    b. Thickness: 16-gauge galvanized sheet steel.
    c. Mitered and welded corners.
    d. 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, roll-formed steel; 16 gauge thick.

6. Blade Edging Seals:

a. Closed-cell neoprene.

7. Blade Jamb Seals: Flexible metal compression type.
8. Blade Axles: Galvanized steel.
9. Bearings:

a. Molded synthetic.
b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.

10. Tie Bars and Brackets: Galvanized steel .
11. Locking device to hold damper blades in a fixed position without vibration.

B. Low-Leakage, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Greenheck Fan Corporation.
b. Nailor Industries, Inc.
c. Pottorff.
d. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.

2. Performance:

a. AMCA Certification: Test and rate in accordance with AMCA 511.
b. Leakage:

1) Class II: Leakage shall not exceed 10 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, U, or angle shaped.
b. Thickness: 0.08-inch aluminum sheet channels.
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. Roll-Formed Aluminum Blades:0.072-inch thick aluminum sheet.

6. Blade Edging Seals:

a. Closed-cell neoprene.

7. Blade Jamb Seals: Flexible metal compression type.
8. Blade Axles: Galvanized steel.
9. Bearings:

    a. Molded synthetic.
    b. Dampers mounted with vertical blades to have thrust bearings at each end of every blade.

10. Tie Bars and Brackets: Galvanized steel.
11. Locking device to hold damper blades in a fixed position without vibration.

C. Jackshaft:

1. Size: 0.5-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.

D. 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.

2.4 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Nailor Industries Inc.
3. Pottorff.
4. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.

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 3000 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. 16-gauge-thick, galvanized sheet steel.
    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. Parallel-blade design.
    c. Galvanized steel.
    d. 16-gauge-thick single skin or 14-gauge-thick air foil dual skin.

5. Blade Edging Seals:

    a. Replaceable Closed-cell neoprene.

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. Molded synthetic.
    b. Dampers mounted with vertical blades to have thrust bearings at each end of every blade.

2.5 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc; a DMI company.
2. Elgen Manufacturing.

B. Description: Add-on or roll-formed, factory fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gauge and Shape: Match connecting ductwork.

2.6 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc; a DMI company.
2. 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.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. 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."

E. Vane Construction:
1. Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.7 REMOTE DAMPER OPERATORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Metropolitan Air Technology.
2. Young Regulator Company.

B. Description: Cable system designed for remote manual damper adjustment.

C. Tubing: Brass.

D. Cable: Stainless steel.

E. Wall-Box Mounting: Recessed.

F. Wall-Box Cover-Plate Material: Stainless steel.

2.8 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc; a DMI company.
2. Elgen Manufacturing.
3. Flexmaster U.S.A., Inc.
4. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 7-2 (7-2M), "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 or 0.032-inch thick aluminum 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.

2.9 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc; a DMI company.
2. Elgen Manufacturing.

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.

2.10 DUCT ACCESSORY HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc; a DMI company.
2. Elgen Manufacturing.

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.

2.11 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 for concealed ducts and No. 4 finish for exposed ducts.

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 and smoke dampers in accordance with UL listing.

I. Connect ducts to duct silencers rigidly.

J. 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 from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. 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.
7. At each change in direction and at maximum 50-ft. spacing.
8. Upstream from turning vanes.
9. Upstream or downstream from duct silencers.
10. For grease ducts, install at locations and spacing as required by NFPA 96.

11. Control devices requiring inspection.
12. Elsewhere as indicated.

K. Install access doors with swing against duct static pressure.

L. 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.

M. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

N. Install flexible connectors to connect ducts to equipment.

O. For fans developing static pressures of 5 inches wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

P. Install duct test holes where required for testing and balancing purposes.

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 23 33 00

SECTION 23 33 46 - FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flexible ducts, insulated.
2. Flexible duct connectors.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Flexible ducts, insulated.
2. Flexible duct connectors.

B. Product Data Submittals: For each type of product.

C. Shop Drawings: For flexible ducts.

1. Include plans showing locations, mounting details, and attachment details.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, 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.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

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 must be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

C. Comply with the Air Duct Council's (formerly, Air Diffusion Council) "ADC Flexible Air Duct Test Code - FD 72-R1" and "Flexible Duct Performance & Installation Standards."

D. Comply with ASTM E96/E96M.

2.2 ACOUSTICAL FLEXIBLE DUCTS, INSULATED

A. Standard: Product is to be UL 181 listed and bearing the UL label. Flex duct shall be specifically rated for acoustical attenuation. Refer to approved products below.

B. Flexible Ducts, Insulated - Class 1, Black Polymer Film Supported by Helically Wound, Spring-Steel Wire; Fibrous-Glass Insulation:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Flexmaster U.S.A., Inc. – Model 1M
   b. Thermaflex – Model MKE

2. Pressure Rating: 4 inch wg positive and 1 inch wg negative.
3. Maximum Air Velocity: 4000 fpm.
4. Temperature Range: Minus 20 to plus 175 deg F.
5. Insulation R-Value: R6.
6. Vapor-Barrier Film: Aluminized.

2.3 FLEXIBLE DUCT CONNECTORS

A. Clamps: Stainless steel band with stainless steel or zinc-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 OF FLEXIBLE DUCTS

A. Install flexible ducts in accordance with applicable details in the following publications:

1. ADC's "Flexible Duct Performance & Installation Standards" for flexible ducts.
2. NAIMA AH116.
3. SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
4. SMACNA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.

B. Install in indoor applications only. Do not install flexible duct in locations where it will be exposed to UV lighting.

C. Connect diffusers and light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.

D. Connect flexible ducts to metal ducts with draw bands.

E. Installation:

1. Install ducts fully extended.
2. Do not bend ducts across sharp corners.
3. Bends of flexible ducting must 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.

6. Install in accordance with ADC instructions.

F. Supporting Flexible Ducts:

1. Support flexible duct at manufacturer's recommended intervals, but at no greater distance than 4 ft.. Provide sufficient support so that maximum centerline sag is 1/2 in. per ft. between supports. A connection to rigid duct or equipment may be considered a support joint.
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 must not exceed the maximum spacing in accordance with manufacturer's written installation instructions.
4. Vertically installed ducts must be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION 23 33 46

SECTION 23 34 00 - HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Ventilators, centrifugal - ceiling mounted.

1.2 ACTION SUBMITTALS

A. Product Data:

   1. For each type of product.

      a. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
      b. Rated capacities, furnished specialties, and accessories for each fan.
      c. Fans:

         1) Certified fan performance curves with system operating conditions indicated.
         2) Certified fan sound-power ratings.
         3) Fan construction and accessories.
         4) Motor ratings and electrical characteristics, plus motor and electrical accessories.
         5) Fan speed controllers.

      d. Material thickness and finishes, including color charts.
      e. Dampers, including housing, linkages, and operators.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans showing fan rooms and fan system layouts, reflected ceiling plans, and other drawings required to illustrate relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

B. Startup service reports.

C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fans and ventilators, include the following:

   1. Operation in normal and emergency modes.
   2. Operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective coverage for storage and identified with labels describing contents.

1. Belts: One set(s) for each belt-driven unit.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of unit components.

C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

E. Service Conditions:
1. Altitude: 1650 feet above sea level.

2.2 VENTILATORS, CENTRIFUGAL - CEILING MOUNTED CABINET FAN.

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Loren Cook Company.
3. Twin City Fan & Blower.
4. Captiveaire

B. Source Limitations: Obtain ceiling-mounted centrifugal ventilators from single manufacturer.

C. Standards: Comply with UL 705.

D. Housing: Steel, lined with acoustical insulation.

E. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel are removable for service.

F. Back-draft damper: Integral.

G. Grille: White, aluminum, louvered or perforated grille with flange on intake and thumbscrew or spring retainer attachment to fan housing.

H. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

I. Accessories:
   1. Insulated housing.
   2. Integral fan speed controller on EC motor.
   3. Vibration Isolation kit.
   4. Refer to schedule for additional accessories.

2.3 SOURCE QUALITY CONTROL

A. AMCA Certification for Fan Sound Performance Rating: Test, rate, and label in accordance with AMCA 311.

B. AMCA Certification for Fan Aerodynamic Performance Ratings: Test, rate, and label in accordance with AMCA 211.

C. AMCA Certification for Fan Energy Index (FEI): Test, rate, and label in accordance with AMCA 211.

D. Fan Operating Limits: Classify fans in accordance with AMCA 99, Section 14.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install fans level and plumb.

B. Disassemble and reassemble units, as required for moving to the final location, in accordance with 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 fans directly from the building structure, using suitable hanging systems.

E. Install units with adequate clearances for service and maintenance.

F. Label fans in accordance with requirements specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."

3.2 DUCTWORK CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 23 33 00 "Air Duct Accessories."

B. Where installing ducts adjacent to fans, allow space for service and maintenance.

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 26 05 26 "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 is to be laminated acrylic or melamine plastic signs, as specified in Section 26 05 53 "Identification for Electrical Systems."

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect wiring in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.5 STARTUP SERVICE:

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. 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. Verify lubrication for bearings and other moving parts.
7. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
8. 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.
9. Shut unit down and reconnect automatic temperature-control operators.
10. Remove and replace malfunctioning units and retest as specified above.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Lubricate bearings.

C. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC."

3.7 CLEANING

A. After completing system installation and testing, adjusting, and balancing and after completing startup service, clean fans internally to remove foreign material and construction dirt and dust.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections with the assistance of a factory-authorized service representative.

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.
3. Fans and components will be considered defective if they do not pass tests and inspections.
4. Prepare test and inspection reports.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC fans.

END OF SECTION 23 34 00

SECTION 23 37 13 - REGISTERS AND GRILLES

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 face grilles.

B. Related Requirements:

   1. Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.
   2. Section 23 37 13.13 "Air Diffusers" for various types of air diffusers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
   2. Register and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 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 assembly members.
   2. Method of attaching hangers to building structure.
   3. Size and location of initial access modules for acoustical tile.
   4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
   5. Duct access panels.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 GRILLES

A. Fixed Face Grille:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Price Industries.
    b. Titus.
    c. Tuttle & Bailey.
    d. MetalAire.

2. Material: Aluminum.
3. Finish: Baked-on powder coat. Color shall be white unless otherwise specified.
4. Face Blade Arrangement: Vertical or horizontal as scheduled.
5. Core Construction: Integral.
6. Frame: 1-1/4 inches wide.
7. Mounting: Countersunk screw.

2.2 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate registers and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where grilles are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install grilles level and plumb.

B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13.23

SECTION 23 37 13.13 - AIR DIFFUSERS

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. Rectangular and square ceiling diffusers.

B. Related Requirements:

   1. Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.
   2. Section 23 37 13.23 "Air Registers and Grilles" for adjustable-bar register and grilles, fixed-face registers and grilles, and linear bar grilles.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
   2. Diffuser Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 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 assembly members.
   2. Method of attaching hangers to building structure.
   3. Size and location of initial access modules for acoustical tile.
   4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
   5. Duct access panels.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 RECTANGULAR AND SQUARE CEILING DIFFUSERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Price Industries Limited.
2. Titus; brand of Johnson Controls International plc, Global Products.
3. Tuttle & Bailey.
4. Reliable.
5. MetalAire.

B. Devices shall be specifically designed for variable-air-volume flows.

C. Material: Aluminum.

D. Finish: Baked-on powder coat. White in color, unless otherwise specified on the drawings.

E. Face Size: 24 by 24 inches.

F. Face Style: Plaque.

G. Mounting: T-bar. (NOTE, provide a rapid mount frame for all Hard Ceiling installations)

H. Pattern: Fixed.

I. Dampers: Refer to Schedule.

J. Accessories:
1. Insulated back pan, R-6.

2.2 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13.13

SECTION 23 81 26 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Split-system air-conditioners.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."

1.6 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 03 30 00 "Cast-in-Place Concrete."

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. For Compressor: Five year(s) from date of Substantial Completion.
b. For Parts: Five year(s) from date of Substantial Completion.
c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SPLIT-SYSTEM AIR-CONDITIONERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carrier Global Corporation.
2. Mitsubishi Electric & Electronics USA, Inc.
3. Trane.
4. Daikin

B. Indoor Units (5 tons (18 kW) or Less):

1. Wall-Mounted, Evaporator-Fan Components:

a. General: Complete with a cooling/heating coil, fan, fan motor, piping connectors, electrical controls, microprocessor control system, and integral temperature sensing. Furnish with integral wall mounting bracket and mounting hardware.
b. Cabinet:

1) High-impact polystyrene.
2) Fully insulated for improved thermal and acoustic performance.

c. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins with anti-corrosive fin coating and galvanized steel tube sheets.
d. Fan: Tangential direct drive.
e. Fan Motors:

1) Multispeed with internal thermal protection and permanent lubrication.

2) Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

f. Condensate Drain Pans:

1) Sloped, corrosion resistant condensate pan provided under the coil.

g. Air Filtration Section:

1) General Requirements for Air Filtration Section:
a) Filter track with factory-supplied cleanable filters.

C. Outdoor Units (5 tons (18 kW) or Less:

1. Air-Cooled, Compressor-Condenser Components:

a. General: Factory assembled, single piece, air-cooled outdoor unit. Contained within the unit enclosure is all the factory wiring, piping, controls, and the compressor.
b. Casing: Steel, finished with a baked enamel finish on the inside and outside, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
c. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

1) Compressor Type: Scroll.
2) Refrigerant: R-410A.
3) Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler.

d. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
e. Fan: Aluminum-propeller type, directly connected to motor.
f. Motor: Permanently lubricated, with integral thermal-overload protection.
g. Low Ambient Kit: Permits operation down to 45 deg F.
h. Mounting Base: Polyethylene.

D. Accessories
1. Thermostat:

a. Low voltage with subbase to control compressor and evaporator fan.

2. Automatic-reset timer to prevent rapid cycling of compressor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 07 72 00 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.

D. Equipment Mounting:

1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
2. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
3. Comply with requirements for vibration isolation devices specified in Section 23 05 48.13 "Vibration Controls for HVAC."

E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

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.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 23 81 26

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire.
2. Fire-alarm wire and cable.
3. Connectors and splices.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Copper building wire.
2. Fire-alarm wire and cable.
3. Connectors and splices.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

1. Southwire Incorporated.

B. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

C. 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."

D. Conductor Insulation:

1. Type THHN and Type THWN-2. Comply with UL 83.
2. Type XHHW-2. Comply with UL 44.

2.2 METAL-CLAD CABLE, TYPE MC

1. Southwire Incorporated.

B. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:

1. Single circuit.
2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

E. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

F. Ground Conductor: Insulated.

G. Conductor Insulation:

1. Type TFN/THHN/THWN-2. Comply with UL 83.
2. Type XHHW-2. Comply with UL 44.

H. Armor: Steel interlocked.

I. Jacket: PVC applied over armor.

2.3 CONNECTORS AND SPLICES

1. Southwire Incorporated.

B. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

C. Jacketed Cable Connectors: For steel jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Copper.
2. Termination: Compression.

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 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:

a. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
b. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

C. 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. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

G. Light Fixture Whips six-foot in length of less: Metal-clad cable, Type MC.

3.3 INSTALLATION, GENERAL

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points in accordance with Section 26 05 33.13 "Conduits for Electrical Systems" prior to pulling conductors and cables.

C. 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.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 26 05 29 "Hangers and Supports for Electrical Systems."

3.4 INSTALLATION OF FIRE-ALARM WIRE AND CABLE

A. Comply with NFPA 72.

B. Wiring Method: Install wiring in metal pathway according to Section 27 05 28.29 "Hangers and Supports for Communications Systems."

1. Install plenum cable in environmental airspaces, including plenum ceilings.
2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system must be installed in a dedicated pathway system.

    a. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.

3. Fire-Rated Cables: Use of two-hour, fire-rated fire-alarm cables, NFPA 70.
4. Signaling Line Circuits: Power-limited fire-alarm cables may be installed in the same cable or pathway as signaling line circuits.

C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.

E. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.

F. Risers: Install at least two vertical cable risers to serve the fire-alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent receipt or transmission of signals from other floors or zones.

G. Wiring to Remote Alarm Transmitting Device: 1 inch conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 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 and that possess equivalent or better mechanical strength and insulation ratings than unspliced 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.

3.6 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 26 05 53 "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.

3.7 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 07 84 13 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.

2. Perform each of the following visual and electrical tests:

    a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    b. Test bolted connections for high resistance using one of the following:

        1) A low-resistance ohmmeter.
        2) Calibrated torque wrench.
        3) Thermographic survey.

    c. Inspect compression-applied connectors for correct cable match and indentation.
    d. Inspect for correct identification.
    e. Inspect cable jacket and condition.
    f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable for a one-minute duration.
    g. Continuity test on each conductor and cable.
    h. Uniform resistance of parallel conductors.

3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

    a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

4. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

B. Cables will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 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. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

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. Burndy; Part of Hubbell Electrical Systems.
2. Dossert; AFL Telecommunications LLC.
3. ERICO International Corporation.
4. Fushi Copperweld Inc.
5. Galvan Industries, Inc.; Electrical Products Division, LLC.
6. Harger Lightning and Grounding.
7. ILSCO.
8. O-Z/Gedney; A Brand of the EGS Electrical Group.
9. Robbins Lightning, Inc.

2.2 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.

2.3 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 B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
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 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 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. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper; 3/4 inch by 10 feet.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger unless otherwise indicated.

B. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches 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.

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 Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Metallic Fences: Comply with requirements of IEEE C2.

1. Grounding Conductor: Bare copper, not less than No. 8 AWG.
2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.4 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 Rods: Drive rods until tops are 2 inches 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.

C. 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.

D. 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.

E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

F. 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 feet apart.

G. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.

1. If concrete foundation is less than 20 feet 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.

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

B. Grounding system will be considered defective if it does not pass tests and inspections.

C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Support, anchorage, and attachment components.
2. Fabricated metal equipment support assemblies.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

a. Slotted support systems, hardware, and accessories.
b. Clamps.
c. Hangers.
d. Sockets.
e. Eye nuts.
f. Fasteners.
g. Anchors.
h. Saddles.
i. Brackets.

2. Include rated capacities and furnished specialties and accessories.

B. Delegated Design Submittals: For hangers and supports for electrical systems.

1. Include design calculations and details of hangers.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.
c. ERICO International Corporation.

d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut; Atkore International.
g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
5. Channel Dimensions: Selected for applicable load criteria.

B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Hilti, Inc.
2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
3) MKT Fastening, LLC.
4) Simpson Strong-Tie Co., Inc.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Cooper B-Line, Inc.
2) Empire Tool and Manufacturing Co., Inc.
3) Hilti, Inc.
4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 05 50 00 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 SELECTION

A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA NEIS 101

B. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways specified in Section 26 05 33.13 "Conduits for Electrical Systems."

D. Comply with requirements for boxes specified in Section 26 05 33.16 "Boxes and Covers for Electrical Systems."

E. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and ERMC as required by NFPA 70. Minimum rod size must be 1/4 inch (6 mm) in diameter.

F. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slottedsupport system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

G. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2 inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 INSTALLATION OF SUPPORTS

A. Comply with NECA NEIS 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA NEIS 1, EMT, IMC and ERMC may be supported by openings through structure members, in accordance with NFPA 70.

C. 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 must be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To New Concrete: Bolt to concrete inserts.
   2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   3. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inch thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inch thick.
   4. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
   5. To Light Steel: Sheet metal screws.
   6. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 05 50 00 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M. Submit welding certificates.

3.4 PAINTING

A. Touchup:

   1. 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.

      a. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

   2. Comply with requirements in Section 09 91 00 “Painting” for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 26 05 29

SECTION 26 05 33.13 - CONDUITS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.

1.2 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

1.3 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

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. AFC Cable Systems, Inc.
2. Allied Tube & Conduit.
3. Anamet Electrical, Inc.
4. Electri-Flex Company.
5. O-Z/Gedney.
6. Picoma Industries.
7. Republic Conduit.
8. Robroy Industries.
9. Southwire Company.
10. Thomas & Betts Corporation.
11. Western Tube and Conduit Corporation.
12. Wheatland Tube Company.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

G. EMT: Comply with ANSI C80.3 and UL 797.

H. FMC: Comply with UL 1; zinc-coated steel.

I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:

a. Material: Steel.
b. Type: Compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

K. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

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. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.
3. Arnco Corporation.
4. CANTEX Inc.
5. CertainTeed Corporation.
6. Condux International, Inc.
7. Electri-Flex Company.
8. Kraloy.
9. Lamson & Sessions; Carlon Electrical Products.
10. Niedax-Kleinhuis USA, Inc.
11. RACO; Hubbell.
12. Thomas & Betts Corporation.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ENT: Comply with NEMA TC 13 and UL 1653.

D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. LFNC: Comply with UL 1660.

F. Rigid HDPE: Comply with UL 651A.

G. Continuous HDPE: Comply with UL 651B.

H. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.

I. RTRC: Comply with UL 1684A and NEMA TC 14.

J. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

K. Fittings for LFNC: Comply with UL 514B.

L. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

M. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: EMT.
3. Underground Conduit: RNC, Type EPC-40-PVC or Type EPC-80-PVC.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations shall also include the following areas:

    a. Kennel/Pet Adoption areas as indicated on plans.

    b. Mechanical rooms.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: GRC.

C. Minimum Raceway Size: 1/2-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing

conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches of enclosures to which attached.

I. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 1 inch of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from ENT to GRC before rising above floor.

J. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

N. 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.

O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Q. 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.

R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

S. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

T. 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 the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

U. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

V. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of 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.

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 all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

W. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 31 20 00 "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 31 20 00 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 31 20 00 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Underground Warning Tape: Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.5 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.

END OF SECTION 26 05 33.13

SECTION 26 05 33.16 - BOXES AND COVERS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Nonmetallic outlet boxes, device boxes, rings, and covers.
3. Junction boxes and pull boxes.
4. Cover plates for device boxes.
5. Hoods for outlet boxes.

B. Products Installed, but Not Furnished, under This Section:

1. See Section 26 05 53 "Identification for Electrical Systems" for electrical equipment labels.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Nonmetallic outlet boxes, device boxes, rings, and covers.
3. Junction boxes and pull boxes.
4. Cover plates for device boxes.
5. Hoods for outlet boxes.

B. Shop Drawings:

1. Shop drawings for floor boxes.

C. Samples:

1. Floor box samples for initial selection.
2. Raised floor box samples for initial selection.
3. Recessed access-floor box samples for initial selection.
4. Concrete box samples for initial selection.

D. Sustainable design submittals.

1. Nonmetallic outlet boxes, device boxes, rings, and covers.
2. Junction boxes and pull boxes.
3. Cover plates for device boxes.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Nonmetallic outlet boxes, device boxes, rings, and covers.
3. Junction boxes and pull boxes.
4. Cover plates for device boxes.

5. Hoods for outlet boxes.

PART 2 - PRODUCTS

2.1 METAL WIREWAYS AND AUXILIARY GUTTERS

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. Cooper B-Line, Inc.
2. Hoffman.
3. Mono-Systems, Inc.
4. Square D.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.2 BOXES, ENCLOSURES, AND CABINETS

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. Adalet.
2. Cooper Technologies Company; Cooper Crouse-Hinds.
3. EGS/Appleton Electric.
4. Erickson Electrical Equipment Company.
5. FSR Inc.
6. Hoffman.
7. Hubbell Incorporated.
8. Kraloy.
9. Milbank Manufacturing Co.
10. Mono-Systems, Inc.
11. O-Z/Gedney.
12. RACO; Hubbell.
13. Robroy Industries.
14. Spring City Electrical Manufacturing Company.
15. Stahlin Non-Metallic Enclosures.
16. Thomas & Betts Corporation.
17. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Metal Floor Boxes:

1. Material: Sheet metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

G. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.

1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

K. Gangable boxes are prohibited.

PART 3 - EXECUTION

3.1 INSTALLATION

A. 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.

B. 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.

C. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

D. Locate boxes so that cover or plate will not span different building finishes.

E. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

F. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

G. Set metal floor boxes level and flush with finished floor surface.

3.2 CLEANING

A. Remove construction dust and debris from boxes before installing wallplates, covers, and hoods.

3.3 PROTECTION

A. After installation, protect boxes from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 26 05 33.16

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Identification for conductors.
2. Underground-line warning tape.
3. Warning labels and signs.
4. Instruction signs.
5. Equipment identification labels.
6. Miscellaneous identification products.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: For each piece of electrical equipment and electrical system components to be index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

2.2 FLOOR MARKING TAPE

A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

2.3 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.

2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE,.
Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE,.

2.4 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 7 by 10 inches.

D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 10 by 14 inches.

E. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.5 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.6 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.7 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

G. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trenchexceeds 16 inches overall.

I. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.

a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
b. Colors for 208/120-V Circuits:

1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.

c. Colors for 480/277-V Circuits:

1) Phase A: Brown.
2) Phase B: Yellow.
3) Phase C: Purple.

d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

B. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.
2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

C. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

D. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.

E. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

F. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

a. Indoor Equipment: Adhesive film label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
b. Enclosures and electrical cabinets.
c. Access doors and panels for concealed electrical items.
d. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
e. Enclosed switches.
f. Enclosed circuit breakers.
g. Contactors.
h. Remote-controlled switches, dimmer modules, and control devices.
i. Battery-inverter units.
j. Monitoring and control equipment.

END OF SECTION 26 05 53

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Electronic dial-time switches.
2. Outdoor photoelectric switches.
3. Indoor occupancy and vacancy sensors.
4. Switchbox-mounted occupancy sensors.
5. Lighting contactors.
6. Emergency shunt relay.
7. Conductors and cables.

B. Related Requirements:
1. Section 26 27 26 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Electronic dial-time switches.
2. Outdoor photoelectric switches.
3. Indoor occupancy and vacancy sensors.
4. Switchbox-mounted occupancy sensors.
5. Lighting contactors.
6. Emergency shunt relay.
7. Conductors and cables.

B. 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.

C. Field quality-control reports.

1.3 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's warranties.

1.4 WARRANTY

A. Special Extended Warranty: Manufacturer and Installer warrant that installed lighting control devices perform in accordance with specified requirements and agree to repair or replace,

including labor, materials, and equipment, devices that fail to perform as specified within extended warranty period.

1. Failures include, but are not limited to, the following:

   a. Faulty operation of lighting control software.
   b. Faulty operation of lighting control devices.

2. Extended Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. Intermatic, Inc.
3. Leviton Manufacturing Co., Inc.
4. NSi Industries LLC.
5. Schneider Electric USA, Inc.
6. TE Connectivity Ltd.
7. Touché Lighting Control.
8. nLight; Acuity Brands Lighting, Inc.

2.2 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: 30 A inductive or resistive, 240 V(ac).
4. Programs:
   a. Two on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holidays.
5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
6. Astronomic Time: Selected channels.
7. Automatic daylight savings time changeover.
8. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.3 OUTDOOR PHOTOELECTRIC SWITCHES, SOLID STATE, FLEXIBLE MOUNTING

A. Description: Solid state, with SPST dry contacts rated for 1800 VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A, and compatible with ballasts and LED lamps.

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. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
3. Time Delay: Fifteen-second minimum, to prevent false operation.
4. Surge Protection: Metal-oxide varistor.
5. Mounting: Twist lock complies with ANSI C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure from same source and manufacturer as switch.
6. Failure Mode: Luminaire stays ON.

2.4 OUTDOOR PHOTOELECTRIC SWITCHES, SOLID STATE, LUMINAIRE-MOUNTED

A. Description: Solid state, with SPST dry contacts rated for 1800 VA inductive, to operate connected load, complying with UL 773, and compatible with CFL and LED lamps.

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. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
3. Time Delay: Thirty-second minimum, to prevent false operation.
4. Lightning Arrester: Air-gap type.
5. Mounting: Twist lock complying with ANSI C136.10, with base from same source and manufacturer as switch.
6. Failure Mode: Luminaire stays ON.

2.5 OUTDOOR PHOTOELECTRIC SWITCHES, LOW VOLTAGE

A. Description: Solid state; one set of NO dry contacts rated for 24 V(dc) at 1 A, to operate connected load, complying with UL 773, and compatible with luminaire.

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. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
3. Time Delay: Thirty-second minimum, to prevent false operation.
4. Mounting: 1/2 inch threaded male conduit.
5. Failure Mode: Luminaire stays ON.
6. Power Pack:

    a. Dry contacts rated for 20 A LED load at 120 and 277 V(ac), for 13 A tungsten at 120 V(ac), and for 1 hp at 120 V(ac). Sensor has 24 V(dc), 150 mA, Class 2 power source.

        1) LED status lights to indicate load status.
        2) Plenum rated.

    b. Digital controller capable of accepting three 8PSJ inputs with one outputs rated for 20 A LED load at 120 and 277 V(ac), for 13 A LED at 120 and 277 V(ac), and for 1 hp at 120 V(ac). Sensor has 24 V(dc), Class 2 power source.

        1) With integral current monitoring.

2) Compatible with digital addressable lighting interface.
3) Plenum rated.

2.6 DAYLIGHT-HARVESTING SWITCHING CONTROLS

A. Description: System operates indoor lighting.

B. Sequence of Operation: As daylight increases, the lights are turned off at a predetermined level. As daylight decreases, the lights are turned on at a predetermined level.

1. Lighting control set point is based on two lighting conditions:

a. When no daylight is present.
b. When significant daylight is present (target level).
c. System programming is done with two hand-held, remote-control tools.

C. Ceiling-Mounted Switching Controls:

1. Solid-state, light-level sensor unit, with integrated power pack, that detects changes in indoor lighting levels that are perceived by the eye.
2. Solid-state, light-level sensor unit, with separate power pack mounted on luminaire, that detects changes in indoor lighting levels that are perceived by the eye.

D. Electrical Components, Devices, and Accessories:

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. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
3. Sensor Output:

a. Contacts rated to operate the associated power pack, complying with UL 773A. Sensor must be powered by the power pack.
b. Digital signal compatible with power pack.

4. Sensor type: Open loop.
5. Zone: Single.
6. Power Pack:

a. Dry contacts rated for 20 A LED load at 120- and 277 V(ac), for 13 A tungsten at 120 V(ac), and for 1 hp at 120 V(ac). Sensor has 24 V(dc), 150 mA, Class 2 power source.

1) LED status lights to indicate load status.
2) Plenum rated.

b. Digital controller capable of accepting 3 8PSJ inputs with one outputs rated for 20 A LED load at 120 and 277 V(ac), for 13 A ballast or LED at 120 and 277 V(ac), and for 1 hp at 120 V(ac). Sensor has 24 V(dc) Class 2 power source.

1) With integral current monitoring
2) Compatible with digital addressable lighting interface.
3) Plenum rated.

7. General Space Sensors Light-Level Monitoring Range: 10 to 200 fc, with an adjustment for turn-on and turn-off levels within that range.

8. Atrium Space Sensors Light-Level Monitoring Range: 100 to 1000 fc, with an adjustment for turn-on and turn-off levels within that range.
9. Skylight Sensors Light-Level Monitoring Range: 1000 to 10 000 fc, with an adjustment for turn-on and turn-off levels within that range.
10. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling.
11. Set-Point Adjustment: Equip with deadband adjustment of 25, 50, and 75 percent above the "on" set point, or provide with separate adjustable "on" and "off" set points.
12. Test Mode: User selectable, overriding programmed time delay to allow settings check.
13. Control Load Status: User selectable to confirm that load wiring is correct.
14. Indicator: Two digital displays to indicate the beginning of on-off cycles.

2.7 INDOOR OCCUPANCY AND VACANCY SENSORS

A. General Requirements for Sensors:

1. Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
2. Dual technology.
3. Separate power pack.
4. Hardwired connection to switch.
5. 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.
6. 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.
    b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
    c. Combination Sensor: Unless otherwise indicated, sensor must be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

7. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A.
8. Power: Line voltage.
9. Power Pack: Dry contacts rated for 20 A LED load at 120 and 277 V(ac), for 13 A tungsten at 120 V(ac), and for 1 hp at 120 V(ac). Sensor has 24 V(dc), 150 mA, Class 2 power source.
10. 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.

11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
12. Bypass Switch: Override the "on" function in case of sensor failure.
13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

B. PIR Type: Ceiling mounted; detect occupants in coverage area by their heat and movement.

1. 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.
2. Detection Coverage (Room, Ceiling Mounted): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96 inch high ceiling.
3. Detection Coverage (Corridor, Ceiling Mounted): Detect occupancy within 90 ft. when mounted on a 10 ft. 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.

C. Ultrasonic Type: Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.

1. Detector Sensitivity: 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.
2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96 inch high ceiling.
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 (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96 inch high ceiling.
5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 ft. when mounted on a 10 ft. high ceiling in a corridor not wider than 14 ft..
6. 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 84 inch above finished floor.

D. Dual-Technology Type: Ceiling 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.

2.8 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.
4. Switch Rating: Not less than 800 VA LED load at 120 V, 1200 VA LED load at 277 V, and 800 W incandescent.

2.9 LIGHTING CONTACTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB, Electrification Business.
2. ASCO Power Technologies.
3. Allen-Bradley/Rockwell Automation.
4. Eaton.
5. Leviton Manufacturing Co., Inc.
6. Square D; Schneider Electric USA.

B. Description: Electrically operated and electrically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.

2.10 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. 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."

C. Class 1 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."

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 26 05 19 "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 FIELD QUALITY CONTROL

A. Field tests must be witnessed by Owner.

B. Tests and Inspections:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Nonconforming Work:

1. Lighting control devices will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

D. Prepare test and inspection reports.

E. Manufacturer Services:

1. Engage factory-authorized service representative to supervise field tests and inspections.

3.7 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.

3.8 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 two 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 26 09 23

SECTION 26 22 13 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Distribution, dry-type transformers with nominal primary and secondary rating of 600 V and less, with capacities up to 1500 kVA.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
b. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.

B. Shop Drawings:

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of field connections.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions: Record copy of official installation instructions issued to Installer by manufacturer for the following:

1. Transformer temporary heating, working clearances, anchoring, torque values, and insulation-resistance testing.

B. Source quality-control reports.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Inspection: On receipt, inspect for and note 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 warm, dry, and temperature-stable location in original shipping packaging.

C. Temporary Heating: Apply temporary heat in accordance with manufacturer's published instructions within enclosure of ventilated-type units, throughout periods during which equipment is not energized and when transformer is not in 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 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB, Electrification Business.
2. Eaton.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D; Schneider Electric USA.

B. Source Limitations: Obtain each type of transformer from single source from single manufacturer.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60 Hz service.

B. 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.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NFPA 70, and list and label as complying with UL 1561.

B. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.

1. One leg per phase.
2. Core volume must allow efficient transformer operation at 10 percent above nominal tap voltage.
3. Grounded to enclosure.

C. Coils: Continuous windings without splices except for taps.

1. Coil Material: Copper.
2. Internal Coil Connections: Brazed or pressure type.
3. Terminal Connections: Bolted.

D. Encapsulation: Transformers smaller than 30 kVA must have core and coils completely resin encapsulated.

E. Enclosure: Ventilated.

1. Core and coil must be encapsulated within resin compound using vacuum-pressure impregnation process to seal out moisture and air.
2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
3. Wiring Compartment: Sized for conduit entry and wiring installation.
4. Environmental Protection:

a. Indoor: UL 50E, Type 2.

b. Outdoor: UL 50E, Type 3R.

5. Finish Color: Gray weather-resistant enamel.

F. Taps for Transformers 3 kVA and Smaller: One 5 percent tap above normal full capacity.

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 two 2.5 percent taps below normal full capacity.

I. Insulation Class, Smaller Than 30 kVA: 180 deg C, UL-component-recognized insulation system with maximum of 115 deg C rise above 40 deg C ambient temperature.

J. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with maximum of 115 deg C rise above 40 deg C ambient temperature.

K. Grounding: Provide ground-bar kit or ground bar installed on inside of transformer enclosure.

L. K-Factor Rating: Transformers indicated to be K-factor rated must comply with UL 1561 requirements for non-sinusoidal load current-handling capability to degree defined by designated K-factor.

1. Unit may not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor, without exceeding indicated insulation class in 40 deg C maximum ambient and 24-hour average ambient of 30 deg C.
2. Indicate value of K-factor on transformer nameplate.
3. Unit must comply with requirements of DOE 2016 efficiency levels when tested in accordance with NEMA TP 2 with K-factor equal to one.

M. Electrostatic Shielding: Windings must have independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.

1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
2. Include special terminal for grounding shield.

N. Neutral: Rated 200 percent of full load current for K-factor-rated transformers.

O. Wall Brackets: Manufacturer's standard brackets.

P. Low-Sound-Level Requirements: 3 dB below NEMAS ST-20

2.4 IDENTIFICATION

A. Nameplates:

1. Engraved, laminated-acrylic or melamine plastic signs for distribution transformers, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 26 05 53 "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for transformers.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's published 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 26 05 26 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance must be 5 Ω at location of transformer.

E. 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.

B. Install transformers level and plumb on concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.

C. Construct concrete bases and anchor floor-mounted transformers in accordance with manufacturer's published instructions and requirements in Section 26 05 29 "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 in accordance with manufacturer's published instructions.

E. Secure covers to enclosure and tighten bolts to manufacturer-recommended torques to reduce noise generation.

F. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

A. Ground equipment in accordance with Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Connect wiring in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

C. Tighten electrical connectors and terminals in accordance with 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 conduit and conductor terminations and supports to eliminate sound and vibration transmission to building structure.

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Small (Up to 167 kVA Single-Phase or 500 kVA Three-Phase) Dry-Type Transformer Field Tests:

a. Visual and Mechanical Inspection.

1) Inspect physical and mechanical condition.
2) Inspect anchorage, alignment, and grounding.
3) Verify that resilient mounts are free and that shipping brackets have been removed.
4) Verify that unit is clean.
5) Perform specific inspections and mechanical tests recommended by manufacturer.
6) Verify that as-left tap connections are as specified.
7) Verify presence of surge arresters and that their ratings are as specified.

b. Electrical Tests:

1) Measure resistance at windings, taps, and bolted connections.
2) Perform insulation-resistance tests winding-to-winding and windings-to-ground. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: value of index may not be less than 1.0.
3) Perform turns-ratio tests at tap positions. Test results may not deviate by more than one-half percent from either adjacent coils or calculated ratio. If test fails, replace transformer.
4) Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.

2. Large (Larger Than 167 kVA Single Phase or 500 kVA Three Phase) Dry-Type Transformer Field Tests:

a. Visual and Mechanical Inspection:

1) Inspect physical and mechanical condition.
2) Inspect anchorage, alignment, and grounding.
3) Verify that resilient mounts are free and that shipping brackets have been removed.
4) Verify that unit is clean.
5) Perform specific inspections and mechanical tests recommended by manufacturer.
6) Verify that as-left tap connections are as specified.
7) Verify presence of surge arresters and that their ratings are as specified.

b. Electrical Tests:

1) Measure resistance at windings, taps, and bolted connections.
2) Perform insulation-resistance tests winding-to-winding and windings-to-ground. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, comply with NETA ATS,

Table 100.5. Calculate polarization index: value of index may not be less than 1.0.

3) Perform power-factor or dissipation-factor tests on windings.
4) Perform turns-ratio tests at tap positions. Test results may not deviate by more than one-half percent from either adjacent coils or calculated ratio. If test fails, replace transformer.
5) Perform excitation-current test on each phase.
6) Perform applied voltage test on line- and load-side windings to ground. See IEEE C57.12.91, Sections 10.2 and 10.9.
7) Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.

B. Test Labeling: On completion of satisfactory testing of units, attach dated and signed "Satisfactory Test" label to tested components.

C. Nonconforming Work:

1. Transformer will be considered defective if it does not pass tests and inspections.
2. Remove and replace units that do not pass tests or inspections and retest as specified above.

3.5 ADJUSTING

A. Record transformer secondary voltage at 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 written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.7 MAINTENANCE

A. Infrared Scanning: Two months after Substantial Completion, perform infrared scan of transformer connections.

1. Use infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
2. Perform two follow-up infrared scans of transformers, one at four months and another at 11 months after Substantial Completion.
3. Prepare certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial actions taken, and scanning observations after remedial action.

END OF SECTION 26 22 13

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Power panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Disconnecting and overcurrent protective devices.

1.2 DEFINITIONS

A. GFEP: Ground-fault equipment protection.

B. MCCB: Molded-case circuit breaker.

C. VPR: Voltage protection rating.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Power panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Disconnecting and overcurrent protective devices.
4. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
5. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Detail bus configuration, current, and voltage ratings.
2. Short-circuit current rating of panelboards and overcurrent protective devices.
3. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for series rating of installed devices.
4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
5. Include wiring diagrams for power, signal, and control wiring.
6. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include Internet link for electronic access to downloadable PDF of coordination curves.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Panelboard Schedules: For installation in panelboards.

B. Manufacturers' Published Instructions: Record copy of official installation instructions issued to Installer by manufacturer for the following:

1. Recommended procedures for installing panelboards.
2. Recommended torque settings for bolted connections on panelboards.
3. Recommended temperature range for energizing panelboards.

1.5 CLOSEOUT SUBMITTALS

A. Warranty documentation.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts: Furnish to Owner spare parts, for repairing panelboards, that are packaged with protective covering for storage on-site and identified with labels describing contents. Include the following:

1. Keys: Two spares for each type of panelboard cabinet lock.

1.7 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 in accordance with NEMA PB 1.

1.8 WARRANTY

A. Special Installer Extended Warranty: Installer warrants that fabricated and installed panelboards perform in accordance with specified requirements and agrees to repair or replace components or products that fail to perform as specified within extended-warranty period.

1. Extended-Warranty Period: Two years from date of Substantial Completion; full coverage for labor, materials, and equipment.

B. Special Manufacturer Extended Warranty: Manufacturer warrants that panelboards perform in accordance with specified requirements and agrees to provide repair or replacement of components or products that fail to perform as specified within extended-warranty period.

1. Extended-Warranty Period: Three years from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing agency recognized by authorities having jurisdiction, and marked for intended location and application.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

E. Enclosures: Flush and Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.

    a. Indoor Dry and Clean Locations: UL 50E, Type 1.
    b. Outdoor Locations: UL 50E, Type 3R.
    c. Other Wet or Damp Indoor Locations: UL 50E, Type 4.

2. Height: 7 ft maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims must cover live parts and may have no exposed hardware.
4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims must cover live parts and may have no exposed hardware.
5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
7. Finishes:

    a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    b. Back Boxes: Galvanized steel.

F. Incoming Mains:

1. Location: Convertible between top and bottom.
2. Main Breaker: Main lug interiors up to 400 A must be field convertible to main breaker.

G. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

    a. Plating must run entire length of bus.
    b. Bus must be fully rated for entire length.

2. Interiors must be factory assembled into unit. Replacing switching and protective devices may not disturb adjacent units or require removing main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure.

H. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations must 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. Main and Neutral Lugs: Mechanical type, with lug on neutral bar for each pole in panelboard.
5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with lug on bar for each pole in panelboard.
6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

I. Quality-Control Label: Panelboards or load centers must be labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers must have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

J. Future Devices: Panelboards or load centers must have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

1. Percentage of Future Space Capacity: 25-percent.

K. Panelboard Short-Circuit Current Rating:

1. Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by qualified electrical testing laboratory recognized by authorities having jurisdiction. Include label or manual with size and type of allowable upstream and branch devices listed and labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for series-connected short-circuit rating.

    a. Panelboards rated 240 V or less must have short-circuit ratings as shown on Drawings, but not less than 10 000 A(rms) symmetrical.
    b. Panelboards rated above 240 V and less than 600 V must have short-circuit ratings as shown on Drawings, but not less than 14 000 A(rms) symmetrical.

2. Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for 100 percent interrupting capacity.

    a. Panelboards and overcurrent protective devices rated 240 V or less must have short-circuit ratings as shown on Drawings, but not less than 10 000 A(rms) symmetrical.

b. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V must have short-circuit ratings as shown on Drawings, but not less than 14 000 A(rms) symmetrical.

2.2 POWER PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB, Electrification Business.
2. Eaton.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D; Schneider Electric USA.

B. Listing Criteria: NEMA PB 1, distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inch high, provide two latches, keyed alike.

D. Mains: See panel schedules.

E. Branch Overcurrent Protective Devices: Bolt-on circuit breakers.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB, Electrification Business.
2. Eaton.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D; Schneider Electric USA.

B. Listing Criteria: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: See panel schedules.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Door-in-door construction with concealed hinges; secured with flush latch with tumbler lock; keyed alike. Outer door must permit full access to panel interior. Inner door must permit access to breaker operating handles and labeling, but current carrying terminals and bus must remain concealed.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB, Electrification Business.

2. Eaton.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D; Schneider Electric USA.

B. 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 must be recorded with type, phase, and magnitude of fault that caused 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. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6 mA trip).
6. GFEP Circuit Breakers: Class B ground-fault protection (30 mA trip).
7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240 V, single-pole configuration.
8. Subfeed Circuit Breakers: Vertically mounted.
9. 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. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
    f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

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 in accordance with 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. Comply with manufacturer's published instructions.

B. Reference Standards:

1. Panelboards: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NEMA PB 1.1.
2. Consult Architect for resolution of conflicting requirements.

C. Special Techniques:

1. Equipment Mounting:

    a. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
    b. Attach panelboard to vertical finished or structural surface behind panelboard.
    c. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.

2. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
3. Mount top of trim 7.5 ft above finished floor unless otherwise indicated.
4. Mount panelboard cabinet plumb and rigid without distortion of box.
5. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
6. Install overcurrent protective devices and controllers not already factory installed.

    a. Set field-adjustable, circuit-breaker trip ranges.
    b. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver in accordance with manufacturer's published instructions.

7. 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.
8. Install filler plates in unused spaces.
9. Stub four 1 inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in future. Stub four 1 inch empty conduits into raised floor space or below slab not on grade.
10. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
11. Mount spare fuse cabinet in accessible location.

D. Interfaces with Other Work:

1. 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.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems."

B. Panelboard Nameplates: Label each panelboard with nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

C. Device Nameplates: Label each branch circuit device in power panelboards with nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems" identifying source of remote circuit.

E. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles must be located on interior of panelboard door.

F. Breaker Labels: Faceplate must list current rating, UL and IEC certification standards, and AIC rating.

G. Circuit Directory:

1. Provide directory card inside panelboard door, mounted in metal frame with transparent protective cover.

    a. Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.

2. Provide computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.

    a. Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.

3. Create 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.

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
    c. Instruments and Equipment:

        1) Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

B. Nonconforming Work:

1. Panelboards will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Collect, assemble, and submit test and inspection reports, including certified report that identifies panelboards included and that describes scanning results, with comparisons of two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

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."

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 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 panelboard, may not exceed 20 percent.

END OF SECTION 26 24 16

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. General-use switches.
2. General-grade single straight-blade receptacles.
3. General-grade duplex straight-blade receptacles.

B. Related Requirements:

1. Section 26 09 23 "Lighting Control Devices" for occupancy sensors, timers, control-voltage switches, and control-voltage dimmers.

1.2 DEFINITIONS

A. Commercial/Industrial-Use Cord Reel: A cord reel subject to severe use in factories, commercial garages, construction sites, and similar locations requiring a harder service-type cord.

B. UL 1472 Type I Dimmer: Dimmer in which air-gap switch is used to energize preset lighting levels.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

B. Preinstallation Coordination Meeting(s): For ceiling-mounted cable reels. Conduct meeting at Project site before drywall installation.

1. Attendees: Installers, fabricators, representatives of manufacturers, and administrants for field tests and inspections. Notify Architect, Construction Manager of scheduled meeting dates.

1.4 ACTION SUBMITTALS

A. Product Data:

1. General-use switches.
2. General-grade single straight-blade receptacles.
3. General-grade duplex straight-blade receptacles.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturers' Instructions: Record copy of official installation instructions issued to Installer by manufacturer for the following:

1. Single straight-blade receptacles.
2. Duplex straight-blade receptacles.
3. Receptacles with GFCI device.

B. Sample warranties.

1.6 WARRANTY FOR DEVICES

A. Special Manufacturer Extended Warranty: Manufacturer warrants that devices perform in accordance with specified requirements and agrees to provide repair or replacement of devices that fail to perform as specified within extended warranty period.

1. Initial Extended Warranty Period: Three years from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 GENERAL-USE SWITCHES

A. Toggle Switch:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
b. Leviton Manufacturing Co., Inc.
c. Pass & Seymour; Legrand North America, LLC.

2. Regulatory Requirements:

a. 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.

3. General Characteristics:

a. Reference Standards: UL CCN WMUZ and UL 20.

4. Options:

a. Device Color: As indicated on architectural Drawings.
b. Configuration:
1) Heavy-duty, 120-277 V, 20 A, single pole.

5. Accessories:

a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
b. Securing Screws for Cover Plate: Metal with head color matching wall plate finish.

2.2 GENERAL-GRADE SINGLE STRAIGHT-BLADE RECEPTACLES

A. Single Straight-Blade Receptacle:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
b. Leviton Manufacturing Co., Inc.
c. Pass & Seymour; Legrand North America, LLC.

2. Regulatory Requirements:

a. 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.

3. General Characteristics:

a. Reference Standards: UL CCN RTRT and UL 498.

4. Options:

a. Device Color: As indicated on architectural Drawings.
b. Configuration:
1) Heavy-duty, smooth face, NEMA 5-20R.

5. Accessories:

a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
b. Securing Screws for Cover Plate: Metal with head color matching wall plate finish.

2.3 GENERAL-GRADE DUPLEX STRAIGHT-BLADE RECEPTACLES

A. Duplex Straight-Blade Receptacle:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
b. Leviton Manufacturing Co., Inc.
c. Pass & Seymour; Legrand North America, LLC.

2. Regulatory Requirements:

a. 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.

3. General Characteristics:

a. Reference Standards: UL CCN RTRT and UL 498.

4. Options:

a. Device Color: As indicated on architectural Drawings.
b. Configuration:

1) Heavy-duty, smooth face, NEMA 5-20R.

5. Accessories:

a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
b. Securing Screws for Cover Plate: Metal with head color matching wall plate finish.

B. General-Grade, Weather-Resistant, Tamper-Resistant Duplex Straight-Blade Receptacle with GFCI Device:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
b. Leviton Manufacturing Co., Inc.
c. Pass & Seymour; Legrand North America, LLC.

2. Regulatory Requirements:

a. 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.

3. General Characteristics:

a. Reference Standards: UL CCN KCXS, UL 498, and UL 943.

4. Options:

a. Device Color: As indicated on architectural Drawings.
b. Configuration: Heavy-duty, NEMA 5-20R.

5. Accessories:

a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
b. Securing Screws for Cover Plate: Metal with head color matching wall plate finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receptacles:

1. Verify that receptacles to be procured and installed for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

3.2 INSTALLATION OF SWITCHES

A. Comply with manufacturer's instructions.

B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.

2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.

3. Consult Architect for resolution of conflicting requirements.

C. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 26 05 53 "Identification for Electrical Systems."

a. Mark cover or cover plate using hot, stamped, or engraved machine printing with black-filled lettering, and provide durable wire markers or tags inside device box or outlet box.
b. Healthcare Facilities: Distinctively identify covers or cover plates of device boxes and outlet boxes that are supplied from life safety and critical branch power supplies following facility's standard practice.

3.3 INSTALLATION OF STRAIGHT-BLADE RECEPTACLES

A. Comply with manufacturer's instructions.

B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
4. Consult Architect for resolution of conflicting requirements.

C. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 26 05 53 "Identification for Electrical Systems."

a. Mark cover or cover plate using hot, stamped, or engraved machine printing with black-filled lettering, and provide durable wire markers or tags inside device box or outlet box.
b. Healthcare Facilities: Distinctively identify covers or cover plates of device boxes and outlet boxes that are supplied from life safety and critical branch power supplies following facility's standard practice.

D. Interfaces with Other Work:

1. Do not install Type 3 SPD, including surge-protected relocatable taps and power strips, on branch circuit downstream of GFCI device.

3.4 FIELD QUALITY CONTROL OF SWITCHES

A. Tests and Inspections:

1. Perform tests and inspections in accordance with manufacturers' instructions.

B. Nonconforming Work:

1. Unit will be considered defective if it does not pass tests and inspections.

2. Remove and replace defective units and retest.

3.5 FIELD QUALITY CONTROL OF STRAIGHT-BLADE RECEPTACLES

A. Tests and Inspections:

1. Insert and remove test plug to verify that device is securely mounted.
2. Verify polarity of hot and neutral pins.
3. Measure line voltage.
4. Measure percent voltage drop.
5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.

B. Nonconforming Work:

1. Device will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

3.6 ADJUSTING

A. Occupancy Adjustments for Controlled Receptacles: 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 PROTECTION

A. Devices:

1. Schedule and sequence installation to minimize risk of contamination of wires and cables, devices, device boxes, outlet boxes, covers, and cover plates by plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials.
2. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 26 27 26

SECTION 26 43 13 - SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Type 1 surge protective devices (SPDs).
2. Type 2 surge protective devices (SPDs).
3. Enclosures.
4. Conductors and cables.

B. Related Requirements:
1. Section 26 24 16 "Panelboards" for integral SPDs installed by panelboard manufacturer.
2. Section 26 27 26 "Wiring Devices" for integral SPDs installed by receptacle manufacturer.

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. Voltage Protection Rating (VPR): A rating selected from UL 1449 list of preferred values assigned to each mode of protection.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

a. Include electrical characteristics, specialties, and accessories for SPDs.
b. Certification of compliance with UL 1449 by qualified electrical testing laboratory recognized by authorities having jurisdiction including the following information:

1) Tested values for VPRs.
2) I_n ratings.
3) MCOV, type designations.
4) OCPD requirements.
5) Manufacturer's model number.
6) System voltage.
7) Modes of protection.

B. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranty.

1.5 WARRANTY

A. Special Manufacturer Extended Warranty: Manufacturer warrants that SPDs perform in accordance with specified requirements and agrees to provide repair or replacement of SPDs that fail to perform as specified within extended warranty period.

1. Initial Extended Warranty Period: Ten year(s) from date of Substantial Completion, for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 TYPE 1 SURGE PROTECTIVE DEVICES (SPDs)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB, Electrification Business.
2. ALLTEC LLC.
3. Advanced Protection Technologies Inc. (APT).
4. Citel, Inc.
5. DITEK Surge Protection.
6. Eaton.
7. Intermatic, Inc.
8. Leviton Manufacturing Co., Inc.
9. Liebert; Vertiv Holdings Co.
10. Mersen USA.
11. SSI, an ILSCO Company.
12. Schneider Electric USA, Inc.
13. Siemens Industry, Inc., Energy Management Division.

B. Source Limitations: Obtain devices from single source from single manufacturer.

C. General Characteristics:

1. Reference Standards: UL 1449, Type 1.
2. MCOV: Not less than 125 percent of nominal system voltage for 208Y/120 V and 120/240 V power systems, and not less than 115 percent of nominal system voltage for 480Y/277 V power systems.

3. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 500kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.
4. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits must not exceed the following:

    a. Line to Neutral: 1200 V for 480Y/277 V.
    b. Line to Line: 2000 V for 480Y/277 V.

5. 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 Line: 1200 V.

6. SCCR: Not less than 200 kA.
7. I_n Rating: 20 kA.

D. Options:

1. Include integral disconnect switch.
2. Include internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Include indicator light display for protection status.
4. Include audible alarm.
5. Include NEMA ICS 5, dry Form C contacts rated at 2 A and 24 V(ac) for remote monitoring of protection status.
6. Include surge counter.

2.2 TYPE 2 SURGE PROTECTIVE DEVICES (SPDs)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB, Electrification Business.
2. ALLTEC LLC.
3. Advanced Protection Technologies Inc. (APT).
4. Citel, Inc.
5. DITEK Surge Protection.
6. Eaton.
7. Intermatic, Inc.
8. Leviton Manufacturing Co., Inc.
9. Liebert; Vertiv Holdings Co.
10. Mersen USA.
11. SSI, an ILSCO Company.
12. Schneider Electric USA, Inc.
13. Siemens Industry, Inc., Energy Management Division.
14.

B. Source Limitations: Obtain devices from single source from single manufacturer.

C. General Characteristics:

1. Reference Standards: UL 1449, Type 2.

2. MCOV: Not less than 125 percent of nominal system voltage for 208Y/120 V and 120/240 V power systems, and not less than 115 percent of nominal system voltage for 480Y/277 V power systems.
3. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 125 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.
4. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or 208Y/120 V, three-phase, four-wire circuits must not exceed the following:

    a. Line to Neutral: 1200 V for 480Y/277 V or 700 V for 208Y/120 V.
    b. Line to Ground: 1200 V for 480Y/277 V or 700 V for 208Y/120 V.
    c. Neutral to Ground: 1200 V for 480Y/277 V or 700 V for 208Y/120 V.
    d. Line to Line: 2000 V for 480Y/277 V or 1200 V for 208Y/120 V.

5. 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.

6. SCCR: Equal or exceed 125 kA.
7. I_n Rating: 20 kA.

D. Options:

1. Include LED indicator lights for power and protection status.
2. Include internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Include NEMA ICS 5, dry Form C contacts rated at 2 A and 24 V(ac) for remote monitoring of protection status.
4. Include surge counter.

2.3 ENCLOSURES

A. Indoor Enclosures: Type 1.

B. Outdoor Enclosures: Type 3R.

2.4 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide OCPD and disconnect for installation of SPD in accordance with UL 1449 and manufacturer's instructions.

B. Install leads between disconnects and SPDs short, straight, twisted, and in accordance with manufacturer's instructions. Comply with wiring methods in Section 26 05 19 "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 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Compare equipment nameplate data for compliance with Drawings and the Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's installation requirements.

B. Nonconforming Work:

1. SPDs that do not pass tests and inspections will be considered defective.
2. Remove and replace defective units and retest.

3.3 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.

END OF SECTION 26 43 13

SECTION 26 50 00 - LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Luminaires.
2. Luminaire fittings.
3. Electric-discharge lamp control equipment.
4. Lamps.

B. Related Requirements:
1. Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables"
2. Section 26 05 29 "Hangers and Supports for Electrical Systems" specifies channel and angle supports installed by this Section.
3. Section 26 05 53 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs installed by this Section.
4. Section 26 09 23 "Lighting Control Devices" specifies automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors installed by this Section.

1.2 DEFINITIONS

A. BUG Rating: Backlight, uplight, and glare rating for light pollution from exterior luminaires.

B. Correlated Color Temperature (CCT): The absolute temperature (in kelvins) of a blackbody whose chromaticity (color quality) most nearly resembles that of the light source.

C. Color Rendering Index (CRI): The measure of the degree of color shift objects undergo when illuminated by the light source as compared with the color of those same objects when illuminated by a reference light source. The lower the CRI of a light source, the more difficult it is to identify colors and stripes on electronic components and wiring.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For luminaires.

a. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.

1) If listed manufacturer differs from selling manufacturer, indicate relationship between entities on submittal. Clearly indicate which entity warrants product performance and fitness for purpose.
2) Listing criteria identified in approval letter must match specified listing criteria. Approval of only equipment's enclosure is not considered approval of equipment for intended application.
3) Product identification in approval letter must match product branding and model numbers in submittal. Approval letters for similar products are not acceptable.

4) Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with current accreditation under National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.

b. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
c. Include operating characteristics, electrical characteristics, and furnished accessories.
d. Include schedule of submitted lighting products. Arrange schedule and accompanying product data in order by luminaire and lamp designations indicated on Drawings.
e. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.

2. For luminaire fittings.

a. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.

1) If listed manufacturer differs from selling manufacturer, indicate relationship between entities on submittal. Clearly indicate which entity warrants product performance and fitness for purpose.
2) Listing criteria identified in approval letter must match specified listing criteria. Approval of only equipment's enclosure is not considered approval of equipment for intended application.
3) Product identification in approval letter must match product branding and model numbers in submittal. Approval letters for similar products are not acceptable.

b. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
c. Include operating characteristics, electrical characteristics, and furnished accessories.
d. Include schedule of submitted lighting products. Arrange schedule and accompanying product data in order by luminaire and lamp designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturers' published instructions.

1.5 CLOSEOUT SUBMITTALS

A. Warranty documentation.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Spare parts.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect exposed surface finishes on lighting equipment by applying strippable, temporary protective covering before shipping.

1.8 WARRANTY FOR LUMINAIRES

A. Special Installer Extended Warranty: Installer warrants that fabricated and installed luminaires perform in accordance with specified requirements and agrees to repair or replace products that fail to perform as specified within extended-warranty period. Warranty must convey to Owner upon acceptance of the Work.

1. Extended-Warranty Period: Two years from date of Substantial

PART 2 - PRODUCTS

2.1 LUMINAIRES

A. Performance Criteria:

1. Regulatory Requirements:

a. 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.
b. See individual product types below for listing criteria.
c. Marked in accordance with UL CCN HYXT, including UL 1598, for compatible power supply, installation location, and environmental conditions.

B. Source Quality Control:

1. Compile and submit product data.

2.2 MANUFACTURERS

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings.

2.3 LUMINAIRE FITTINGS

A. Performance Criteria:

1. Regulatory Requirements:

a. 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.
b. See individual product types below for listing criteria.

B. Source Quality Control:

1. Compile and submit product data.

C. Luminaire Support Accessories:

1. Product Characteristics:

a. Sized and rated for luminaire weight.

2. Required Product Options:

a. Hook Hangers: Integrated assembly matched to luminaire, supply voltage, and equipment with threaded attachment, cord, and locking-type plug.
b. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage wire supports adjustable to 10 ft in length.
c. Aircraft Cables: 5/32 inch diameter aircraft cable supports adjustable to 10 ft in length.
d. Single-Stem Hangers: 1/2 inch nominal diameter steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
e. Rod Hangers: 3/16 inch nominal diameter, cadmium-plated, threaded steel rod.

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 PREPARATION

A. Shop Drawings: Prepare and submit the following:

1. Drawings, Diagrams, and Supporting Documents for Custom Luminaires:

a. Include plans, elevations, sections, and mounting and attachment details.
b. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
c. Include diagrams for power, signal, and control wiring.

3.3 INSTALLATION OF LIGHTING

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:

1. Installation of Indoor Lighting Systems: NECA NEIS 500.
2. Installation of Exterior Lighting Systems: NECA NEIS 501.
3. Installation of Industrial Lighting Systems: NECA NEIS 502.

C. Special Installation Techniques:

1. Install luminaires level, plumb, and square with finished floor or grade unless otherwise indicated.
2. Install luminaires at height and aiming angle as indicated on Drawings.
3. Coordinate layout and installation of luminaires with other construction.
4. Adjust luminaires that require field adjustment or aiming.
5. Flush-Mounted Luminaire Support:

a. Secured to outlet box.
b. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
c. Trim ring flush with finished surface.

6. Wall-Mounted Luminaire Support:

a. Attached to structural members in walls.
b. Do not attach luminaires directly to gypsum board.

7. Suspended Luminaire Support:

a. Ceiling Mount:

1) Hook hangers.
2) Four aircraft cables.

b. Pendants and Rods: Where longer than 48 inch, brace to limit swinging.
c. 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.
d. Continuous Rows of Luminaires: Provide tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
e. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

8. Ceiling-Grid-Mounted Luminaire Support:

a. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each luminaire. Locate not more than 6 inch from luminaire corners.
b. Support Clips: Fasten to luminaires and to ceiling grid members at or near each luminaire corner with clips that are UL listed for application.
c. Luminaires of Sizes Smaller Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support luminaires independently with no fewer than two 3/4 inch metal channels spanning and secured to ceiling tees.

9. Remote Mounting of Ballasts: Do not exceed distance between ballast and luminaire recommended by ballast manufacturer.
10. Emergency Power Units: Secure with approved fasteners in four or more locations, spaced near corners of unit.
11. Install wiring connections for luminaires.
12. Identification: Provide labels for luminaires and associated electrical equipment.

a. Identify field-installed conductors, interconnecting wiring, and components.
b. Provide warning signs.
c. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL OF LIGHTING

A. Tests and Inspections:

1. Perform manufacturer's recommended tests and inspections.
2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

3. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to emergency power and retransfer to normal.
4. Verify operation of photoelectric controls.

B. Nonconforming Work:

1. Luminaire will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

3.5 SYSTEM STARTUP

A. Perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's published instructions.

3.6 PROTECTION

A. After installation, protect lighting equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 26 50 00